



Chicago Department of
Transportation
Division of Engineering

**Electrical Engineering Design Requirements &
Guidelines**

CURRENT AS OF March 17, 2017

- The main purpose of the guideline is to improve the quality of City street lighting and traffic signal control designs, to minimize plan review time, and to minimize construction conflicts.
- In the preparation of contract plans which includes the design of street lighting and traffic signal modernization, CDOT requires that the layouts for this work conform to the standard format and nomenclature (Drawing #826) as presented in sample projects by engineering Design Sections, including City title block at the lower right corner. Street lighting plan sheets should be divided into three types of sheets: street light removal plan, conduit and foundation plan, and cable plan. Traffic signal designs can usually be accommodated on one sheet per intersection.
- This format is necessary because the information from the drawings, such as conduit for underground construction is recorded and filed separately from the circuitry, which identifies the circuits loads, controller placement and service points which are entered onto our Edison Atlas and used for billing and maintenance purposes. Also, for traffic signal designs, the new signal cable plan is copied from the drawing and stored in the controller for maintenance.
- All of these drawings are used for record retrieval information to the CDOT / Office of Underground Construction in identifying the City's electrical system within a specific project and for locating City electric underground facilities through the Digger System.
- All photometric lighting levels, materials, circuiting and workmanship shall comply with the Division of Engineering's requirements and specifications for material and construction standards.
- All projects that propose the installation of a new street lighting system must be submitted to engineering for review and approval prior to initiating design. After the approval has been obtained, three submittals are required. This is to insure that proposals are consistent with the current palette of poles and fixtures to be maintained by CDOT-DEO.

- ❑ CDOT has an electronic file of material and construction specifications, which are to be, incorporated into the contract documents.
- ❑ CDOT has standard drawing details available on electronic format. These design standards for foundations, hand holes, manholes, poles, etc. are to be used with no modifications, unless prior approval has been received from the Deputy Commissioner.
- ❑ In order to review and comment effectively on a set of plans, the traffic/lighting design drawings must be included within the plan set at an early percentage of completion. Plan reviews are requested at the following completion milestones:
 1. Preliminary-50% This will include:
 - Preliminary System design with pole location.
 - Project limits & special conditions.
 - Pole & Luminaire type.
 - Utility conflicts.
 - If designer is confident, then Voltage drop calculations including equations used, cable resistance, as depicted by the latest NEC table.
 - Commonwealth Edison service coordination. A letter to ComEd indicating revised or new service locations, including the old loads and the new proposed loads.
 - Photometric calculations, these calculations shall include a performance table, included in this guideline with:
 - a. Street width.
 - b. Optimum spacing, taking into consideration existing tree location and their drip lines.
 - c. Luminaire typically type III, unless indicated otherwise by engr.
 - d. Recommended levels as required by IESNA and city of Chicago and contract specified levels.
 2. Pre-Final-80%
 - Refined lighting layout, including Atlas & group number per controller.
 - DEO record number (given by Engineering).
 - Specifications.
 3. Final-100%
 - Two plan sets are requested with contract specifications at final submittal.
 - Vellum and Electronic copies of layout.
- ❑ The CDOT project manager must be present when a meeting with Construction. This way CDOT can fully access the progress of work to meet design time lines and issues that are presented.
- ❑ All As-Built Drawings must be made submitted on a CD to CDOT on .dgn format Micro-Station. This transmittal must be received by the CDOT prior to final acceptance of the electrical facilities for city maintenance.
 4. Shop drawings must be submitted with letter of conformance with CDOT specifications. Any deviation must be outlined.

Illuminance & Luminance for Roadways / City of Chicago:

Arterial Streets, Residential Streets and Alleys as per Spec 1600

Traffic Intersections: As recommended by IESNA and CDOT

- ❑ Roadway Lighting ratios shall conform to recommendations by IESNA.
- ❑ Total light loss factor as per Spec 1600
- ❑ Photometric calculations shall be provided for each project in the provided performance table. Roadway photo-metrics shall be calculated as indicated by IESNA. The calculations shall be submitted for the project limits.

Residential Street Lighting Design:

The residential street lighting system must consist of the following design elements:

Plan Layout:	Conduit and foundation plan to be drawn 1"= 30ft. scale. Cable, and removal Plan may be drawn not to scale; however, it must be legible even if reduced.
Foundations:	Helix foundation 5 ft, 10" bolt circle (Drawing No. 936).
Conduit:	1.25" Uni-duct, direct bored. For open trench use 2" sch.40 in parkway, sch.80 under driveway or roadway.
Poles:	Aluminum 18'-0" mounting height davit (Drwg.#940) or as directed by Commissioner, with 8' MA. Fixture: LED-240 volts, with piggy back acorn fixture (Drwg.#958-959) or as directed by Commissioner. Installation shall be in a staggered lighting pattern.
Circuitry:	Each side of streetlights shall be fed from a separate street light controller.
Branch Cable:	3TC, 2-#6 & 1-#8 conductors, or as per Engineering specifications
Photocell:	Inside controller or as directed by Commissioner.
Controller:	60 amp / with 2-30 amp-2P branch circuit breakers or as directed by Commissioner. Design capacity @ 80%.
Fusing:	In luminaire fixture with 10 amps or as per Spec 1600.
Splicing:	No underground splicing allowed.
Cable:	All cable must be racked, trained and tagged in all manholes and hand holes with approved materials.
Handhole:	Required at: every service feed from the alley for circuitry purposes; For OEC, every 325 feet for cable pulling purposes.
Grounding:	System ground and equipment ground must be implemented as per NEC Article 250, as well as in Engineering Specifications.

Arterial – Ornamental Street Lighting System

The standard arterial street lighting system must consist of the following design elements:

- Plan Layout:** Conduit and foundation plan to be drawn 1"= 30ft. scale. Cable, and Removal Plan will not be drawn to scale; however, it must be legible even if reduced.
- Foundations:** Concrete, or Helix as directed by Commissioner with reference standard drawing for diameter, depth and anchor bolts. Minimum 3' from face of curb to center line of pole, U.N.O.
- Conduit:** Standard 2"PVC/ sch. 40 in parkway, sch.80 under driveway or roadway. If applied use it for both, the lighting and the outlet circuits.
- Poles:** Aluminum 35'-0" davit (Drwg.#971) with 8' MA. (Drwg.#948) Ornamental pole as indicated by the Deputy Commissioner. Installation shall be opposite lighting pattern or as approved staggered by the Division of Engineering. Alternative poles may be used in accordance with the City of Chicago Street Lighting Master Plan, as determined by Commissioner.
- Street Light Circuit** One street light controller shall be installed for each lighting service. For one sided lighting a 100 amp lighting controller will be installed with one branch circuit going in each opposite direction. For two sided lighting a 200 amp lighting controller shall be installed with four branch circuits. Each branch circuit should be as equal in length and load as possible. Each controller shall have a manhole or handhole adjacent to it. For two sided lighting another handhole must be installed on the opposite side of the street to accommodate the two lighting branch circuits for that side. All street lighting and pedestrian lighting in one direction shall be on a single branch circuit. No alternating circuits will be allowed unless approved by the Department.
- Street Light Cable:** (3TC) 2#6 & 1-#8 conductors. Three individual triplexed conductors. The two hot conductors shall be red and black. The ground shall be green.
- Festoon Circuits:** If festoon lighting receptacles on light poles, outlets in planters, irrigation systems, clocks, etcetera are present, these items must be metered. A separate controller cabinet with 100 amp main breaker shall be provided. This cabinet shall be located next to the street lighting cabinet and shall share the same ComEd feed. All systems that require 24/7 power shall be wired in the cabinet to bypass the photo-cell. Festoon lighting receptacles shall be 120 volt. For design purposes each receptacle will be considered to have a 1.5 amp maximum load. It will be acceptable to alternate circuits in one direction.
- Festoon Cable:** Each receptacle circuit shall consist of one hot and one neutral wire. Receptacle circuits shall not share neutrals. Wiring should be #6. Hot wires should be black. Neutrals should be white.
- Photocell:** Inside controller or as directed by Commissioner.

- Service Cable:** 3-1/c, #2, or # 1/0 for 100 amp controller or 3-1/c, #2/0 for 200 amps controller for single phase. In three phase four wire system shall be implemented.
- Controller:** 100-amp/with 2-50 amp-2P branch circuit breakers. Design capacity @ 80% (Drg.876)
200-amp/with 4-50 amp-2p branch circuit breakers. Design capacity @ 80% (Drg.880)
- Fusing:** No in-line fuses.
- Splicing:** No underground splicing allowed.
- Cable:** All cable must be racked, trained and tagged in all manholes and hand holes with approved materials.
- Handhole:** Required at: every service feed from the alley; at most every ninety-degree angle turn. Up to five ducts shall be the norm for a 30" HH. Up to ten ducts for a 36" HD HH. More than ten ducts a Manhole is to be used. For OEC, every 325 feet, for cable pulling purposes a Hand hole is used, whereas this requirement may change depending upon the OEC cable size.
- Grounding:** System ground and equipment ground must be implemented as per NEC Article 250, as well as in Division of Engineering Specifications.

CDOT LUMINAIRE PERFORMANCE TABLE

GIVEN CONDITIONS		
ROADWAY DATA	Width, face to face	_____
	Number of Lanes	_____
	I.E.S. Surface Classification	_____
	Segment Limits	_____
	Sidewalk width	_____
LIGHT POLE DATA	Mounting Height	_____
	Mast Arm Length	_____
	Pole Set-Back From Face of Curb	_____
LUMINAIRE DATA	Type & Wattage	_____
	Lumens	_____
	I.E.S. File Number	_____
	LLD (at 60,000 hours, per TM-21-11)	_____
	LDD	_____
	Total Light Loss Factor, LLF	_____
LAYOUT DATA	Spacing	_____
	Configuration	_____
	Luminaire Overhang over Face of Curb	_____

NOTE: Variations from the above specified I.E.S. distribution pattern may be requested and acceptance of variations will be subject to review by the Engineer based on how well the performance requirements are met.

PERFORMANCE REQUIREMENTS VS. RESULTS		
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NOTE: These performance requirements shall be the minimum acceptable standards of photometric performance for the luminaire, based on the given conditions listed above.

		Per Spec 1600 Requirements	Results
ILLUMINATION	Average Horizontal Illumination, E_{AVE}		
	Intersect. Or Sidewalk Uniformity Ratio, E_{AVE}/E_{MIN}		
LUMINANCE	Average Luminance, L_{AVE}		
	Uniformity Ratio, L_{AVE}/L_{MIN}		
	Uniformity Ratio, L_{MAX}/L_{MIN}		
	Max. Veiling Luminance Ratio, L_V/L_{AVE}		

Calculations shall be performed in conformance with I.E.S. RP-8 recommended procedures.

Traffic Signal System

The standard traffic signal system must consist of the following design elements:

Plan Layout:	Conduit and foundation plan to be drawn 1"= 20 ft. scale. Cable and signal Plan may be drawn not to scale, however, it must be legible. Removal plan shall be not to scale. Corresponding street lighting must be included in the plans.
Foundations:	Concrete, reference standard drawing for diameter, depth and anchor bolts.
Conduit:	Standard (4) 3"PVC / sch.80, at street crossings MH to MH (minimum). If crossing will include fire alarm cable, install (4) 3" PVC schedule 80. Conduit from HH or MH to combination traffic/street light pole foundation to be (2) 3" PVC sch 40, 1-3" to traffic pedestal. For service 2" GRS from ComEd pole to 1 st HH, thereafter 2" or as required pvc to Cabinet.
Manhole:	On quadrant where traffic controller is be installed use MH 3' x4'x 4'(Drwg.#730). All manholes shall have 24" frames and covers.
Handhole:	Required at: a quadrant, other than where traffic controller is to be installed. At every service feed from the alley; at most every ninety-degree angle turn. For long conduit runs(such as signal interconnect) every 325 feet for cable pulling purposes.
Poles:	Corten steel. Poles to have a junction box with a terminal strip for 19/c cable connections. Poles adjust to intersection photometrics.
Signal Cable:	#14-19/c EPR / Low smog Zero Halogen Jacket from TS controller to junction box on pole. Each quadrant shall have a 19/c, with 20% spares and 2 neutrals. #16-8/c SO cord from junction box to signal heads.
Service Cable:	Service cable to controller - 3/C #4 (min.).
TS Req.:	All signal timing, head locations, mast arm positions and pole placements must be approved by Division of Traffic Safety.
Splicing:	No underground splicing allowed.
Cable:	All cable must be racked, trained and tagged in all manholes and hand holes with approved materials.
Signals:	All signal and pedestrian heads to be polycarbonate with 12" LED lenses.
Equipment:	All traffic signal equipment to be gloss black in color.
Actuation:	Wireless detection shall be installed for any actuated traffic movements. Detector loops or video detection to be used only through BOE approval.
Controller:	ATC traffic controller in a 16 bay - P cabinet for all traffic signals. All traffic signal controllers at railroad crossings shall have UPS systems. Circuit breaker 120v-1P-70Amp.
Base Found:	When TS controller is on a fiber optic interconnect system, the furthest conduit on the left shall be reserved for the fiber optic cable placement.

Grounding: System ground and equipment ground must be implemented as per NEC Article 250, as well as in Engineering Specifications.

APPENDIX A

Street lighting & Traffic Signal CADD Guidelines

UNDERGROUND CONDUIT FACILITIES

IF LEVEL SYMBOLOGY IS USED: Use gray scale as described below

IF PEN TABLE IS USED:

Gray Scale:

- It shall be used within the 3rd row of colors in CADD Microstation V8, color Numbers 32-47.
- All utilities lines with their respective identification, size of pipes, ducts. Fonts shall be the same as all other height:2, width:2.
- All trees scaled exactly with trunk & drip line, color #34.
- All other appurtenances such as CTA Bus shelters, Kiosks must be shown to scale
- All commercial signs hanging from nearby properties near the proposed traffic or lighting pole must be noted on the plan with their size & height.

Black Scale:	Style	Weight
• Curb Lines	0	3
• Sidewalk Lines	0	1
• ROW-Property Line	Dashed(Cust)	1
• Conduits, MH	Dashed(#2)	5
• Equipment Symbols	0(per 826)	4
• Conduit Identification	0	2
• Dimension, 2 coordinates	0	2
• All fonts: Engineering, H:2, W:2	0	3

INSTALLATION OF CABLE & SIGNAL PLAN

- All black scale, except vegetation or trees
- Curbs
 0 | 3 |
- Equipment & signals (Code 826)
 0 | 4 |
- Cable
 Dashed(2) | 3 |
- Dimension & ID
 0 | 3 |

STREET LIGHTING & TRAFFIC SIGNAL REMOVAL PLAN

- Equipment
 0(as per 826) | 2 |
- Cable
 0(as per 826) | 2 |

LEVEL ASSIGNMENTS

Default	(Reference file frames)
Level 4-Vegetation	(All trees, bushes, shrubs, etc.)
Level 5-Body of Water	(Streams, rivers, ponds, etc.)
Level 6-R.O.W.	(Existing Right of way)
Level 8-Non-Roadway Improvements	(Buildings, fences, mailboxes, signs, benches, bike racks, bus shelters, etc)
Level 14-Utility-Existing-CDOT	(Existing Hand holes, Manholes, conduit, cable, splice boxes, controllers, etc.)
Level 14-Utility-(Description)	(Water, Gas, ComEd, DEO, etc.) i.e. Each utility is to be assigned its own level
Level 14-2n-Cable	(Direct burial cable)
Level 14-2w-Cable	(Aerial cable)
Level 14-Existing Light-Pole	(Existing light poles and luminaries)
Level 25-Roadside Features	(Sidewalks, driveways, entrances)
Level 27-Curb	(All curb represented as face of curb)
Level 38-Railroad	(Railroads)
Level 39-Structures	(Bridges)
Level 44-Proposed-Utilities-BOE-DEO	(Proposed Hand holes, Manholes, conduit, cable, splice boxes, foundations, poles, luminaries, controllers, etc.)
Level 54-Removal-Items	(Hatching for sidewalk/pavement removal)
Level 55-Lighting Notes	(All notes, borders, dimensions, existing utility dimensions should be placed on the corresponding level, additional notes needed for other items should be placed on the corresponding level as well)

APPENDIX B

CDOT-Division of Engineering Personnel Contacts

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(Call 312-744-7183 to ensure this is the most current edition available)

**ELECTRICAL CONSTRUCTION SPECIFICATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO**

Number	Description	File	Date
	UNDERGROUND		
101	Trench & Backfill for 6 – 3” Duct	101.doc	01/01/02
102	Adjust Frame & Lid	102.doc	01/01/02
103	Pavement Removal	103.doc	01/01/02
104	Sidewalk Removal	104.doc	04/02/01
105	Pavement Removed and Replaced	105.doc	01/01/02
106	Temporary Pavement Patching	106.doc	08/28/06
107	Sidewalk Removed and Replaced	107.doc	08/28/06
107A	Sidewalk Removed and Replaced for Pedestrian Ramp	107.doc	08/28/06
107B	Combination Curb and Gutter Removal and Replacement	107a.doc	04/03/01
107C	Warning Tiles in Sidewalk Ramp	107c.doc	10/06/06
108	Trench and Backfill with Screenings	108.doc	01/01/02
108A	Additional Trench and Backfill – 1’ Depth	108a.doc	08/28/06
110	Trench & Backfill for 2-4 Ducts	110.doc	04/02/01
111	Pavement, Special, Remove and Replace for Conduit under CTA Tracks	111.doc	01/01/02
112	Electrical Handhole, 30", 24" Frame and Lid	112.doc	01/01/02
113	Electrical Handhole, Heavy Duty, 36"X 36", 24" Frame & Lid	112.doc	01/01/02
113A	Electrical Handhole, Heavy Duty, 36"X 36", 30" Frame & Lid	112.doc	01/01/02
114	Roof on 3'X4'X4' Manhole in Parkway	114.doc	04/04/01
115	Roof on 3'X4'X4' Manhole in Pavement	114.doc	04/04/01

116	Replace 24" F&L with 30" F&L	102.doc	01/01/02
117	Electrical Manhole 3'X4'X4' with 24" Frame and Lid	117.doc	04/04/01
118	Electrical Manhole 3'X4'X4' with 30" Frame and Lid	117.doc	04/04/01
119	Electrical Manhole 4'X6'X6' with 24" Frame and Lid	117.doc	04/04/01
119A	Electrical Manhole 4'X6'X6' with 30" Frame and Lid	117.doc	04/04/01
120	Drill Existing Manhole or Handhole	120.doc	01/01/02
121	Electrical Frame and Lid, 24"	102.doc	01/01/02
122	Electrical Frame and Lid, 30"	102.doc	01/01/02
123	Clean Existing Manhole/Handhole	123.doc	01/01/02
123B	Conduit on Structure, 3/4" Galvanized Steel	124.doc	08/29/06
123G	Conduit on Structure, 3/4" Aluminum	124.doc	08/29/06
124	Conduit in Trench, 2" Galvanized Steel	124.doc	08/29/06
125	Ground Rod, Adjacent to Foundation/Manhole	125.doc	06/23/08
125A	Ground Rod in Handhole	125.doc	06/23/08
126	Conduit in Trench, 3" Galvanized Steel	124.doc	08/29/06
127	Conduit in Trench, 4" Galvanized Steel	124.doc	08/29/06
128	Conduit pushed, 2" Galvanized Steel	124.doc	08/29/06
129	Conduit on Structure, 1-1/4" Galvanized Steel	124.doc	08/29/06
130	Conduit on Structure, 1-1/2" Galvanized Steel	124.doc	08/29/06
131	Conduit on Structure, 2" Galvanized Steel	124.doc	08/29/06
131A	Coilable Conduit in Trench, 1.25", Schedule 40	124.doc	08/29/06
131B	Coilable Conduit in Trench, 1.25", Schedule 80	124.doc	08/29/06
132	Conduit in Trench, 2" PVC	124.doc	08/29/06
133	Conduit in Trench, 3" PVC	124.doc	08/29/06
134	Conduit in Trench, 4" PVC	124.doc	08/29/06
135	Conduit pushed, 3" Galvanized Steel	124.doc	08/29/06
136	Conduit in Trench, 2" PVC Schedule #80	124.doc	08/29/06
137	Conduit in Trench, 3" PVC Schedule #80	124.doc	08/29/06
138	Conduit in Trench, 4" PVC Schedule #80	124.doc	08/29/06
139	Concrete Foundation, Precast 5'	150.doc	05/17/01

140	PVC Conduit in Duct, Concrete Encased, 2 - 3"	140.doc	01/01/02
141	PVC Conduit in Duct, Concrete Encased, 4 - 3"	140.doc	01/01/02
1411	PVC Conduit in Duct, Concrete Encased, 4 - 4"	140.doc	01/01/02
1413	PVC Conduit in Duct, Concrete Encased, 2 - 4"	140.doc	01/01/02
142	Concrete Encasement	142.doc	01/11/02
143	PVC Conduit in Duct, Concrete Encased, 6 - 3"	140.doc	01/01/02
144	Rod and Clean Duct in Existing Conduit System	144.doc	04/02/01
145	Concrete Foundation for Base Mounted "P" Cabinet	145.doc	08/08/06
145A	Concrete Foundation for Base Mounted "Super P" Cabinet	145.doc	08/08/06
146	Concrete Foundation for Base Mounted "M" Cabinet	146.doc	03/21/95
147	Concrete Foundation for Base Mounted Street Light Cabinet	147.doc	08/03/93
148	Concrete Foundation for Fire Alarm Cabinet	148.doc	02/14/90
149	Concrete Foundation, 20" X 5' with 3/4" A.R.	149.doc	08/08/06
150	Concrete Foundation, 20" X 5' with 1" A.R.	150.doc	05/17/01
151	Concrete Foundation, 24" X 9' with 1 1/4" A.R.	151.doc	10/05/20
151A	Concrete Foundation, 24" X 7' with 1 1/4" A.R.	151.doc	10/05/20
151B	Concrete Foundation, 28" X 7' with 1 1/4" A.R.	151.doc	10/05/20
152	Concrete Foundation, 30" Diameter, 17 1/4" Bolt Circle, 1 1/4" A.R.	151.doc	10/05/20
152A	Concrete Foundation, 30" X 7' with 1" A.R.	151.doc	10/05/20
153	Concrete Foundation, 30" Diameter, 16 1/2" Bolt Circle, 1 1/2" A.R.	151.doc	10/05/20
154	Additional 2" Elbow in Concrete Foundation	154.doc	08/08/06
155	Additional 3" Elbow in Concrete Foundation	154.doc	08/08/06
156	Additional 4" Elbow in Concrete Foundation	154.doc	08/08/06
157	Helix Foundation, 5', 10"B.C., 4 Anchor Bolts	157.doc	08/08/06
157A	Helix Foundation, 5', 13"B.C., 3 Anchor Bolts	157.doc	08/08/06
157B	Helix Foundation, 7', 10"to15"B.C., 4 Anchor Bolts	157.doc	08/08/06
159	Elbow, Conduit, Steel, 2" Adjacent to Embedded Pole/Structure	159.doc	10/01/86
161	Elbow, Conduit, Steel, 3" Adjacent to Embedded Pole/Structure	159.doc	10/01/86

162	Elbow, Conduit, Steel, 4" Adjacent to Embedded Pole/ Structure	159.doc	10/01/86
163	Intercept Existing Conduit	163.doc	08/08/06
164	Elbow, PVC, 2", capped, for detector loop	164.doc	08/08/06
165	Conduit under vaulted walk, 4" Galvanized Steel	124.doc	08/29/06
166	Conduit under vaulted walk, 3" Galvanized Steel	124.doc	08/29/06
167	Elbow, PVC, 2", for pedestrian push-button post	167.doc	03/05/08
168	Guard Post	168.doc	05/17/01
170	Foundation Plate in Vaulted Walk	170.doc	05/23/01
171	Concrete Foundation in Vaulted Walk, 24" Diameter	171.doc	05/23/01
173	Handhole, Fiberglass	173.doc	05/18/01
180	Concrete Foundation, 24", Offset, 1 1/4" A.R.	151.doc	08/08/06
181	Concrete Foundation, 20", Offset, 1" A.R.	151.doc	08/08/06
193	Conduit, Polyethylene #40, Directional Boring, 1.25"	190.doc	08/08/06
193A	Conduit, Polyethylene #80, Directional Boring, 1.25"	190.doc	08/08/06
195	Conduit, Polyethylene #40, Directional Boring, 2"	190.doc	08/08/06
195a	Conduit, Polyethylene #80, Directional Boring, 2"	190.doc	08/08/06
196	Conduit, Polyethylene #80, Directional Boring, 3"	190.doc	08/08/06
197	Trench & Backfill to Facilitate Directional Change	197.doc	11/05/09
	STREET LIGHTING		
203	Pole, Steel, 32'6", anchor base, 8-1/2"D, 7 gauge	203.doc	04/12/01
204	Pole, Steel, 32'6", anchor base, 8-1/2"D, 3 gauge	203.doc	04/12/01
205	Pole, Steel, 34'6", anchor base, 10"D, 7 gauge	205.doc	04/12/01
206	Pole, Steel, 34'6", anchor base, 10"D, 3 gauge	205.doc	04/12/01
207	Pole, Steel, 34'6", anchor base, 11"D, 3 gauge	205.doc	04/12/01
208	Pole, Steel, 34'6", anchor base, 12.5"D, 3 gauge	205.doc	04/12/01
209	Pole, Steel, 35', Embedded, 9"D, 7 gauge	209.doc	05/18/01
210	Pole, Steel, 35', Embedded, 9"D, 3 gauge	209.doc	05/18/01
211	Pole, Wood, 40', Embedded	211.doc	05/18/01

212	Pole, Embedded, Relocate Complete	212.doc	05/21/01
213	Pole, Anchor Base, Relocate Complete	213.doc	05/21/01
214	Pole, Arm, Luminaire, Existing Residential, Paint Complete	214.doc	10/06/06
214A	Pole, Arm, Luminaire, Existing Arterial, Paint Complete	214.doc	10/06/06
215	Plate, Weld to Pole, 2-Bolt	215.doc	04/03/09
216	Base, Ballast Housing, Steel, 7 Gauge	216.doc	05/21/01
218	Mast Arm, Steel, Street Lighting, 1 Foot	218.doc	01/23/04
219	Mast Arm, Steel, Street Lighting, 4 Foot	218.doc	01/23/04
220	Mast Arm, Steel, Street Lighting, 8 Foot	218.doc	01/23/04
221	Mast Arm, Steel, Street Lighting, 12 Foot	218.doc	01/23/04
222	Mast Arm, Steel, Street Lighting, 15 Foot	218.doc	01/23/04
224	Luminaire, Street Light, HPS, 150 Watt, 120 Volt, Residential, Crime-fighter Model	224.doc	08/14/06
225	Luminaire, Street Light, HPS, 150 Watt, 240 Volt, Residential, Crime-fighter Model	224.doc	08/14/06
226	Luminaire, Street Light, HPS, 310 Watt, 208 Volt, Arterial, Crime-fighter Model	224.doc	08/14/06
227	Luminaire, Street Light, HPS, 310 Watt, 240 Volt, Arterial, Crime-fighter Model	224.doc	08/14/06
228	Luminaire, Street Light, HPS, 400 Watt, 240 Volt, Arterial, Semi-cutoff	224.doc	08/14/06
229	Luminaire, Street Light, HPS, 400 Watt, 240 Volt, Arterial, Cut-off	224.doc	08/14/06
229A	Luminaire, Street Light, HPS, 1000 Watt, 240 Volt, Arterial, Semi-cutoff	224.doc	08/14/06
2973	Luminaire, Street Light, HPS, 250 Watt, 240 Volt, Alley, Semi-cutoff	224.doc	08/14/06
2972	Luminaire, Street Light, HPS, 250 Watt, 120/240 Volt, Residential, Vertical Burn Lamp	224.doc	08/14/06
230	Luminaire, Floodlight, 240V, 400WHPS	224.doc	08/14/06
231	Rack, Secondary, Aerial 1-Wire	231.doc	03/21/95
232	Rack, Secondary, Aerial 2-Wire	231.doc	03/21/95
233	Rack, secondary, Aerial 3- Wire	231.doc	03/21/95
234	Service Entrance on Pole Top 1-1/4"	234.doc	08/14/06
234A	Service Entrance on Pole Top 2"	234.doc	08/14/06

235	Conduit Riser on Pole, 2"	235.doc	10/01/86
236	Conduit Riser on Pole, 3"	235.doc	10/01/86
237	Circuit Breaker, 1-Pole, 50 Amp, 600 Volt, in Existing Street Lighting Controller	237.doc	03/21/95
237A	Circuit Breaker, 2-Pole, 50 Amp, 600 Volt, in Existing Street Lighting Controller	237.doc	03/21/95
238	Circuit Breaker, 1-Pole, 70 Amp, 600 Volt, in Existing Street Lighting Controller	237.doc	03/21/95
239	Fuse-in-Line, 10 Amp	239.doc	04/16/01
240	Service Installation, 100 Amp	240.doc	04/03/09
241	Service Installation, 200 Amp	240.doc	04/03/09
242	Aerial Cable, 3-1/c No. 4 with Messenger Wire	242.doc	10/06/06
243	Aerial Cable, 3-1/c No. 2 with Messenger Wire	242.doc	10/06/06
244	Wire, Aerial, 1/c No. 6	244.doc	10/01/86
245	Cable, 3/C #14, shielded/RR Pre-empt	245.doc	07/05/09
246	Photocell, Twistlock	246.doc	04/03/03
247	Electric Cable in Conduit, 1/c No. 6	247.doc	08/14/06
248	Insulated Ground Cable in Conduit, 1/c No. 8	248.doc	08/14/06
249	Triplex Cable in Conduit, 2 1/C#6& 1 1/C#8	249.doc	08/14/06
250	Electric Cable in Conduit, 1/c No. 4	247.doc	08/14/06
251	Electric Cable in Conduit, 1/c No. 2	247.doc	08/14/06
252	Electric Cable in Conduit, 1/c No. 1/0	247.doc	08/14/06
253	Remove and Reinstall Electric Cables in Conduit	253.doc	08/14/06
254	Cable in Conduit, 1/C No. 2/0	247.doc	08/14/06
255	Electric Cable Splice, No. 6	255.doc	08/14/06
256	Cable Splice, 3TC	255.doc	08/14/06
257	Cable Splice in CECO Manhole, #4	257.doc	09/19/06
258	Cable Splice in CECO Manhole, #2	257.doc	09/19/06
259	Cable Splice, #1/0	255.doc	08/14/06
260	Cable Splice, #2/0	255.doc	08/14/06
265	Controller, Residential Street Light 240 Volt	265.doc	09/20/06
266	Controller, Residential Street Light 120 Volt	266.doc	09/20/06

267	Service Connection to CECO Line	267.doc	05/21/01
268	Service Cable, 3/C #2	268.doc	09/21/06
270	Wire, Temporary Aerial, 2-1/C #8 Aluminum	270.doc	09/20/06
280	Luminaire, Floodlight, 240V, 250WHPS	224.doc	08/14/06
280A	Aviation Warning Light, LED	280a.doc	09/20/06
299	Bridge Beacon, Blue LED	299.doc	09/21/06
354	Remove Existing Street Light Equipment	354.doc	08/18/06
358	Controller, Street Light, 3-Phase, 100 Amp, Base Mounted	358.doc	04/03/09
360	Controller, Street Light, 3-Phase, 200 Amp, Base Mounted	358.doc	04/03/09
361	Circuit Breaker, 2-Pole, 240 V	361.doc	09/01/06
366	Controller, Street Light, 1-Phase, 100 Amp, Base Mounted	358.doc	04/03/09
369	Controller, Street Light, 1-Phase, 200 Amp, Base Mounted	358.doc	04/03/09
	ORNAMENTAL STREET LIGHTING		
2903	10' Loop Pole and Base (Short Loop Pole)	2903.doc	05/15/01
2904	16' Loop Pole and Base (Extended Loop Pole)	2903.doc	05/15/01
2905	Loop Pole Twin Arm Assembly	2905.doc	05/15/01
2907	Pole Receptacle	2907.doc	05/16/01
2908	Pole, Florentine, 10', 8" B.C.	2908.doc	05/15/01
2910	Davit Arm, 12', for 10" Pole, 7 Gauge	2910.doc	08/15/06
2911	Davit Arm, 12' Double, for 10" Pole, 7 Gauge	2910.doc	08/15/06
2912	Davit Arm, 12', for 10" Pole, 3 Gauge	2910.doc	08/15/06
2913	Davit Arm, 12', for 11" Pole, 3 Gauge	2910.doc	08/15/06
2914	Davit Arm, 12', for 12.5" Pole, 3 Gauge	2910.doc	08/15/06
2915	Davit Arm, 8', for 10" Pole, 7 Gauge	2910.doc	08/15/06
2920	Electrolier and Arms	2920.doc	10/06/06

2920 A	Luminaire, Electrolier, 100 W HPS	2920a.doc	08/15/06
2920 B	Luminaire, Electrolier, 150 W HPS	2920a.doc	08/15/06
2921	Gaslight Pole	2902.doc	08/14/06
2921 A	Luminaire, Gaslight Style, 50 W HPS	2921a.doc	08/14/06
2921 B	Luminaire, Gaslight Style, 150 W HPS	2921a.doc	08/14/06
2925	Park Pole, Concrete, 13'9", with Base	2925.doc	08/15/06
2926	Park Pole, Concrete, 10', with Base	2925.doc	08/15/06
2927	Park Pole, Concrete, 10', with Base, Black	2925.doc	08/15/06
2928	Luminaire, Acorn, 150WHPS, for Park Pole	2928.doc	08/15/06
2929	Luminaire, Globe, 100WHPS, for Park Pole	2928.doc	08/15/06
2935	Florentine Pole, 14'	2908.doc	05/15/01
2936	Twin Arm Assembly for Florentine Pole	2936.doc	05/15/01
2939	Luminaire, Acorn, 150WHPS, Type III, for Loop Pole	2939.doc	08/15/06
2975	Chicago 2000, Banner Attachments	2975.doc	08/15/06
2977	Chicago 2000, Mast Head & Finial, for 10" Pole	2977.doc	08/15/06
2978	Chicago 2000, Mast Head & Finial, for 11" Pole	2977.doc	08/15/06
2979	Chicago 2000, Mast Head & Finial, for 12.5" Pole	2977.doc	08/15/06
2980	Chicago 2000 Street Light Pole	2980.doc	08/15/06
2981	Chicago 2000, Luminaire Arm with Scroll, 8'	2981.doc	05/14/01
2983	Chicago 2000 Pole Base	2983.doc	08/15/06
2984	Luminaire, Chicago 2000 Pendant, 310WHPS, Type 3	2984.doc	08/15/06
2985	Chicago 2000 Pedestrian 14' Pole	2985.doc	05/15/01
2986	Chicago 2000 Pedestrian Pole Base	2986.doc	08/15/06
2987	Luminaire, Chicago 2000 Acorn, 100WHPS, Type 5	2987.doc	08/15/06
2988	Acorn Luminaire, 150WHPS, Type V, for Loop Poles	2906.doc	08/14/06
2989	Mid-Mount Art. Luminaire & Arm, 100WHPS, Silver	2989.doc	11/10/09
2990	Mid-Mount Art. Luminaire & Arm, 100WHPS, Black	2989.doc	11/10/09
2991	Mid-Mount Res. Luminaire & Arm, 50WHPS, Black	2989.doc	11/10/09
2992	Mid-Mount Res. Luminaire & Arm, 50 WHPS, Silver	2989.doc	11/10/09

2993	Mid-Mount Res. LED Luminaire & Arm, Silver	2989.doc	11/10/09
	STREET LIGHTING – ALUMINUM POLES/ARMS		
701	Pole, Aluminum, Arterial Conventional, 27'10.5"	701.doc	04/07/03
701a	Arm, Truss, Aluminum, 6" Arterial, 8'	702.doc	04/07/03
701b	Arm, Truss, Aluminum, 6" Arterial, 12'	702.doc	04/07/03
701c	Arm, Truss, Aluminum, 6" Arterial, 15'	702.doc	04/07/03
702	Pole, Aluminum, Skyway Conventional, 32'10.5"	701.doc	04/07/03
703	Pole, Aluminum, Residential Conventional, 20'	701.doc	04/07/03
703a	Arm, Truss, Aluminum, 4.5" Skyway/Residential, 6'	702.doc	04/07/03
703b	Arm, Truss, Aluminum, 4.5" Skyway/Residential, 8'	702.doc	04/07/03
703c	Arm, Truss, Aluminum, 4.5" Skyway/Residential, 12'	702.doc	04/07/03
703d	Arm, Truss, Aluminum, 4.5" Skyway/Residential, 15'	702.doc	04/07/03
704	Pole, Aluminum, Davit, Skyway, 29'5"	704.doc	11/05/09
705	Pole, Aluminum, Davit, Residential, 12'5"	704.doc	11/05/09
705s	Pole, Aluminum, Davit, Short Residential, 10'	704.doc	11/05/09
705a	Arm, Davit, Aluminum, 4.5" Sky/Res, 8'	705.doc	04/08/03
705b	Arm, Davit, Aluminum, 4.5" Sky/Res, 12'	705.doc	04/08/03
705c	Arm, Davit, Aluminum, 4.5" Sky/Res, 15'	705.doc	04/08/03
705d	Arm, Davit, Twin 180° Aluminum, 4.5" Sky/Res, 8'	705.doc	04/08/03
705e	Arm, Davit, Twin 180° Aluminum, 4.5" Sky/Res, 12'	705.doc	04/08/03
705f	Arm, Davit, Twin 180° Aluminum, 4.5" Sky/Res, 15'	705.doc	04/08/03
706	Pole, Aluminum, Davit, Arterial, 24'-5"	704.doc	11/05/09
706s	Pole, Aluminum, Davit, Short Arterial, 20' 5"	704.doc	11/05/09
706a	Arm, Davit, Aluminum, 6" Arterial, 8'	706.doc	04/08/03
706b	Arm, Davit, Aluminum, 6" Arterial, 12'	706.doc	04/08/03
706c	Arm, Davit, Aluminum, 6" Arterial, 15'	706.doc	04/08/03
706d	Arm, Davit, Twin 180°, Aluminum, 6" Arterial, 8'	706.doc	04/08/03
706e	Arm, Davit, Twin 180°, Aluminum, 6" Arterial, 12'	706.doc	04/08/03
706f	Arm, Davit, Twin 180°, Aluminum, 6" Arterial, 15'	706.doc	04/08/03

	TRAFFIC SIGNALS		
302	Signal Head, Polycarbonate, LED, 3-Section, Plumbizer Mounted	302.doc	04/24/01
303	Signal Head, Polycarbonate, LED, 3-Section, Bracket Mounted	303.doc	04/16/01
304	Signal Head, Polycarbonate, LED, 4-Section, Bracket Mounted	303.doc	04/16/01
305	Signal Head, Polycarbonate, LED, 5-Section, Bracket Mounted	303.doc	04/16/01
306	Optically Programmed Signal Head, 1-Face, 3-Section, Bracket Mounted	306.doc	08/16/06
307	Optically Programmed Signal Head, 1-Face, 4-Section, Bracket Mounted	306.doc	08/16/06
308	Optically Programmed Signal Head, 1-Face, 5-Section, Bracket Mounted	306.doc	08/16/06
309	Signal Head, Polycarbonate, LED, 3-Section, Mast Arm Mounted	309.doc	08/16/06
310	Signal Head, Polycarbonate, LED, 4-Section, Mast Arm Mounted	309.doc	08/16/06
311	Signal Head, Polycarbonate, LED, 5-Section, Mast Arm Mounted	309.doc	08/16/06
312	Optically Programmed Signal Head, 1-Face, 3-Section, Mast Arm Mounted	309.doc	08/16/06
313	Optically Programmed Signal Head, 1-Face, 4-Section, Mast Arm Mounted	309.doc	08/16/06
314	Optically Programmed Signal Head, 1-Face, 5-Section, Mast Arm Mounted	309.doc	08/16/06
315	Pedestrian Signal Head, Polycarbonate, LED, Bracket Mounted	315.doc	08/16/06
315A	Countdown Pedestrian Traffic Signal	315.doc	08/16/06
315B	Audible Pedestrian Traffic Signal Station	315b.doc	03/05/08
315C	Audible Pedestrian Traffic Signal Controller	315c.doc	03/05/08
316	Junction Box, Pole or Post Mounted	316.doc	04/03/09
317	Pedestrian Push Button	317.doc	03/05/08
324	Pedestrian Push Button Post	324.doc	03/05/08
325	Mast Arm, Traffic, Steel Monotube, 16 Foot	325.doc	08/18/06
326	Mast Arm, Traffic, Steel Monotube, 20 Foot	325.doc	08/18/06

327	Mast Arm, Traffic, Steel Monotube, 26 Foot	325.doc	08/18/06
328	Mast Arm, Traffic, Steel Monotube, 30 Foot	325.doc	08/18/06
329	Mast Arm, Traffic, Steel Monotube, 35 Foot	325.doc	08/18/06
330	Mast Arm, Traffic, Steel Monotube, 40 Foot	325.doc	08/18/06
331	Mast Arm, Traffic, Steel Monotube, 44 Foot	325.doc	08/18/06
332	Mast Arm, Steel, 4' with Pole Plate	332.doc	05/23/01
333	Mast Arm, Steel, 8' with Pole Plate	332.doc	05/23/01
335	Traffic Signal Post, Aluminum, 15 Foot	335.doc	06/27/08
336	Traffic Signal Post, Aluminum, 17 Foot	335.doc	06/27/08
337	Traffic Signal Post, Aluminum, 20 Foot	335.doc	06/27/08
338	Cut Off Pole and Install Cap	338.doc	05/23/01
339	Paint Existing Controller Cabinet	214.doc	10/06/06
340	Paint Existing Traffic Signal Pedestal and Heads	214.doc	10/06/06
341	Paint Existing Traffic Signal Pole	214.doc	10/06/06
341A	Paint Existing Traffic Signal Pole and Mast Arm	214.doc	10/06/06
342	Vehicle Detector Amplifier, 1-Channel	342.doc	04/27/01
3421	Vehicle Detector Amplifier, 4-Channel	342.doc	04/27/01
343	Detector Loop	343.doc	08/31/06
344	Flashing Beacon with Downlight	344.doc	10/23/06
344A	Flashing Beacon, Bracket Mounted	344a.doc	10/23/06
344B	Flashing Beacon, Mast Arm Mounted	344b.doc	10/23/06
345	Flashing Beacon, Solar Powered, Bracket Mounted	345.doc	10/23/06
346	Electric Cable in Conduit, #14 2/C Shielded	346.doc	03/05/08
347	Electric Cable in Conduit, #4 2/C	347.doc	09/01/06
348	Electric Cable in Conduit, #14 7/C	347.doc	09/01/06
349	Electric Cable in Conduit, #14 10/C	347.doc	09/01/06
350	Electric Cable in Conduit, #14 19/C	347.doc	09/01/06
351	Cable Termination, #14 7/C	351.doc	09/07/06
352	Cable Splice, 7/C, in Manhole	352.doc	09/07/06
353	Remove Existing Traffic Signal Equipment	353.doc	10/19/20

362	Harness Cable, #16, 8/C	362.doc	09/01/06
364	Cable, T.S., Temp. Aerial	364.doc	09/01/06
371A	Illuminated Symbolic Sign, LED, NLT, Bracket Mt.	371.doc	08/18/06
371B	Illuminated Symbolic Sign, LED, NRT, Bracket Mt.	371.doc	08/18/06
371C	Illuminated Symbolic Sign, LED, DNE, Bracket Mt.	371.doc	08/18/06
372A	Illuminated Symbolic Sign, LED, NLT, Mast Arm Mt.	371.doc	08/18/06
372B	Illuminated Symbolic Sign, LED, NRT, Mast Arm Mt.	371.doc	08/18/06
372C	Illuminated Symbolic Sign, LED, DNE, Mast Arm Mt.	371.doc	08/18/06
376	ATC Controller, Traffic, 16 Load Bay, "Super P" Cabinet, UPS	376.doc	04/07/14
3781	Uninterruptible Power Supply for Traffic Control (piggy-back cabinet)	3781.doc	04/07/14
380	ATC Controller, Traffic, 16 Load Bay, "P" Cabinet	380.doc	04/07/14
381	Interconnect, 7 Wire Master	381.doc	05/23/01
381a	Interconnect, 7 Wire Local	381.doc	05/23/01
382	Controller, Traffic, Temp., Post or Pole Mounted	382.doc	05/23/01
385	Concrete Pedestal Block	385.doc	05/23/01
386	Maintenance of Existing Traffic Signal Installation	386.doc	10/24/06
388	Traffic Control and Protection	388.doc	10/24/06
389	Street Name Signs, Mast Arm Mounted	389.doc	05/23/01
3901	Fiber Optic Add-in for Local Controller	3901.doc	05/23/01
3905	Fiber Optic Add-in for Master Controller	3901.doc	05/23/01
3909	Fiber Optic Star Modem	3901.doc	05/23/01
3913	Fiber Optic Hybrid Cable in Conduit	3913.doc	05/23/01
3917	Innerduct in Conduit, 1 1/4"	3917.doc	05/23/01
3921	Multi-mode Fiber in Conduit, 200' with ST Connection (Pigtail)	3921.doc	10/24/06
3925	Fiber Optic Splice, 30-8 Fiber, New	3925.doc	10/24/06
3929	Fiber Optic Splice, 30-8 Fiber, Existing	3925.doc	10/24/06
3933	Fiber Optic Splice, 30-30 Fiber, Straight	3925.doc	10/24/06

	TRAFFIC – VIDEO DETECTION		
2002	Video Detection Camera/Mount	2002.doc	11/29/06
2007	Coaxial Cable in Conduit	2007.doc	11/29/06
2009	Electrical Cable in Conduit, 3/C #14(same as 245)	2009.doc	08/14/06
2011	Video Cable Harness	2011.doc	11/29/06
2012	Video Processor Card/Rack	2012.doc	11/29/06
2013	Video Processor Card	2013.doc	11/29/06
2014	Video Detection Card Rack, 4 Camera	2014.doc	11/29/06
2015	Video Detection Card Rack, 8 Camera	2015.doc	11/29/06
2016	Interface Panel, 2 Camera	2016.doc	11/29/06
2017	Interface Panel, 4 Camera	2017.doc	11/29/06
2018	Interface Panel, 6 Camera	2018.doc	11/29/06
2019	Interface Panel, 8 Camera	2019.doc	11/29/06
2020	Video Detection Power Supply	2020.doc	11/29/06
2021	Coaxial Jumper Cable	2021.doc	11/29/06
	REMOVAL		
502	Remove Urban Renewal Light Pole	502.doc	08/18/06
503	Remove Pole, Wood	504.doc	08/18/06
504	Remove Pole, Steel, A.B., 11 Ga., 20'	504.doc	08/18/06
505	Remove Pole, Aluminum, AB, 25'	504.doc	08/18/06
506	Remove Pole, Steel, Embedded, CTA, 30'	506.doc	05/10/01
507	Remove Pole, Steel, Embedded, 7 Ga., 33'	506.doc	05/10/01
508	Remove Pole, Steel, Embedded, 7 Ga., 35'	506.doc	05/10/01
509	Remove Pole, Steel, Embedded, 3 Ga., 35'	506.doc	05/10/01
510	Remove Pole, Steel, AB, 7 Ga., 27'6"	504.doc	08/18/06
511	Remove Pole, Steel, AB, 3 Ga., 27'6"	504.doc	08/18/06

512	Remove Pole, Steel, AB, 7 Ga., 29'6"	504.doc	08/18/06
513	Remove Pole, Steel, AB, 3 Ga., 29'6"	504.doc	08/18/06
514	Remove Pole, Steel, AB, 7 Ga., 32'6"	504.doc	08/18/06
515	Remove Pole, Steel, AB, 3 Ga., 32'6"	504.doc	08/18/06
516	Remove Pole, Steel, AB, 10", 7 Ga., 34'6"	504.doc	08/18/06
517	Remove Pole, Steel, AB, 10", 3 Ga., 34'6"	504.doc	08/18/06
518	Remove Pole, Steel, AB, 11", 3 Ga., 34'6"	504.doc	08/18/06
519	Remove Pole, Steel, AB, 12.5", 3 Ga., 34'6"	504.doc	08/18/06
521	Remove Ballast House Base	502.doc	08/18/06
523	Remove Riser on Embedded Pole, 1 1/4" - 2"	502.doc	08/18/06
524	Remove Riser on Embedded Pole, 2 1/2"	502.doc	08/18/06
526	Remove Luminaire, 400w/310w,150w	504.doc	08/18/06
526A	Remove Underpass Luminaire	504.doc	08/18/06
528	Remove Mast Arm, Steel, 2' or 4'	504.doc	08/18/06
529	Remove Mast Arm, Steel, 8'	504.doc	08/18/06
530	Remove Mast Arm, Steel, 12'	504.doc	08/18/06
531	Remove Mast Arm, Steel, 15'	504.doc	08/18/06
533	Remove Wire Rack	502.doc	08/18/06
534	Remove Steel Cross Arm	502.doc	08/18/06
536	Remove Service Equipment, Drg#801 or #11925	536.doc	05/10/01
537	Remove Service Equipment on Embedded Pole, Drg. #561	536.doc	05/10/01
539	Remove Pole Mounted Street Light Controller	504.doc	08/18/06
541	Remove Aerial Cable, SS 3/C #4	502.doc	08/18/06
542	Remove Aerial Cable, SS 3/C #2	502.doc	08/18/06
544	Remove Service Cable in conduit, 3 #6, 2 #4	502.doc	08/18/06
545	Remove Service Cable in conduit, 4 #6, 3 #4	502.doc	08/18/06
546	Remove Service Cable in conduit, 2 #2	502.doc	08/18/06
547	Remove Service Cable in conduit, 3 #2	502.doc	08/18/06
548	Remove Service Cable in conduit, 3 #1/0	502.doc	08/18/06
549	Remove Service Cable in conduit, 2 #1/0	502.doc	08/18/06

550	Remove Branch Wires, 2 #6	502.doc	08/18/06
553	Remove TS Head, 1 - Face	504.doc	08/18/06
554	Remove Illuminated Sign	504.doc	08/18/06
555	Remove Ped. Signal Head	504.doc	08/18/06
556	Remove Ped. Push Button-	504.doc	08/18/06
557	Remove Truss Al. M.A. 15'	502.doc	08/18/06
558	Remove Truss Al. M.A. 20'	502.doc	08/18/06
559	Remove Truss Al. M.A. 25'	502.doc	08/18/06
560	Remove Monotube M.A. 16'	504.doc	05/10/01
561	Remove Monotube M.A. 20'	504.doc	05/10/01
562	Remove Monotube M.A. 26'	504.doc	05/10/01
563	Remove Monotube M.A. 30'	504.doc	05/10/01
564	Remove Monotube M.A. 35'	504.doc	05/10/01
565	Remove Monotube M.A. 40'	504.doc	05/10/01
566	Remove Monotube M.A. with 2 Signals, 40'	504.doc	05/10/01
567	Remove Steel 2" conduit M.A., 20'	502.doc	08/18/06
568	Remove TS Post, 3.5'	502.doc	08/18/06
569	Remove TS Post, 7',15',17',20'	504.doc	05/10/01
570	Remove Controller & Post	504.doc	05/10/01
571	Remove Controller	504.doc	05/10/01
572	Remove Controller, Base Mounted	504.doc	05/10/01
573	Remove Cable in Conduit, 7,10,14,19,22 C	502.doc	08/18/06
574	Remove Service Cable in Conduit, 2/C	502.doc	08/18/06
575	Remove Concrete Block	504.doc	05/10/01
576	Remove Junction Box, TSS 18	504.doc	05/10/01
577	Remove Deadend Cable with Strandwise	502.doc	08/18/06
578	Remove Guy Wire	502.doc	08/18/06
579	Remove Cable Clamp, FA	502.doc	08/18/06
580	Remove Aerial Cable, 5-6 Pr. FA	502.doc	08/18/06
581	Remove Aerial Cable, 10-30 Pr. FA	502.doc	08/18/06

5811	Remove Aerial Cable, 50 Pr. FA	502.doc	08/18/06
582	Remove Aerial Wire, #10 FA	502.doc	08/18/06
583	Remove Cable in Conduit, 3-5-6 Pr. FA	502.doc	08/18/06
584	Remove Cable in Conduit, 15-30 Pr. FA	502.doc	08/18/06
585	Remove Cable in Conduit, 50 Pr. FA	502.doc	08/18/06
586	Remove Cable in Conduit, 100 Pr. FA	502.doc	08/18/06
587	Remove Cable in Conduit, 150 Pr. FA	502.doc	08/18/06
588	Remove Cable in Conduit, 202 Pr. FA	502.doc	08/18/06
589	Remove Pedestal & Box FA	504.doc	05/10/01
590	Remove Terminal Cabinet	504.doc	05/10/01
593	Remove Fiber Optic Cable in Conduit	502.doc	08/18/06
596	Breakdown Existing Handhole	596.doc	05/22/01
597	Breakdown Manhole in Parkway	596.doc	05/22/01
598	Breakdown Manhole in Street	596.doc	05/22/01
600	Breakdown Foundation, Type A	600.doc	08/18/06
601	Breakdown Street Light Foundation	600.doc	08/18/06
602	Breakdown Foundation, Type B	600.doc	08/18/06
603	Breakdown Foundation for Base Mounted Controller	600.doc	08/18/06
604	Breakdown Foundation, 24" FA	600.doc	08/18/06
	REINSTALL		
6200	Reinstall Signal Head, 3 Section, Bracket Mounted	6200.doc	08/18/06
6201	Reinstall Signal Head, 3 Section, Mast Arm Mounted	6200.doc	08/18/06
6202	Reinstall Signal Head, 2 Section, Mast Arm Mounted	6200.doc	08/18/06
6203	Reinstall Signal Head, 2 Section, Bracket Mounted	6200.doc	08/18/06
6204	Reinstall Ped. Signal, 2 Section, Bracket Mounted	6200.doc	08/18/06
6210	Reinstall MA, Monotube, 16'	6210.doc	05/23/01
6211	Reinstall MA, Monotube, 20'	6210.doc	05/23/01

ITEM 101, TRENCH AND BACKFILL FOR 6 - 3 INCH DUCT

1. **DESCRIPTION** This work will consist of excavating a trench for the installation of a six (6) duct conduit package, encased in concrete, and backfilling with limestone screenings as a portion of the total backfill of the trench. This work must meet all applicable requirements of Article 815 of the Standard Specifications.
2. **MATERIAL**. Underground Cable Marking Tape must meet the requirements of Section 1066.05 of the Standard Specifications. Screenings must meet the requirements of Section 1003.04 of the Standard Specifications.
3. **CONSTRUCTION REQUIREMENTS**. The trench must not be less than four feet two inches (4'2") deep to provide thirty inches (30") of cover over the concrete encased conduit to be installed in the trench. The trench must be between eighteen and twenty-four inches (18"-24") in width and must not exceed twenty-four inches (24") in width, unless approved by the Resident Engineer. The bottom of the trench must be tamped, and the trench inspected by the Resident Engineer before conduit is installed. All trenches must be backfilled as soon as possible after the installation of the conduit. Any material excavated from the trenches that in the opinion of the Resident Engineer is satisfactory backfill, may be used for backfill above the layer of screenings. Limestone screenings must be used to fill the bottom of the trench to a depth of one foot above the top of the conduit or duct encasement. Cinders, rocks, or other inappropriate materials will not be permitted to be used as backfilling material. Backfilling material, beginning with limestone screenings must be deposited in the trench in layers not to exceed six inches (6") in depth, and must be thoroughly compacted with a mechanical tamper before the next layer is deposited in the trench. All trenches for conduit must be backfilled as per this specification. Unsuitable material must be disposed of according to the requirements of Section 202.03 of the Standard Specifications. Underground cable marking tape must be installed twelve inches (12") below the finished grade for all conduit runs.
4. **METHOD OF MEASUREMENT**. This work will be measured in feet along the centerline of the trench. Trench and backfill will not be measured for payment for conduit which is installed by pushing or by directional boring.
5. **BASIS OF PAYMENT**. This work will be paid for at the contract unit price per lineal foot, measured with duct in place, for TRENCH AND BACKFILL FOR 6 DUCT. Such price will include the cost of all excavation, furnishing and placing all backfill material, and disposal of all surplus excavated material. This price does not include the cost of conduit or encasement which will be paid for separately. If sidewalk, driveway pavement, or pavement must be removed and replaced, such work will be paid for separately.

January 1, 2002

ITEM 102, ADJUST FRAME AND LID

ITEM 116 REPLACE 24" FRAME AND LID WITH 30" FRAME AND LID

ITEM 121, ELECTRICAL FRAME AND LID, 24"

ITEM 122, ELECTRICAL FRAME AND LID, 30"

1. **DESCRIPTION.** This item will consist of adjusting or replacing an existing or new 24 inch or 30 inch frame and lid for an existing manhole or handhole to the new or existing grade. The existing manhole or handhole may be in the street, in the sidewalk, or in the parkway.
2. **MATERIAL.** The 24 inch frame and lid must be as shown in Standard Drawing 872. The 30 inch frame and lid must be as shown in Standard Drawings 874 and 10927. All frames and lids must conform to Material Specification 1458. Bricks must meet the requirements of Article 1041 of the Standard Specifications.
3. **INSTALLATION.** Pavement, sidewalk, and dirt must be removed to the extent necessary to adjust the frame. Material must be disposed of according to the requirements of Section 202.03 of the Standard Specifications. Mortar and brick, or mortar and concrete rings, must be used to adjust to the proper grade. With the approval of the Resident Engineer, the contractor may use precast adjusting rings. Adjustment rings, bricks, and frames are to be set in a full mortar bed. Mortar must be mixed in a proportion of one (1) part cement to three (3) parts sand by volume of dry mix. The interior of the adjustment must be smooth. Use of partial bricks will not be allowed. Bricks must be laid in full header courses only. In no instance will the neck of the manhole or handhole exceed two (2) feet in depth.

The pavement, sidewalk, or parkway must be restored to the proper grade after adjustment. Patching of pavement around a structure must be with high early strength concrete meeting the requirements of Articles 1001 and 1020 of the Standard Specifications. The bituminous concrete layer must be properly restored. Sidewalk must be replaced to the nearest full slab, or expansion joint, and must be a minimum of 5 inches in thickness. Parkways must be properly backfilled and topped with appropriate soil material.

4. **METHOD OF MEASUREMENT.** This work will be measured on a per each basis.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract price per each unit for ADJUST FRAME AND LID, or ELECTRICAL FRAME AND LID 24", or ELECTRICAL FRAME AND LID 30", or REPLACE 24" FRAME AND LID WITH 30" FRAME AND LID. All excavation and restoration, as well as bricks, concrete, mortar, backfill, soil, disposal of surplus excavated material, reinforcement bars, frames and lids, etcetera will be included in the unit price.

MATERIAL
1458

DRAWINGS
872
874
10927

January 1,2002

Item 102, 116, 121, 122

ITEM 103, PAVEMENT REMOVAL

1. **DESCRIPTION.** This item will consist of full depth removal of street pavement, including all bituminous concrete and Portland cement concrete. Sections of pavement to be removed will consist of 18 inch to 24 inch widths, from curb to curb, or other lengths identified for installing conduits, or the removal of rectangular sections to accommodate manhole construction.
2. **REMOVAL.** The pavement removal must conform to all applicable sections of Articles 440 and 442 of the Standard Specifications. Removal will be necessitated by the need for conduit and manhole installations. The width and length of the removal will be such that associated conduit or manhole installations may be easily facilitated.

The size of the areas worked precludes the use of large machinery, permitting generally the use of a hand operated pneumatic hammer, a machine operated hydraulic bull point, or a concrete saw, with manual labor or a small back-hoe to load the broken concrete into a high-lift bucket or a dump truck for removal and off-site disposal of the spoil. Spoil will be disposed of according to Section 202.03 of the Standard Specifications.

To maintain necessary lanes open to traffic, work will proceed in one lane at a time where possible. The use of a steel plate to cover cleared work areas permits immediate resumption of vehicular traffic. Steel plates will be used and secured to the roadway as directed by the Resident Engineer.

3. **METHOD OF MEASUREMENT.** Pavement removal will be measured by the surface area removed, measured in square yards. The depth of removal will not be measured for payment and will be considered incidental. The use of steel plates will be incidental. Saw cuts necessary to perform this work will be considered incidental. The proper disposal of all spoil will be considered incidental.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per square yard for PAVEMENT REMOVAL. The contract unit price will include removing and disposing of the entire pavement structure.

ITEM 104, SIDEWALK REMOVAL

1. **DESCRIPTION.** This item will consist of the full depth removal of concrete sidewalk, including any sub base material.
2. **REMOVAL.** The sidewalk removal will conform to all applicable sections of Article 440 of the Standard Specifications. Removal will be necessitated by the need for conduit, handhole, foundation, and manhole installations. The width and length of the removal will be such that associated installations may be easily facilitated. Removal must include the entire concrete sidewalk slab, unless directed otherwise by the Engineer. All material will be disposed of according to the requirements of Section 202.03 of the Standard Specifications.
3. **METHOD OF MEASUREMENT.** Sidewalk removal will be measured by the surface area removed, measured in square feet. The depth of removal will be 5 inches on average, but must include the entire concrete slab regardless of depth. No additional measurements will be allowed for depth variances.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per square foot for SIDEWALK REMOVAL. The contract unit price must include removing and disposing of all concrete. No additional payments will be made for sidewalks that are thicker than 5 inches. Any saw-cuts necessary to remove the sidewalk will be considered incidental to this pay item.

April 2, 2001

ITEM 105, PAVEMENT REMOVED AND REPLACED

1. DESCRIPTION

The scope of the work covered by this item is the removal and replacement of concrete pavement in small confined areas, such as the removal and replacement of an 18 inch or 24 inch wide section for installing a conduit or multiple conduits across a roadway, or the removal of a rectangular area approximately four feet wide by five feet long (2.22 sq. yd.) for manhole construction.

2. MATERIAL

The concrete must meet the pavement patching concrete requirements for Portland Cement Concrete, Article 1020 of the Standard Specifications. Reinforcement bars and dowel rods must meet the requirements of the Standard Specifications, Article 1006, Sections 10 and 11, respectively.

3. METHOD OF CONSTRUCTION

The method of construction must conform to all applicable sections of Article 442 of the Standard Specifications. Reinforcement bars and dowel rods will be used if so directed by the Resident Engineer.

The size of the areas worked precludes the use of large machinery, permitting generally the use of a hand operated pneumatic (jack) hammer, a machine operated hydraulic bull point, or a concrete saw, with manual labor or a small back-hoe to load the broken concrete into a high-lift bucket or a dump truck for removal and off-site disposal of the spoil. Spoil disposal must meet the requirements of Section 202.03 of the Standard Specifications.

To maintain necessary lanes open to traffic, work will proceed in one lane at a time where possible. The use of a steel plate to cover cleared work areas will permit immediate resumption of vehicular traffic. Steel plates will be used and secured to the roadway as directed by the Resident Engineer.

When the below grade work is completed, the (top six inches 6") of sub grade must be compacted either by a mechanical or hand tamper meeting the approval of the Resident Engineer.

The concrete replacement must consist of Portland cement concrete, a minimum of 9 inches in depth, which will be struck-off and consolidated by the hand method. The Portland cement must be poured to a level even with the bituminous wearing surface. Before the concrete has taken its initial set, the surface must be roughened by brooming, racking or other methods meeting the

approval of the Resident Engineer.

The use of temporary steel plates to protect new concrete replacement eliminates closing of the roadway while the concrete cures.

4. **METHOD OF MEASUREMENT**

Pavement removal and replacement must be measured by the surface area affected, and must be measured only once for both removal and replacement. The depth of the removal and associated replacement will be incidental to the cost. The surface area must be measured in square yards. The use of steel plates will be incidental to this item. Saw-cuts will not be measured or paid for separately and will be considered incidental to this item. Any reinforcement bars or dowel rods installed will be considered incidental to this pay item.

5. **BASIS OF PAYMENT**

This work will be paid for at the contract unit price per square yard for PAVEMENT REMOVED AND REPLACED, and will be payment in full for removing and replacing concrete pavement as required by the plans.

ITEM 106, TEMPORARY PAVEMENT PATCHING

1. **DESCRIPTION** This work will consist of temporarily filling in excavations, creating temporary ramps for grade changes, temporarily filling voids left by removed sidewalk or removed pavement, or for any other use as directed by the Resident Engineer. Since this is temporary patching, the removal of the patching material will be included in this item.
2. **MATERIAL**. The material must meet the requirements of Article 406 of the Standard Specifications. The bituminous concrete must be Class 1, mixture C or D.
3. **CONSTRUCTION REQUIREMENTS**. The bituminous mixture must be applied as directed by the Engineer. The material must be placed on a dry base under favorable weather conditions. The temperature should not be below 60° Fahrenheit. Any material placed in areas exposed to vehicular traffic must be properly compacted. After placement, the bituminous patches must be level with any abutting surface. The patching should be removed at the direction of the Engineer. When patching is removed, it should be immediately replaced with a permanent surface. Patching materials must be disposed of according to the requirements of Section 202.03 of the Standard Specifications.
4. **METHOD OF MEASUREMENT**. This work will be measured per ton of material placed.
5. **BASIS OF PAYMENT**. This work will be paid for at the contract unit price per metric ton for TEMPORARY PAVEMENT PATCHING. Such price will include the cost of all material and labor necessary to provide the patching, including disposal of material.

August 28, 2006

ITEM 107, SIDEWALK REMOVED AND REPLACED
ITEM 107A, SIDEWALK REMOVED AND REPLACED FOR PEDESTRIAN
RAMPS

1. **DESCRIPTION.**

The scope of the work covered by this item is the removal and replacement of concrete sidewalk in small areas to accommodate the installation of conduit, foundations, handholes, or manholes. The boundaries of the removal and replacement will include all sidewalks to the nearest break point or expansion joint as directed by the Resident Engineer.

The Contractor will also be required to construct pedestrian ramps at the intersection of streets where existing sidewalks have been removed and are being replaced, at alley returns, or as indicated on the plans or as directed by the Engineer.

This work must be in accordance with Article 440 of the Standard Specifications for removal, applicable sections of Article 424 of the Standard Specifications for installation, and the latest standards for pedestrian ramps, as described in the latest versions of the Standard Drawing 960, "Sidewalk Ramp Detail" and Standard Drawing 961, "Alley Return/ Driveway Detail".

2. **MATERIAL**

The concrete must be Class SI meeting the requirements of Article 1020 of the Standard Specifications.

3. **METHOD OF CONSTRUCTION.**

The size of the areas worked precludes the use of large machinery, permitting generally the employment of a hand operated pneumatic jack hammer, a machine operated bull point, where required, or a concrete saw. Manual labor, or small back hoe, can be used to load broken concrete into a high lift bucket or a dump truck for removal and off-site disposal of the spoil. Spoil must be disposed according to the requirements of Section 202.03 of the Standard Specifications. The sidewalk to be removed must be cut with a concrete saw to produce a clean straight edge to meet the replacement work. Normally sidewalk is replaced by the whole slab. When the below grade work is completed, the sub grade must be compacted to match that of the surrounding soil, either by a mechanical or hand tamper meeting the approval of the Resident Engineer.

The concrete replacement must consist of Portland cement concrete, five inches (5") in depth and meet the requirements of Article 424 of the Standard Specifications.

4. **METHOD OF MEASUREMENT.**

Sidewalk removal and replacement must be measured by the surface area affected in square feet. There will be only one measurement for both removal and replacement. The depth of the work will be incidental.

5. **BASIS OF PAYMENT.**

This work will be paid for at the contract unit price per square foot for **SIDEWALK REMOVED AND REPLACED**, or **SIDEWALK REMOVED AND REPLACED FOR PEDESTRIAN RAMPS**, and will be payment in full for removing and replacing concrete sidewalk as required by the plans, and must include all material, labor, and equipment necessary. The construction of side flares, expansion joints, vertical height, edge treatment, saw cutting, minor grading, and removal and disposal of unsuitable material will not be paid for separately, but must be included in the contract unit price.

DRAWINGS

960 961

ITEM 107B, COMBINATION CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT

1. **DESCRIPTION.** Work under this item will be performed in accordance with Standard Specification Article 440 for removal and Article 606 for construction of combination curb and gutter, except as herein noted.
2. **MATERIAL.** The Portland cement concrete must be Class SI meeting the requirements of Article 1020 of the Standard Specifications.
3. **CONSTRUCTION.** This work will consist of removal and replacement of existing curb and gutter at the intersection of streets where sidewalk ramps are to be constructed or as otherwise indicated in the plans, or as directed. Spoil will be disposed of according to Section 202.03 of the Standard Specifications.

The contractor must saw cut a perpendicular, clean, joint between the portion of the curb and gutter to be removed and that which is to remain in place. The cost of this work will be included in the contract unit price for this item.

If the contractor removes, or damages, the existing curb and gutter, or sidewalk, outside of the limits designated by the plans, he will be required to repair that portion at his own expense.

If, upon removal of the existing curb and gutter, a soft or unstable sub-base is encountered, this material must be excavated and replaced with sub-base granular material, Type B. The cost of excavation and replacement of the unstable sub-base will be included in the unit price for this item.

The cost of replacement of missing tie bars adjacent to existing Portland cement must be included in the contract unit price for this item.

All concrete curb and gutter transitions and depressed curb and gutter will be included in this item.

4. **METHOD OF MEASUREMENT.** Removal and replacement will not be measured separately. The actual length of replacement must be used as the basis of payment. Measurement will be made in feet.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for COMBINATION CURB AND GUTTER REMOVAL AND REPLACEMENT. All labor, material, and equipment necessary to correctly remove and install the curb and gutter is included in this item.

April 3, 2001

ITEM 107C, WARNING TILES IN SIDEWALK RAMP

1. **DESCRIPTION.**

The scope of the work covered by this item is the placement of warning surface tiles in pedestrian sidewalk ramps. The tiles are to be located to provide warnings to pedestrians of a hazardous crossing. Tiles will be placed at locations indicated in the plans, or as directed by the engineer.

This work must be in accordance with Article 424.09 of the Standard Specifications for Detectable Warnings, and the latest standards for pedestrian ramps, as described in the latest versions of the Standard Drawing 960, "Sidewalk Ramp Detail" and Standard Drawing 961, "Alley Return/ Driveway Detail".

2. **MATERIAL**

The warning tiles must meet the requirements of Material Standard 1555.

3. **METHOD OF CONSTRUCTION.**

The installation must be an integral part of the walking surface. The tiles must be installed at the same time as the pedestrian ramps. After installation, the tiles must be in the correct location and at the proper angles, as indicated in the Standard Drawings. Only the truncated domes in the tiles will project above the walking surface. The materials, equipment, and installation procedures used must be according to the manufacturer's installation instructions.

4. **METHOD OF MEASUREMENT.**

Tile placement must be measured by the surface area installed in square feet.

5. **BASIS OF PAYMENT.**

This work will be paid for at the contract unit price per square foot for WARNING TILES IN SIDEWALK RAMP and will be payment in full for placing the tiles in the sidewalk ramp as required by the plans, and must include all material, labor, and equipment necessary.

MATERIAL
1555

DRAWINGS
960 961

October 6, 2006

ITEM 108, TRENCH AND BACKFILL WITH SCREENINGS

1. **DESCRIPTION** This work will consist of excavating a trench for the installation of conduit and backfilling with limestone screenings as a portion of the total backfill of the trench, all as shown in Bureau of Electricity Standard Drawings No. 579 and No. 813. This work must meet all applicable requirements of Article 815 of the Standard Specifications.
2. **MATERIAL**. Underground Cable Marking Tape must meet the requirements of Section 1066.05 of the Standard Specifications. Backfill must meet the requirements of Section 1003.04 of the Standard Specifications.
3. **CONSTRUCTION REQUIREMENTS**. The trench must be deep enough to provide thirty inches (30") of cover over the conduit to be installed. The trench must not exceed twelve inches (12") in width unless approved by the Resident Engineer. The bottom of the trench must be tamped, and the trench inspected by the Resident Engineer before conduit is installed. All trenches must be backfilled as soon as possible after the installation of the conduit or cable. Any material excavated from the trenches that in the opinion of the Resident Engineer is satisfactory backfill, may be used for backfill above the layer of screenings. The limestone screenings must be used to fill the bottom of the trench to a depth of one foot above the top of the conduit or duct encasement. Cinders, rocks, or other inappropriate materials will not be permitted to be used as backfilling material. Backfilling material, beginning with limestone screenings must be deposited in the trench in layers not to exceed six inches (6") in depth, and must be thoroughly compacted with a mechanical tamper before the next layer is deposited in the trench. All trenches for conduit must be backfilled as per this specification. Unsuitable material must be disposed of according to the requirements of Section 202.03 of the Standard Specifications. Underground cable marking tape must be installed twelve inches (12") below the finished grade for all conduit runs.
4. **METHOD OF MEASUREMENT**. This work will be measured in feet along the centerline of the trench. Trench and backfill will not be measured for payment for conduit which is installed by pushing or by directional boring. Where more than one (1) conduit is installed in a single trench, only one run will be measured for payment.
5. **BASIS OF PAYMENT**. This work will be paid for at the contract unit price per lineal foot, measured with conduit in place, for TRENCH AND BACKFILL WITH SCREENINGS. Such price will include the cost of all excavation, furnishing and placing all backfill material, and disposal of all surplus excavated material. If sidewalk, driveway pavement or pavement must be removed and replaced, such work will be paid for separately.

MATERIAL SPECIFICATION

DRAWINGS

813

579

Item 108 Page 2

January 1, 2002

ITEM 108A, TRENCH AND BACKFILL WITH SCREENINGS – ONE FOOT

1. **DESCRIPTION** This work will consist of excavating a trench for the installation of conduit and backfilling with limestone screenings as a portion of the total backfill of the trench, all as shown in Bureau of Electricity Standard Drawings No. 579 and No. 813. This work must meet all applicable requirements of Article 815 of the Standard Specifications.
2. **MATERIAL**. Underground Cable Marking Tape must meet the requirements of Section 1066.05 of the Standard Specifications. Backfill must meet the requirements of Section 1003.04 of the Standard Specifications.
3. **CONSTRUCTION REQUIREMENTS**. The trench must be one (1) foot deep. This trench in addition to any existing excavation will provide thirty inches (30") of cover over the conduit to be installed. The trench must not exceed twelve inches (12") in width unless approved by the Resident Engineer. The bottom of the trench must be tamped, and the trench inspected by the Resident Engineer before conduit is installed. All trenches must be backfilled as soon as possible after the installation of the conduit or cable. Any material excavated from the trenches that in the opinion of the Resident Engineer is satisfactory backfill, may be used for backfill above the layer of screenings. The limestone screenings must be used to fill the bottom of the trench to a depth of one foot above the top of the conduit or duct encasement. Cinders, rocks, or other inappropriate materials will not be permitted to be used as backfilling material. Backfilling material, beginning with limestone screenings must be deposited in the trench in layers not to exceed six inches (6") in depth, and must be thoroughly compacted with a mechanical tamper before the next layer is deposited in the trench. All trenches for conduit must be backfilled as per this specification. Unsuitable material must be disposed of according to the requirements of Section 202.03 of the Standard Specifications. Underground cable marking tape must be installed twelve inches (12") below the finished grade for all conduit runs.
4. **METHOD OF MEASUREMENT**. This work will be measured in feet along the centerline of the trench. Trench and backfill will not be measured for payment for conduit which is installed by pushing or by directional boring. Where more than one (1) conduit is installed in a single trench, only one run will be measured for payment.

5. **BASIS OF PAYMENT**. This work will be paid for at the contract unit price per lineal foot, measured with conduit in place, for TRENCH AND BACKFILL WITH SCREENINGS - ONE FOOT. Such price will include the cost of all excavation, furnishing and placing all backfill material, and disposal of all surplus excavated material. If sidewalk, driveway pavement or pavement must be removed and replaced, such work will be paid for separately.

MATERIAL SPECIFICATION

DRAWINGS

813

579

Item 108A

Page 2

August 28, 2006

ITEM 110, TRENCH AND BACKFILL FOR 2 TO 4 DUCTS

1. **DESCRIPTION** This work will consist of excavating a trench for the installation of a two 3 inch or a two 4 inch or a four 3 inch or a four 4 inch duct conduit package, encased in concrete, and backfilling with limestone screenings as a portion of the total backfill of the trench. This work will meet all applicable requirements of Article 815 of the Standard Specifications.
2. **MATERIAL**. Underground Cable Marking Tape must meet the requirements of Section 1066.05 of the Standard Specifications. Backfill must meet the requirements of Section 1003.04 of the Standard Specifications.
3. **CONSTRUCTION REQUIREMENTS**. The trench must not be less than three feet ten inches (3'10") deep to provide a minimum thirty inches (30") of cover over the concrete encased conduit to be installed in the trench. The trench must be between eighteen and twenty-four inches (18"-24") in width and must not exceed twenty-four inches (24") in width unless approved by the Resident Engineer. The bottom of the trench must be tamped, and the trench inspected by the Resident Engineer before conduit is installed. All trenches must be backfilled as soon as possible after the installation of the conduit. Any material excavated from the trenches that in the opinion of the Resident Engineer is satisfactory backfill, may be used for backfill above the layer of screenings. The limestone screenings must be used to fill the bottom of the trench to a depth of one foot above the top of the conduit or duct encasement. Cinders, rocks, or other inappropriate materials will not be permitted to be used as backfilling material. Backfilling material, beginning with limestone screenings will be deposited in the trench in layers not to exceed six inches (6") in depth, and must be thoroughly compacted with a mechanical tamper before the next layer is deposited in the trench. All trenches for conduit must be backfilled as per this specification. Unsuitable material must be disposed of according to the requirements of Section 202.03 of the Standard Specifications. Underground cable marking tape must be installed twelve inches (12") below the finished grade for all conduit runs.
4. **METHOD OF MEASUREMENT**. This work will be measured in feet along the centerline of the trench. Trench and backfill will not be measured for payment for conduit which is installed by pushing or by directional boring. Only one measurement will be made for the trench regardless of the number of conduit in the trench.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot, measured with duct in place, for TRENCH AND BACKFILL FOR 2 TO 4 DUCT. Such price will include the cost of all excavation, furnishing and placing all backfill material, and disposal of all surplus excavated material. Conduit and encasement will be paid for separately and are not included in this pay item. If sidewalk, driveway pavement or pavement must be removed and replaced, such work will be paid for separately.

Item 110

Page 2

April 2, 2001

ITEM 111, PAVEMENT, SPECIAL REMOVAL AND REPLACEMENT FOR CONDUIT UNDER CTA TRACKS

1. **DESCRIPTION** This work will consist of opening and restoring a section of granite block and concrete pavement approximately eighteen inches (18") wide by eighteen feet (18') long which includes and encases CTA street car rails attached to wooden ties. This operation will be performed at the location indicated on the plans, or as directed by the Resident Engineer with the direction of the removal and trench construction perpendicular to the CTA track line. This work must meet all applicable requirements of Articles 442 and 815 of the Standard Specifications.
2. **MATERIAL** The concrete must meet the pavement patching concrete requirements for Portland Cement Concrete, Section 1020 of the Standard Specifications. Reinforcement bars and dowel rods must meet the Standard Specification requirements of Article 1006, Sections 10 and 11, respectively.
3. **METHOD OF CONSTRUCTION** - The size of the areas to be worked precludes the use of large machinery, permitting generally the use of a hand operated pneumatic (jack) hammer, a machine operated hydraulic bull point, or a concrete saw, with manual labor or a small back-hoe to load the broken concrete into a high-lift bucket or a dump truck for removal and off-site disposal of the spoil. Spoil must be removed according to Section 202.03 of the Standard Specifications.

To maintain necessary lanes open to traffic, work will proceed in one lane at a time where possible. The use of a steel plate to cover cleared work areas permits immediate resumption of vehicular traffic. The concrete section of CTA roadbed containing rails and ties is approximately seventeen inches (17") thick and must be removed to excavate the sub grade thereby requiring destructive removal of crossties which will not be replaced. Care must be exercised to avoid cutting the CTA stranded copper ground drain cable which may or may not exist beneath the concrete. When this cable is cut, it must be repaired to the satisfaction of the CTA engineers. Care must be exercised to avoid damaging CTA conduit located midway between the sets of rails. The rails must not be cut.

The concrete replacement must consist of Portland cement concrete, a minimum of 9 inches in depth which will be struck-off and consolidated by the hand method. Concrete will be even with the existing wearing surface of bituminous material. Before the concrete has taken its initial set, the surface must be roughened by brooming, raking or other methods meeting the approval of the Resident Engineer.

The use of temporary steel plates to protect new concrete replacement eliminates closing the roadway while the concrete cures.

4. **METHOD OF MEASUREMENT** This work will be measured laterally in feet from one end of the trench to the other end.

5. **BASIS OF PAYMENT** This work will be paid for at the contract unit price per lineal foot for PAVEMENT, SPECIAL REMOVAL AND REPLACEMENT for conduit under CTA tracks and will be payment in full for removing the granite block and concrete pavement and replacing it with concrete. Trench and backfill will be paid for under a separate pay item. The installation of the conduit will not be considered a part of this work but will be paid for under a different unit cost item.

ITEM 112, ELECTRICAL HANDHOLE, 30", 24" FRAME AND LID
ITEM 113, ELECTRICAL HANDHOLE, 36", 24" FRAME AND LID
ITEM 113A, ELECTRICAL HANDHOLE, 36", 30" FRAME AND LID

1. **DESCRIPTION.** This item is for supplying and installing an electrical handhole 30" in diameter with a 24" frame and lid or a handhole 36" in diameter with a 24" frame and lid in a parkway or sidewalk, or a handhole 36" in diameter with a 30" frame and lid in pavement or in a driveway.
2. **MATERIAL.** The frame and lid must meet the requirements of Material Specification 1458. The handhole must meet the requirements of Material Specification 1528. A 24" frame and lid must also meet the requirements of Standard Drawing 872. A 30" frame and lid must also meet the requirements of Standard Drawings 874 and 10927. Bricks must meet the requirements of Article 1041 of the Standard Specifications. All other materials used must meet the appropriate material requirements of the Standard Specifications.
3. **METHOD OF CONSTRUCTION.** The handhole will be a precast concrete structure, or, if conditions merit, a cast in place concrete structure, complete with cast iron frame and cover, and conforming in detail with either Drawing Number 867, Drawing Number 866, or Drawing 871, except that the number of conduit openings must be as shown on the construction plans.

Each handhole must be installed at the location specified on the plans or at the location identified by the Resident Engineer.

The area where the handhole is to be placed must be properly excavated. All disposable material must be properly disposed of per Section 202.03 of the Standard Specifications. Each handhole must be set or constructed on a foundation of loose stone not less than eight inches (8") deep. The 36" handhole for pavement installation must have a floor as shown in Drawing Number 871. The frame casting must be accurately set on a full bed of mortar to the finished elevation so that no subsequent adjustment will be necessary. It is desirable not to use a neck for the frame. However, if approved by the Resident Engineer, mortar and brick, or mortar and concrete rings, may be used to adjust to the proper grade. Adjustment rings, bricks, and frames must be set in a full mortar bed. Use of partial bricks will not be allowed. Bricks must be laid in full header courses only. Mortar must be mixed in a proportion of one (1) part of cement to three (3) parts sand by volume of dry materials. After entering laterals have been installed in place in the handhole, the openings in the wall must be plugged in an approved manner flush with the inner surface. If backfill is required, screenings must be used and properly compacted. Parkway must be restored to the proper grade. Pavement must be properly restored to the correct grade. Patching of the pavement must be done with high early strength concrete meeting the requirements of Articles 1001 and 1020 of the Standard Specifications. Sidewalks

must be restored to the proper grade using a 5 inch thickness of concrete. The inside of the handhole must be clean of all debris.

- 4. **METHOD OF MEASUREMENT.** This item will be paid for at the contract unit price per each unit installed.

- 5. **BASIS OF PAYMENT.** The necessary excavation, backfilling and restoration of parkway and pavement must be made in accordance with the foregoing specifications, and the cost thereof must be included in the unit price each for installing ELECTRICAL HANDHOLE 30" IN DIAMETER WITH 24" FRAME AND LID, ELECTRICAL HANDHOLE.36" IN DIAMETER WITH 24" FRAME AND LID, or ELECTRICAL HANDHOLE 36" IN DIAMETER WITH 30" FRAME AND LID. No additional payment will be allowed for restoring parkway, sidewalk, or pavement. Removal of sidewalk or pavement will be paid for separately under a different pay item.

MATERIAL SPECIFICATION	DRAWING		
1458	866	874	871
1528	867	872	10927

January 1, 2002

ITEM 114, ROOF ON 3'X4'X4' ELECTRICAL MANHOLE, IN PARKWAY
ITEM 115, ROOF ON 3'X4'X4' ELECTRICAL MANHOLE, IN PAVEMENT

1. **DESCRIPTION.** This item will consist of removing the existing roof of an existing manhole due to its condition or to its relationship to the new grade, where adjusting the frame and cover will not be sufficient.
2. **MATERIAL.** The frame and lid must be re-used, unless the plans call for new, in which case the frame and lid will be paid for under a separate pay item. Concrete must meet the requirements for Portland cement concrete, SI Class, in Article 1020 of the Standard Specifications. Dowel rods must meet the requirements of Section 1006.11 of the Standard Specifications. Reinforcement bars must meet the requirements of Section 1006.10 of the Standard Specifications.
3. **CONSTRUCTION.** The area above the roof will be excavated. Sidewalk or pavement will be removed if necessary. The existing roof must be broken down and all debris removed. All debris must be disposed of per Section 202.03 of the Standard Specifications. The existing manhole walls must be preserved. The existing walls will be keyed so as to form a better bond with the new concrete roof. Dowelling may be used by drilling holes in the existing walls and inserting reinforcement bars of sufficient size, and grouting. Wooden forms will be used to form the new concrete roof. The new roof will be poured in place and must be reinforced as per Drawing 729 or Drawing 730. The new roof must be dimensioned as per Drawing 729 or Drawing 730.

The roof for parkway or sidewalk areas must accommodate a 24" frame and lid.
The roof for a roadway must accommodate a 30" frame and lid.

The parkway must be restored to grade. Pavement must be properly restored to the correct grade. Patching of the pavement will be done with high early strength concrete meeting the requirements of Articles 1001 and 1020 of the Standard Specifications. Sidewalks must be restored to the proper grade using a 5 inch thickness of concrete. The inside of the manhole must be clean and free of all debris.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed complete.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price, and will include all excavation, backfilling, and restoration of parkway, sidewalk, and pavement. The unit measurement will be EACH for ROOF ON 3'X4'X4' ELECTRICAL MANHOLE IN PARKWAY or ROOF ON 3'X4'X4' ELECTRICAL MANHOLE IN PAVEMENT. Removal of sidewalk or pavement will be paid for separately. New frames and lids will be paid for separately.

DRAWINGS 729 730

April 4, 2001

ITEM 117, ELECTRICAL MANHOLE 3'X4'X4' WITH 24" FRAME AND LID
ITEM 118, ELECTRICAL MANHOLE 3'X4'X4' WITH 30" FRAME AND LID
ITEM 119, ELECTRICAL MANHOLE 4'X6'X6' WITH 24" FRAME AND LID
ITEM 119A, ELECTRICAL MANHOLE 4'X6'X6' WITH 30" FRAME AND LID

1. **DESCRIPTION.** This item will consist of furnishing and installing an electrical manhole of the dimensions indicated with either a 24" or 30" frame and lid.
2. **MATERIAL.** The concrete manhole must meet the applicable requirements of Material Specification 1528. The frame and lid must meet the requirements of Material Specification 1458. A 24" frame and lid must meet the requirements of Standard Drawing 872. A 30" frame and lid must meet the requirements of Standard Drawings 874 and 10927. Bricks must meet the requirements of Article 1041 of the Standard Specifications. All other materials used must meet the appropriate material requirements of the Standard Specifications.
3. **METHOD OF CONSTRUCTION.** The manhole will be a precast concrete structure, or, if conditions merit, a cast in place concrete structure, complete with cast iron frame and lid. A 3'X4'X4' manhole with a 24" frame and lid must conform to the requirements of Drawing 730. A 3'X4'X4' manhole with a 30" frame and lid must conform to Drawing 729. A 4'X6'X6' manhole with a 24" frame and lid must conform to Drawing 732. A 4'X6'X6' manhole with a 30" frame and lid must conform to Drawing 733. The number and size of conduit openings will be as shown on the construction plans.

Each manhole will be installed in paved sidewalk, earth parkway, or in pavement at the location specified on the construction plans or at a location as directed by the Resident Engineer.

The area where the manhole is to be placed must be properly excavated. All disposable material will be properly disposed of per Section 202.03 of the Standard Specifications. Each manhole must be set or constructed to conform with the appropriate City of Chicago drawings, except that the number and size of conduit openings will be in accordance with the construction plans. The frame casting must be accurately set on a full bed of mortar to the finished elevation so that no subsequent adjustment will be necessary. Mortar and brick, or mortar and concrete rings, may be used to adjust to the proper grade. Adjustment rings, bricks, and frames must be set in a full mortar bed. Use of partial bricks will not be allowed. Bricks must be laid in full header courses only. In no instance will the neck of the manhole exceed two (2) feet in height. Mortar will be mixed in a proportion of one (1) part cement to three (3) parts sand by volume of dry materials. After entering laterals have been installed in place in the manhole, the openings in the wall must be plugged in an approved manner flush with the inner surface. If backfill is required, screenings must be used and properly compacted.

Parkway must be restored to the proper grade. Pavement must be restored to the correct grade. Patching of the pavement must be done with high early strength concrete meeting the requirements of Articles 1001 and 1020 of the Standard Specifications. Sidewalks must be restored to the proper grade using a 5 inch thickness of concrete. The inside of the manhole must be clean of all debris.

Replacing Handhole with Manhole. When a present handhole is to be replaced with a new manhole, the handhole must be broken down and all debris removed. This will be paid for as a separate pay item. The present laterals and cables must be maintained during breakdown of a present handhole and construction of a new manhole. Present laterals must be cut back to terminate at a distance from the inner face of the new manhole wall, as directed by the Resident Engineer. The cost of cutting back the present laterals will be included in the cost of the new manhole. New laterals terminating in the manhole must be included in the cost of installing new lateral. The new manhole must be installed in accordance with the appropriate City of Chicago drawings. All other work associated with this replacement will be considered incidental to this pay item.

- 4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed.

- 5. **BASIS OF PAYMENT.** The unit price for installing manholes will include necessary excavation, backfilling and restoration of parkway and pavement in accordance with the foregoing specifications. No additional payment will be allowed for restoring parkway or the restoration of sidewalk or pavement. Removal of sidewalk or pavement will be covered by separate pay items. New conduit, if necessary, will also be paid for separately. The unit cost will be for complete installation for each unit for ELECTRICAL MANHOLE 3'X 4'X 4' WITH 24" FRAME AND LID, or ELECTRICAL MANHOLE 3'X 4'X 4' WITH 30" FRAME AND LID, or ELECTRICAL MANHOLE 4'X6'X6' WITH 24" FRAME AND LID, or ELECTRICAL MANHOLE 4'X6'X6' WITH 30" FRAME AND LID.

MATERIAL SPECIFICATION		DRAWING	
1458	1528	730	872
		874	10927
		729	733
			732

ITEM 120, DRILL EXISTING MANHOLE OR HANDHOLE

1. **DESCRIPTION.** This work will consist of drilling a hole in an existing handhole or manhole for the installation of a new conduit. This item must meet the requirements of Article 879 of the Standard Specifications.
2. **CONSTRUCTION.** The size of the hole must be as close as possible to the size of the conduit to be installed. The conduit must be installed in the drilled hole with a bushing before the hole is grouted. The conduit will be covered by a separate item. The space between the conduit and the handhole or manhole wall must be caulked with a waterproof grout. Drawing 814 provides additional information.
3. **METHOD OF MEASUREMENT.** This work will be measured per each hole drilled.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for DRILL EXISTING MANHOLE OR HANDHOLE, which price will be payment in full for drilling the hole, grouting, and any additional work required to accomplish this task.

DRAWING 814

January 1, 2002

ITEM 123, CLEAN EXISTING MANHOLE OR HAND HOLE

1. **DESCRIPTION.** This item will consist of furnishing all labor, materials, tools and equipment necessary to clean a manhole or handhole. Work must include the removal and disposal of all foreign debris and liquids from the manhole or handhole. Manholes or handholes to be cleaned will be identified on the plans or by the Resident Engineer.
2. **CLEANING.** The inside dimension of the hand hole will normally be 30 to 36 inches in diameter and three feet in depth. The inside dimension of the manhole will normally be 3'x4'x4' or 4'x6'x6'. Handholes and manholes of other dimensions may be encountered. Cleaning will include opening the lid and placing the lid back in place after cleaning. The cables must not be damaged or disturbed during the cleaning process. All debris removed from the hole must be properly disposed of in an approved manner and not be left in the public way or dumped into the City sewer system. Guidelines outlined in Section 202.03 of the Standard Specifications should be followed.
3. **METHOD OF MEASUREMENT.** This work will be measured per each manhole/handhole cleaned.
4. **BASIS OF PAYMENT.** This work will be paid at the contract unit price each for CLEAN EXISTING MANHOLE OR HANDHOLE, as directed by the Resident Engineer, which payment will include both cleaning and debris disposal.

January 1, 2002

ITEM 124, GALVANIZED STEEL CONDUIT IN TRENCH 2"
ITEM 126, GALVANIZED STEEL CONDUIT IN TRENCH 3"
ITEM 127, GALVANIZED STEEL CONDUIT IN TRENCH 4"

ITEM 128, GALVANIZED STEEL CONDUIT PUSHED 2"
ITEM 135, GALVANIZED STEEL CONDUIT PUSHED 3"

ITEM 123B, GALVANIZED STEEL CONDUIT ATTACHED TO STRUCTURE 3/4"
ITEM 129, GALVANIZED STEEL CONDUIT ATTACHED TO STRUCTURE 1-1/4"
ITEM 130, GALVANIZED STEEL CONDUIT ATTACHED TO STRUCTURE 1-1/2"
ITEM 131, GALVANIZED STEEL CONDUIT ATTACHED TO STRUCTURE 2"

ITEM 131A, COILABLE NON-METALLIC CONDUIT IN TRENCH, 1.25", SCHEDULE 40
ITEM 131B, COILABLE NON-METALLIC CONDUIT IN TRENCH, 1.25", SCHEDULE 80

ITEM 132, PVC CONDUIT IN TRENCH 2"
ITEM 133, PVC CONDUIT IN TRENCH 3"
ITEM 134, PVC CONDUIT IN TRENCH 4"
ITEM 136, PVC CONDUIT IN TRENCH 2" (Schedule #80)
ITEM 137, PVC CONDUIT IN TRENCH 3" (Schedule #80)
ITEM 138, PVC CONDUIT IN TRENCH 4" (Schedule #80)

ITEM 165, GALVANIZED STEEL CONDUIT UNDER VAULTED WALK 4"
ITEM 166, GALVANIZED STEEL CONDUIT UNDER VAULTED WALK 3"

ITEM 123G, ALUMINUM CONDUIT ATTACHED TO STRUCTURE 3/4"

1. DESCRIPTION

This work will consist of furnishing and installing a conduit lateral of the type and size specified.

2. MATERIALS

Galvanized rigid steel conduit and PVC coated steel conduit must conform to the requirements of Material Specification 1462.

Polyvinyl chloride (PVC) conduit must conform to the requirements of Material Specification 1533 and to the requirements of the National Electrical Manufacturers Association Standard, Publication Number TC2 for EPC-40, or EPC-80. Conduit color will be determined by the Resident Engineer.

Coilable non-metallic conduit must be a high density polyethylene meeting the requirements of Material Specification 1533 and ASTM-D1248, Type III, Grade PE34, Category 5, and Class C. The duct must meet the requirements of Section 1088.01(c) of the Standard Specifications. The average outside diameter of the 1.25 inch duct must be 1.66 inches, with a minimum wall thickness of .15 inches for the Schedule 40 conduit, and a wall thickness of .20 for the Schedule 80 conduit. Conduit color will be as determined by the Resident Engineer.

Aluminum conduit will be rigid wall conduit with a minimum wall thickness of 0.099". The conduit will be extruded from 6063 aluminum alloy and tempered to T-1. Aluminum conduit must meet the requirements of UL-6 and ANSI C80.5.

3. CONSTRUCTION.

DEFINITION OF LATERALS - A lateral will mean a conduit raceway extending from one sub-surface location to another sub-surface location, and in every case intended to encase electric circuit cable under paved surfaces, or in unpaved parkway, street or alley, where specifically designated.

LOCATIONS - Laterals must be installed at the locations shown on the construction plans. Laterals must be installed in the shortest practicable line between points of termination, or under adverse conditions, as directed by the Resident Engineer. Laterals not shown on the drawing, but necessary to be installed will be paid for at the unit price bid for laterals as additional units of construction.

INSTALLATION REQUIREMENTS - Galvanized rigid steel conduit may be installed in a trench, pushed underground, or attached to a structure. PVC conduit will normally be installed in a trench or attached to a structure. Coilable conduit will be installed in a trench for short distances only. The normal installation method for coilable conduit is directional boring. The Contractor must exercise care in installing the conduit to ensure that it is smooth, free from sharp bends or kinks, and has the minimum practicable number of bends. Crushed or deformed conduit will not be accepted. All conduit and fittings must have the burrs and rough places smoothed, and all conduit runs must be cleaned and swabbed before installation of electric cables. If cable is not to be installed immediately after cleaning of the conduit, a light weight pulling line such as 1/8" polyethylene line must be placed in the conduit and will remain in the conduit for future work. The excavation for pushing conduit must be located at least two feet (2') from the edge of pavement. All underground conduits must have a minimum cover of thirty inches (30") below grade. If conduit cannot be installed with a minimum cover of thirty inches (30"), the conduit must be encased in concrete for protection. The method of encasement and protection must be approved by the engineer. Concrete encasement will

be paid for as a separate pay item.

When multiple laterals in a common trench are required, no more than three (3) three inch (3") or smaller conduit laterals can be laid on a single, horizontal level. Four or more conduit laterals must be installed on two (2) levels in accordance with instructions of the Resident Engineer.

Conduit laterals attached to a structure must be flush to the structure where possible. Clamps or hangers must be used at a maximum interval of five feet (5') to hold the conduit rigidly in place. Fittings must be supplied and installed that are compatible with the conduit in use. Expansion couplings must be used at locations where the conduit crosses expansion joints in the structure.

Conduit laterals installed under vaulted walks must be securely attached to the retaining wall by means of galvanized clamps and clamp backs held in place by anchor bolts. Laterals will be fastened as close to the underside of the sidewalk as possible, and securing clamps installed every five feet (5'). Laterals must be continuous through party walls.

Threaded fittings and bends of the same material as conduit must be furnished and installed as required. Threadless couplings may be used only for splicing existing conduit. All conduit splices, where required, will be considered incidental to this pay item.

4. METHOD OF MEASUREMENT

The length measured will be the number of lineal feet of conduit installed and accepted, measured in place. Each conduit will be measured separately even if in a single trench. The length for measurement will be the distance horizontally between changes in the direction of the conduit plus the conduit vertically attached to structures. All conduit on structures will be measured from point to point, whether vertical or horizontal.

5. BASIS OF PAYMENT

This work will be paid for at the contract unit price per lineal foot for Conduit of the type and size as specified, which price will be payment in full for furnishing and installing the conduit and fittings complete. Cleaning, swabbing, and p-lining of new conduit will be incidental to this pay item. Hangers, clamps, and fittings for conduit attached to structure will be incidental to this item. Trench and backfill will be paid for separately. Concrete encasement, if required, will be paid for separately. No additional payment will be allowed for pushing under pavements or for jackholes for conduit laterals.

MATERIAL SPECIFICATIONS
1462 1533

DRAWINGS
579 813

March 14, 2014

Item 124 126 127 128 129 130 131 131a 131b 132 133 134 135 136 137 138 165 166
123B 123G

**ITEM 125, GROUND ROD ADJACENT TO FOUNDATION/MANHOLE
ITEM 125A, GROUND ROD IN HANDHOLE**

1. **GENERAL.** This item will consist of providing and installing a ground rod in a handhole, adjacent to a foundation or manhole, or at any location as described by the plans or as directed by the Resident Engineer.
2. **MATERIAL.** The ground rod and clamp must meet the requirements of Material Specification 1465. The grounding electrode, if required, will be a one conductor number 6 AWG solid, soft drawn bare copper wire.
3. **CONSTRUCTION.** The ground rod will be driven into undisturbed soil as straight down as possible. In a handhole, no more than 6 inches of the rod should protrude into the handhole floor. In the handhole, a clamp must be attached to accommodate #6 through #12AWG bare copper wire.

For a manhole or foundation, the ground rod must be driven adjacent to the manhole or foundation. Enough soil must be removed to accommodate driving the rod and to extend the cable into the foundation or manhole. The top of the ground rod must be at least 30 inches below grade. A ground rod should never be installed in the sump of a manhole. The wire will enter the manhole through one of the knockouts provided near the top of the manhole. Any disturbed soil must be restored.

If required, a bare #6 copper wire must be exothermically welded to the ground rod. The wire will be extended into the manhole or foundation. The length of the wire must be such that there will be no strain in the wire once it is attached to a grounding lug or ground bus.

4. **METHOD OF MEASUREMENT.** The unit of measurement will be each, for each ground rod installed.
5. **BASIS OF PAYMENT.** Each ground rod installed will include labor and material, including grounding clamp and copper wire if required. Payment will be for each GROUND ROD. No additional payment will be made for welding the wire to the rod, or for providing and attaching the bare ground wire. No additional payment will be made for excavating or restoring the soil adjacent to a foundation or manhole.

MATERIAL
1465

June 23, 2008

ITEM 140, PVC CONDUIT IN DUCT, 2 - 3 INCH
ITEM 141, PVC CONDUIT IN DUCT, 4 - 3 INCH
ITEM 1411, PVC CONDUIT IN DUCT, 4 - 4 INCH
ITEM 1413, PVC CONDUIT IN DUCT, 2 - 4 INCH
ITEM 143, PVC CONDUIT IN DUCT, 6 - 3 INCH

1. **DESCRIPTION.** This item will consist of providing the proper materials and installing a duct bank in an open trench. The duct bank will be of the size specified and be encased in concrete.
2. **MATERIAL.** Polyvinyl chloride (PVC) must conform to the requirements of the National Electrical Manufacturers Association Standard, Publication Number TC2 for EPC-40 and to Material Specification 1533. All PVC conduits for duct banks will be Schedule 40. Concrete will be Portland Cement Concrete meeting the requirements for SI concrete in Article 1020 of the Standard Specifications.
3. **CONSTRUCTION.** Construction must meet the requirements of Sections 810.03(b) and 810.03(d) of the Standard Specifications, except as otherwise noted herein. No steel reinforcement will be used. All conduits must be inspected by the Engineer before concrete is poured. All conduits must be cleaned and swabbed. If cable is not to be installed immediately following the cleaning, a light weight pulling line such as 1/8" polyethylene must be installed in each conduit and will remain in each conduit for future work.

The layout of the conduits within a duct bank will be as follows: two conduits will be laid vertically one atop another (1X2); four conduits will be laid in two rows of two conduits laid side by side (2X2); six conduits will be laid in three rows of two conduits laid side by side (2X3). Any other configuration must be directed or approved by the Engineer. A minimum of one inch of concrete must separate the conduits. The outer surface of the encasement must have a minimum of three inches of cover to the nearest conduit. Conduits between manholes or handholes must be arched in the middle of the run to ensure proper draining of the conduit.

4. **METHOD OF MEASUREMENT.** This item will be measured in lineal feet, horizontally from one end of the duct to the other. Individual conduits will not be measured separately, but will be measured as a configuration encased in concrete.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price per lineal foot for PVC CONDUIT IN DUCT of the size and configuration specified. All material and labor necessary for a complete installation will be included in said price. Concrete will not be paid for separately.

ITEM 142, CONCRETE ENCASUREMENT

1. **DESCRIPTION.** This item will consist of providing the proper materials and installing concrete encasement around one or more conduit in an open trench.
2. **MATERIAL.** Concrete must be Class SI Portland Cement Concrete according to the Standard Specifications Article 1020.
3. **CONSTRUCTION.** Construction must meet the requirements of Section 810.03(d) of the Standard Specifications, except as otherwise noted herein. No steel reinforcement will be used. All conduits must be inspected by the Engineer before concrete is poured. All conduits that are installed with less than a 30 inch cover must be encased in concrete.
4. **METHOD OF MEASUREMENT.** This item will be measured in cubic yards of concrete placed.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price per cubic yard for CONCRETE ENCASUREMENT at the places indicated on the plans or as directed by the Engineer. All material and labor necessary for a complete encasement installation must be included in said price.

January 11, 2002

ITEM 144, ROD AND CLEAN DUCT IN EXISTING CONDUIT SYSTEM

1. **DESCRIPTION AND SCOPE.** This work will consist of inserting a duct rod or electrical fish rod or tape of sufficient length and rigidity into an electrical conduit opening in one electrical manhole or handhole, and pushing the said rod through the conduit to emerge at the next or subsequent manhole in the conduit system at the location shown on the plans. The duct rod may be inserted and removed by any standard construction method which causes no damage to the conduit system. The size of the conduit may vary from two inch (2") to four inch (4"), but there will be no differentiation in cost for the size of the conduit.

The conduit system which is to be rodded and cleaned may exist with various amounts of standing water in the manholes. The contractor must pump the water or sufficient water from the manholes to drain the conduit and to afford compatible working conditions for the installation of the duct rods and/or cables. The pumping of the manholes will be incidental to the work of rodding and cleaning of the conduit.

Any manhole which, in the opinion of the Resident Engineer contains excessive debris, dirt or other materials to the extent that conduit rodding and cleaning is not feasible, will be cleaned at the Engineer=s order and payment approved as a separate pay item, and not a part of this specification.

Prior to removal, of the duct rod, a duct cleaning attachment such as a properly sized wire brush or cleaning mandrel must be attached to the duct rod, which by removal of the duct rod will be pulled through the conduit to remove sand, grit, or other light obstructions from the duct to provide a clean, clear passage for the installation of cable. Whenever the installation of cables is not performed as an adjunct to or immediately following the cleaning of the duct, a light weight pulling line such as a 1/8" polyethylene line or conduit measuring tape must be placed and will remain in the conduit to facilitate future work. When great difficulty of either inserting the duct rod or removal of the cleaning mandrel is encountered, the duct may require further cleaning by use of a compressed air gun, or a low pressure water hose. In the case of a broken duct line, the conduit must be excavated and repaired. The existence and location of breaks in the duct line may be determined by rodding, but the excavation and repair work required will not be a part of this pay item.

2. **METHOD OF MEASUREMENT.** This work will be measured per lineal foot for each conduit cleaned. Measurements will be made from point to point horizontally. No vertical rises will count in the measurement.

3. **BASIS OF PAYMENT**. This work will be paid for at the contract unit price per lineal foot for ROD AND CLEAN DUCT IN AN EXISTING CONDUIT SYSTEM for the installation of new electric cables. Such price will include the furnishing of all necessary tools, equipment, and polyethylene line as required to prepare a conduit for the installation of cable. When the number of cables to be installed requires the use of more than one conduit in the same run, each additional conduit required will be rodded and cleaned as a separate unit and paid for at the contract unit price.

Item 144

Page 2

April 2, 2001

ITEM 145, CONCRETE FOUNDATION FOR TYPE "P" BASE MOUNTED TRAFFIC SIGNAL CONTROLLER

ITEM 145A, CONCRETE FOUNDATION FOR TYPE "SUPER P" BASE MOUNTED TRAFFIC SIGNAL CONTROLLER

1. **DESCRIPTION.** This item will be for all work necessary for installing a foundation for a "P" cabinet, or a foundation for a "Super P" cabinet.
2. **MATERIAL.** Concrete will be Portland cement concrete, SI Class, meeting the requirements of Article 1020 of the Standard Specifications. Ground rods will meet the requirements of Material Specification 1465. Conduit will be PVC meeting the requirements of Material Specification 1533. Anchor rods will meet the applicable requirements of Material Specification 1467.
3. **CONSTRUCTION.** The Contractor will install a concrete foundation for a base mounted traffic signal controller cabinet, as shown on City of Chicago Drawing Number 888 for a "P" cabinet, or as shown on Drawing 888A for a "Super P" cabinet. Work under this item will be performed in accordance with Article 800 of the Standard Specifications.

The foundation will have a minimum depth of at least forty inches (40") below grade and must have large radius conduit elbows in quantity, size and type shown. The elbow ends above ground will be capped with standard conduit bushings. The ground rod will be installed adjacent to the foundation and will be driven straight down with the top to be no higher than 30 inches below finished grade. The Contractor will furnish anchor bolts, hardware, conduit elbows, and all other material shown on the foundation construction drawing.

All excavation and restoration of parkway will be considered as part of this item. If the foundation is in sidewalk, an expansion joint will be required between the sidewalk and the foundation.

4. **METHOD OF MEASUREMENT.** This work will be measured as each for each unit installed complete.
5. **BASIS OF PAYMENT.** Unit price will include cost of all material and labor required to install this foundation, as per applicable construction plans and these specifications. The conduit elbows will be considered as part of the foundation and will not be paid for as a separate item or as part of the conduit laterals leading to the foundation. All necessary excavation and restoration of parkway to the original condition will be included in the unit price. Any sidewalk removal will be paid for as a separate pay item. However, any restoration of sidewalk will be considered as part of this item, including any expansion joint between the sidewalk and the foundation. This work will be paid for at the Contract Unit Price

of EACH for CONCRETE FOUNDATION FOR TYPE "P" BASE MOUNTED
TRAFFIC SIGNAL CONTROLLER CABINET.

MATERIAL SPECIFICATION

1465

1467

1533

DRAWING

888

888A

March 30, 2022

Item 145, Item 145A

Page 2

ITEM 146, CONCRETE FOUNDATION FOR TYPE "M" BASE MOUNTED TRAFFIC SIGNAL CONTROLLER

1. **DESCRIPTION.** This item will be for all work necessary for installing a foundation for an AM@ cabinet.
2. **MATERIAL.** Concrete will be Portland cement concrete, SI Class, meeting the requirements of Article 1020 of the Standard Specifications. Ground rods will meet the requirements of Material Specification 1465. Conduit will be PVC meeting the requirements of Material Specification 1533. Anchor rods will meet the applicable requirements of Material Specification 1467.
3. **CONSTRUCTION.** The Contractor will install a concrete foundation for a base mounted traffic signal controller cabinet, as shown on City of Chicago Drawing Number 854. Work under this item will be performed in accordance with Article 800 of the Standard Specifications.

The foundation will have a minimum depth of at least forty inches (40") below grade and must have large radius conduit elbows in quantity, size and type shown. The elbow ends above ground will be capped with standard conduit bushings. The Contractor must furnish anchor bolts, hardware, conduit elbows, and all other material shown on the foundation construction drawing.

All excavation and restoration of parkway will be considered as part of this item. If the foundation is in sidewalk, an expansion joint will be required between the sidewalk and the foundation.

4. **METHOD OF MEASUREMENT.** This work shall be measured as each for each unit installed complete.

5. **BASIS OF PAYMENT.** Unit price will include cost of all material and labor required to install this foundation, as per applicable construction plans and these specifications. The conduit elbows will be considered as part of the foundation and will not be paid for as a separate item or as part of the conduit laterals leading to the foundation. All necessary excavation and restoration of parkway to the original condition shall be included in the unit price. Any sidewalk removal will be paid for as a separate pay item. However, any restoration of sidewalk will be considered as part of this item, including any expansion joint between the sidewalk and the foundation. This work will be paid for at the Contract Unit Price of EACH for CONCRETE FOUNDATION FOR TYPE "M" BASE MOUNTED TRAFFIC SIGNAL CONTROLLER CABINET.

MATERIAL SPECIFICATION

1465

1467

1533

DRAWING

854

March 21, 1995

Item 146

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ITEM 147, CONCRETE FOUNDATION FOR BASE MOUNTED STREET LIGHT CONTROLLER CABINET

1. **GENERAL.** The Contractor will install a concrete foundation for a base mounted street light controller cabinet, as shown on City of Chicago Drawing Number 876.
2. **MATERIAL.** Concrete will be Portland cement concrete, SI Class, meeting the requirements of Article 1020 of the Standard Specifications. Ground rods must meet the requirements of Material Specification 1465. Conduit will be PVC meeting the requirements of Material Specification 1533. Anchor rods must meet the applicable requirements of Material Specification 1467.
3. **CONSTRUCTION.** The contractor will install the concrete foundation as shown on Drawing 876. Work under this item will be performed in accordance with Article 800 of the Standard Specifications.

The foundation must have a minimum depth of at least fifty inches (50") below grade and will have large radius conduit elbows in quantity, size and type shown. The elbow ends above ground will be capped with standard conduit bushings. The Contractor must furnish anchor bolts, hardware, conduit elbows, and all other material shown on the foundation construction drawing.

All excavation and restoration of parkway will be included in this item. If the foundation is in sidewalk, an expansion joint will be required between the sidewalk and the foundation.

4. **METHOD OF MEASUREMENT.** This work will be measured as each for each unit installed complete.
5. **BASIS OF PAYMENT.** Unit price will include cost of all material and labor required to install this foundation, as per applicable construction plans and these specifications. The conduit elbows will be considered as part of the foundation and will not be paid for as a separate item or as part of the conduit laterals leading to the foundation. All necessary excavation and restoration of parkway to the original condition will be included in the unit price. Any sidewalk removal will be paid for as a separate pay item. However, any restoration of sidewalk will be considered as part of this item, including any expansion joint between the sidewalk and the foundation. This work will be paid for at the Contract Unit Price of EACH for CONCRETE FOUNDATION FOR A BASE MOUNTED STREET LIGHT CONTROLLER CABINET.

MATERIAL SPECIFICATION

1465

1467

1533

DRAWING

876

August 3, 1993

Item 147

Page 2

ITEM 148, CONCRETE FOUNDATION FOR BASE MOUNTED FA/PC TERMINAL CABINET TYPE "B"

1. **GENERAL.** The Contractor will install a concrete foundation for a base mounted FA/PC Terminal cabinet Type "B" as per City of Chicago Drawing Number 11972.
2. **MATERIAL.** Concrete will be Portland cement concrete, SI Class, meeting the requirements of Article 1020 of the Standard Specifications. Ground rods must meet the requirements of Material Specification 1465. Conduit will be PVC meeting the requirements of Material Specification 1533. Anchor rods must meet the applicable requirements of Material Specification 1467.
3. **CONSTRUCTION.** The contractor will install a concrete foundation as shown on Drawing 11972. Work under this item must meet the requirements of Article 800 of the Standard Specifications.

The foundation will have a minimum depth of at least thirty six inches (36") below grade and must have large radius conduit elbows in quantity size and type specified on the construction plans. The elbow ends above ground will be capped with standard conduit bushings. The Contractor must furnish anchor bolts, hardware, conduit elbows, and all other material shown on applicable foundation construction drawing. .

All excavation and restoration of parkway will be included in this item. If the foundation is in sidewalk, an expansion joint will be required between the sidewalk and the foundation.

4. **METHOD OF MEASUREMENT.** This item will be measured per each foundation installed complete.
5. **BASIS OF PAYMENT.** Unit price will include cost of all material and labor

required to install this foundation, as per applicable construction plans and these specifications. The conduit elbows will be considered as part of the foundation and will not be paid for as a separate item or as part of the conduit laterals leading to the foundation. All necessary excavation and restoration of parkway to the original condition will be included in the unit price. Any sidewalk removal will be paid for as a separate pay item. However, any restoration of sidewalk will be considered as part of this item, including any expansion joint between the sidewalk and the foundation. This work will be paid for at the Contract Unit Price of EACH for CONCRETE FOUNDATION FOR A BASE MOUNTED FA/PC TERMINAL CABINET TYPE "B".

MATERIAL SPECIFICATION

1465

1467

1533

DRAWING

11972

11825

February 14, 1990

Item 148

Page 2

ITEM 149, CONCRETE FOUNDATION, 20" DIAMETER, 3/4" ANCHOR RODS

1. **DESCRIPTION.** This foundation will be for structural support of a traffic signal post, or other pedestal mounted equipment. The foundation must be poured in place and must be 20" in diameter, with a 13" bolt circle, 3/4" diameter anchor rods, and must be 5 feet in depth.
2. **MATERIAL.** Concrete must be Portland cement concrete meeting the requirements of Article 1020 of the Standard Specifications for SI Class concrete. Anchor rods must meet the requirements of Material Specification 1467 and the ground rod must meet the requirements of Material Specification 1465. Conduit must be PVC meeting the requirements of Material Specification 1533.
3. **CONSTRUCTION.** Foundations must conform to Drawing Number 709. Top surface of these foundations will be at an elevation of two inches (2") above grade or as required by the Resident Engineer. Care must be taken to install a level foundation and to ensure adequate anchor rod projections for double-nut installation. The foundation top must be chamfered 3/4 of an inch. The foundation must be centered back from the face of the curb in accordance with dimensions shown on the construction plans. When the foundation is in a solid sidewalk area, the foundation must be installed level, with the height of the foundation as close to the height of the sidewalk as possible, or as directed by the Engineer. A proper expansion joint must be installed between the sidewalk and the foundation.

Foundation raceways must consist of large radius conduit elbow(s) in quantity, size and type specified on Drawing 709 or as indicated on the construction plans. Elbows, in excess of those shown on Drawing 709, will be paid for separately under an additional pay item. The elbow ends above ground must be capped with standard conduit bushings. The Contractor must furnish anchor rods, hardware, conduit elbow(s) and all other material shown on applicable foundation construction drawings. Depth of foundation will be as noted on Drawing 709.

The anchor rods will be set by means of a metal template which must be submitted for approval before any foundation work is begun. The template must hold the rods vertical, and in proper position.

All excavation and restoration of parkway will be considered as part of this item. If the foundation is in sidewalk, an expansion joint will be required between the sidewalk and the foundation.

4. **METHOD OF MEASUREMENT.** The measurement will be based on each foundation installed complete.

5. **BASIS OF PAYMENT.** Payment will be made for foundations installed in place including an elbow in accordance with construction plans and these specifications. All necessary excavation and restoration of parkway, or sidewalk and expansion joint will be included in the unit price. This work will be paid for at the contract unit price per each, or per lineal foot, as designated in the contract, for CONCRETE FOUNDATION, 20" DIAMETER, 3/4" ANCHOR RODS.

MATERIAL SPECIFICATION

1465 1467 1533

DRAWING

709 844 11825

August 8, 2006

Item 149

Page 2

**ITEM 150, CONCRETE FOUNDATION, 20" DIAMETER, 1" ANCHOR RODS
ITEM 139, CONCRETE FOUNDATION, 20" DIAMETER, 1" ANCHOR RODS,
PRECAST**

1. **DESCRIPTION.** This foundation will be for structural support of a residential street light pole. The foundation will be poured in place or precast as specified, and must be 20" in diameter, with a 10" bolt circle, 1" diameter anchor rods, and must be 5 feet in depth.
2. **MATERIAL.** Concrete must be Portland Cement Concrete meeting the requirements of Article 1020 of the Standard Specifications for SI Class concrete. Anchor rods must meet the requirements of Material Specification 1467 and the ground rod must meet the requirements of Material Specification 1465. Conduit elbows will be PVC conduit meeting the requirements of Material Specification 1533.
3. **CONSTRUCTION.** Foundations must conform to Drawing Number 565. The top surface of the foundation in parkway must be at an elevation of two inches (2) above grade, or as directed by the Engineer. Care should be taken to install a level foundation and to ensure adequate anchor rod projections for double-nut installation. The foundation top must be chamfered 3/4 of an inch. The foundations must be centered back from the face of the curb in accordance with dimensions shown on the construction plans. When the foundation is in a solid sidewalk area, the foundation must be installed level, with the height of the foundation as close to the height of the sidewalk as possible, or as directed by the Engineer. A proper expansion joint must be installed between the sidewalk and the foundation.

Foundation raceways must consist of large radius conduit elbow(s) in quantity, size and type specified on Drawing 565 or as shown on the construction plans. Elbows, in excess of the number shown on Drawing 565, will be paid for under a separate pay item. The Contractor must furnish anchor rods, hardware, conduit elbow(s) and all other material shown on applicable foundation construction drawings. Depth of foundation will be as noted on Drawing 565.

For poured in place foundations, a hole must be augered for placement of a form for the concrete. The anchor rods must be set by means of a metal template which must be submitted for approval before any foundation work is begun. The template must hold the rods vertical, and in proper position.

Foundations that are precast must conform to Standard Drawing 565. The conduit elbows must be installed as specified, at angles to each other of from 0 to 180 degrees. A one inch conduit sleeve must be installed in the precast foundation to accommodate the ground rod. A 36" hole must be augered for the precast foundation to a depth of 5'6". Screenings must be used as backfill and must be

tamped at every 6" level. The last 6 inches of fill should be topsoil. Two inches of the foundation should be exposed above grade.

- 4. **METHOD OF MEASUREMENT**. The measurement will be for each foundation installed complete.

- 5. **BASIS OF PAYMENT**. Payment will be made for foundations installed in place including two (2) elbows in accordance with construction plans and these specifications. Removal of sidewalk or pavement will be paid for separately. All necessary excavation and restoration of pavement, sidewalk and expansion joint, and fill to its original condition will be included in the unit price. This work will be paid for at the contract unit price per each, or per lineal foot, as per the contract, for CONCRETE FOUNDATION, 20" DIAMETER, 1" ANCHOR RODS or per each for CONCRETE FOUNDATION, 20" DIAMETER, 1" ANCHOR RODS, PRECAST.

MATERIAL SPECIFICATION			DRAWING		
1465	1467	1533	565	830	11825

May 17, 2001

ITEM 151, CONCRETE FOUNDATION, 24" DIAMETER, 1 1/4" ANCHOR RODS, 15" BOLT CIRCLE, 9 FEET
ITEM 151A, CONCRETE FOUNDATION, 24" DIAMETER, 1 1/4" ANCHOR RODS, 15" BOLT CIRCLE, 7 FEET
ITEM 151B, CONCRETE FOUNDATION, 28" DIAMETER, 1 1/4" ANCHOR RODS, 15" BOLT CIRCLE, 7 FEET
ITEM 152, CONCRETE FOUNDATION, 30" DIAMETER, 1 1/4" ANCHOR RODS, 17 1/4" BOLT CIRCLE
ITEM 152A, CONCRETE FOUNDATION, 30" DIAMETER, 1" ANCHOR RODS, 15" BOLT CIRCLE, 7 FEET
ITEM 153, CONCRETE FOUNDATION, 30" DIAMETER, 1 1/2" ANCHOR RODS, 16 1/2" BOLT CIRCLE
ITEM 180, CONCRETE FOUNDATION, 24" DIAMETER, 1 1/4" ANCHOR RODS, 15" BOLT CIRCLE, OFFSET
ITEM 181, CONCRETE FOUNDATION, 20" DIAMETER, 1" ANCHOR RODS, 10" BOLT CIRCLE, OFFSET

1. **DESCRIPTION.** The foundation will be a poured in place concrete structure used for structurally supporting street light poles or traffic signal poles.
2. **MATERIAL.** Concrete must be Portland cement concrete meeting the requirements of Article 1020 of the Standard Specifications for SI Class concrete. Reinforcement bars must meet the requirements of Section 1006.10 of the Standard Specifications. Anchor rods must meet the requirements of Material Specification 1467 and the ground rod must meet the requirements of Material Specification 1465. Conduit elbows must be PVC conduit meeting the requirements of Material Specification 1533.
3. **CONSTRUCTION.** Every foundation will be installed at the location designated and in the manner herein specified or in special cases as specifically directed. The contractor will locate foundations as per plan or as directed by the Resident Engineer. A hole must be augered for placement of the concrete form.

Item 151 is a foundation for a traffic pole which can accommodate a 16, 20, or 26 foot monotube arm (Standard Drawing 818). Item 152 is a foundation for a traffic pole which can accommodate a 30 foot monotube arm (Standard Drawing 816). Item 153 is a foundation for a traffic pole which can accommodate a 35, 40, or 44 foot monotube arm (Standard Drawing 817). Item 151A is a foundation for arterial street light pole; either steel or aluminum, conventional or davit (Standard Drawing 818). Item 151B is a foundation for the Chicago 2000 Gateway and Pedestrian ornamental light poles (Standard Drawing 953). Item 152A is a foundation for both the Extended Loop pole and the Loop pole (Standard Drawing 956). Item 180 is an offset foundation for an arterial street light pole (Standard Drawing 937). Item 181 is an offset foundation for a residential street light pole (Standard Drawing 937, with exception that pole base is 20" diameter with 1"

anchors in a 10" bolt circle).

Top surface of these foundations in parkway will be at an elevation of two inches (2") above grade or as required by the Engineer. Care must be taken to install a level foundation and to ensure adequate anchor rod projections for double-nut installation. The foundations must be centered back from the face of the curb in accordance with dimensions shown on the construction plans. Foundation raceways must consist of large radius conduit elbow(s) in quantity, size and type as specified on the corresponding standard drawing or in the construction plans. Any number of elbows in excess of the number shown on the standard drawing must be paid for under a separate pay item. The elbow ends above ground will be capped with standard conduit bushings. The Contractor must furnish anchor rods, a ground rod, hardware, conduit elbow(s) and all other material shown on applicable foundation construction drawings. Depth of foundation will be as shown on the appropriate drawing. The foundation top must be chamfered 3/4 of an inch. When the foundation is installed in a sidewalk, the foundation must be installed level, with the height of the foundation as close to the height of the sidewalk as possible, or as directed by the Engineer. A proper expansion joint will be installed between the sidewalk and the foundation.

Anchor rods must be set in accordance with applicable construction plans so that when poles are mounted on the foundations, the street lighting mast arm will be properly oriented as indicated on the construction plans. The anchor rods will be set by means of a metal template which shall be submitted for approval before any foundation work is begun. The template must hold the rods vertical, and in proper position. Anchor rods must conform in all respects to the appropriate City drawing.

4. **METHOD OF MEASUREMENT.** This item will be measured per each foundation installed complete.
5. **BASIS OF PAYMENT.** Payment will be made for foundations installed in place, including elbows, in accordance with construction drawings, constructions plans and these specifications. All necessary excavation and restoration of pavement, sidewalk and fill to their original conditions will be included in the unit price. This work will be paid for at the contract unit price per each, or per lineal foot, as specified in the contract, for CONCRETE FOUNDATION of the diameter and size specified. The offset foundation will be paid for per each.

MATERIAL SPECIFICATION	DRAWING		
1465	953	818	956
1467	806	837	830
1533	811	937	11825
1541	816	817	844

October 5, 2020

**ITEM 154, ADDITIONAL ELBOW 2" IN CONCRETE FOUNDATION
ITEM 155, ADDITIONAL ELBOW 3" IN CONCRETE FOUNDATION
ITEM 156, ADDITIONAL ELBOW 4" IN CONCRETE FOUNDATION**

1. **GENERAL.** The Contractor will install additional, large radius, polyvinyl chloride (PVC), Schedule 40, conduit elbows, which will be joined by suitable connectors, as required, to the horizontal laterals. The elbows must meet the requirements of Material Specification 1533. Additional elbows must be installed as specified on the construction plans and in accordance with City of Chicago Drawing Numbers 709, 816, 817 and 818. The elbows must be installed in new foundations. The new foundations are covered under separate items.
2. **METHOD OF MEASUREMENT.** This item will be measured per each elbow installed, complete.
3. **BASIS OF PAYMENT.** Unit price will include cost of all materials and labor required to install ADDITIONAL ELBOW 2" IN CONCRETE FOUNDATION, ADDITIONAL ELBOW 3" IN CONCRETE FOUNDATION or ADDITIONAL ELBOW 4" IN CONCRETE FOUNDATION. This work will be paid for at the contract unit price each for additional elbow in proposed foundation. The foundation and original number of elbows must be paid for separately under another pay item.

MATERIAL SPECIFICATION
1533

DRAWING
709
816
817
818
11825

August 8, 2006

ITEM 157, HELIX FOUNDATION, 5 FOOT, 10 INCH BOLT CIRCLE, 4 ANCHOR BOLTS

ITEM 157A, HELIX FOUNDATION, 5 FOOT, 13 INCH BOLT CIRCLE, 3 ANCHOR BOLTS

ITEM 157B, HELIX FOUNDATION, 7 FOOT, 10 INCH to 15 INCH BOLT CIRCLE, 4 ANCHORS BOLTS

1. **DESCRIPTION.** This item will include furnishing and installing a steel light pole foundation, as shown on the plans or as directed by the Engineer, of the size indicated. Proper size anchor bolts and hardware will be furnished for each foundation.
2. **MATERIAL.** The steel foundation must meet the applicable requirements of Section 1070.01 of the Standard Specifications unless specified differently here and in City Material Specification 1526. Each anchor rod must have a hex head. In addition, each anchor rod must include a washer and nut for tightening. Each anchor bolt and associated hardware must be hot dipped galvanized and must meet the applicable requirements of Material Specification 1467. The foundation for residential light poles must have a 10 inch bolt circle for 4 bolts. The shaft length must be 5 feet. The base plate must be 12 inches square. The bolts must be one inch in diameter and 5 inches in thread length. The bolts must meet the applicable requirements of Standard Drawing 830. The foundation for pedestals must have a 5 foot shaft and a 13 inch bolt circle for 3 anchor bolts. The base plate must be 16 inches in diameter. The bolts must be 3/4 inches in diameter and 4 inches in thread length. The bolts must meet the applicable requirements of Standard Drawing 844. The foundation for arterial street light poles must have a 7 foot shaft and must accommodate a 10 inch to 15 inch bolt circle for 4 anchor bolts. The base plate must be 15.5 inches square. The bolts must be 1 1/4 inches in diameter with a 6 inch thread length. The bolts must meet the applicable requirements of Standard Drawing 811. Each steel foundation must meet the applicable requirements of Standard Drawing 936.
3. **INSTALLATION.** The installation must follow the requirements of Article 836.03 (d) of the Standard Specifications for metal foundations. The foundation must be plumb with the base plate level with the existing grade. If installed in a sidewalk, the helix must be set lower than the sidewalk and topped with concrete level to the top of the sidewalk. An expansion joint must also be installed. Any improperly installed or damaged foundations will be replaced at no additional cost.
4. **METHOD OF PAYMENT.** This work will be paid for at the contract unit price per each for HELIX FOUNDATION, 5 FOOT, 10 INCH BOLT CIRCLE, or HELIX FOUNDATION, 5 FOOT, 13 INCH BOLT CIRCLE, or HELIX FOUNDATION, 7 FOOT, which payment will include all material and labor to

properly provide and install the foundation.

MATERIAL SPECIFICATIONS

1467 1526 1465

DRAWINGS

936 844 811 830

August 8, 2006

Item 157 157A 157B

Page 2

**ITEM 159, ELBOW, CONDUIT, STEEL 2" ADJACENT TO EMBEDDED POLE,
ELEVATED STRUCTURE STEEL COLUMN, OR ABUTMENT WALL**
**ITEM 161, ELBOW, CONDUIT, STEEL 3" ADJACENT TO EMBEDDED POLE,
ELEVATED STRUCTURE STEEL COLUMN, OR ABUTMENT WALL**
**ITEM 162, ELBOW, CONDUIT, STEEL 4" ADJACENT TO EMBEDDED POLE,
ELEVATED STRUCTURE STEEL COLUMN, OR ABUTMENT WALL**

1. **DESCRIPTION.** This item will consist of furnishing and installing a steel conduit elbow of the size indicated adjacent to a vertical surface to connect and extend a horizontal underground conduit lateral to a proposed extension of that lateral to run vertically up the face of an embedded pole, a structural steel column, or a wall of a building or an abutment for the installation of cables for street lighting, or traffic signals at the location shown on the plans or as directed by the Resident Engineer.
2. **MATERIAL.** The material must meet the requirements of the Material Specification 1462 for Rigid Steel Conduit, Zinc coated.
3. **METHOD OF INSTALLATION.** The earth must be excavated to form a trough approximately one foot wide by three feet deep adjacent to the vertical surface at the desired location and extending in a direction to meet the lateral to which the elbow will be connected. Sidewalk or pavement removal required for this excavation will be performed and paid for as work under the appropriate pay item and will not be a part of this item. A groove or channel of sufficient size to accommodate the desired elbow, and to allow the elbow to fit flush against the pole or column, will be cut into the concrete of the pole encasement, the column or the abutment foundation, as required, by use of a hydraulic chipping hammer, drill or saw. The groove must be cut in a workmanlike manner using care that the column foundation will not be cracked nor will the pole encasement concrete be cracked and separated from the pole.

The elbow must be grouted to the concrete encasement of the pole, column or abutment foundation with a mortar consisting of one (1) part cement to three (3) parts sand by volume of dry materials to support the elbow in a vertical position. The elbow must extend eleven inches (11") above the finished surface grade and must be attached to the pole or column with stainless steel banding or to the abutment wall with a pipe clamp secured to the wall.

The top of the pole encasement must be finished smooth. The earth must be replaced and compacted in the area of the new elbow and all concrete debris and surplus backfill must be removed from the area.

4. **METHOD OF MEASUREMENT.** This item will be measured per each elbow installation, complete.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price EACH for a Steel Conduit Elbow adjacent to an Embedded Pole, Column, or Wall, and will be payment in full for furnishing and installing the elbow, providing all hardware and materials, removing and replacing any fill, and repairing the concrete encasement of the pole or footing.

MATERIAL SPECIFICATION
1462

DRAWING
561

October 1, 1986

ITEM 163, INTERCEPT EXISTING CONDUIT

1. **DESCRIPTION.** This item will consist of intercepting an existing city conduit or conduits for the purpose of installing a new foundation, a new manhole or handhole, or making a connection to a new conduit.
2. **CONSTRUCTION.** Work under this item will be performed in accordance with Article 800 of the Standard Specifications, Bureau of Electricity Standards and the City of Chicago Electrical Code, except as herein modified.

The contractor must carefully cut the conduit so that the cut conduit ends will be flush with the inside walls of the new manhole or handhole. Where existing cables are in service in the conduit(s) being intercepted, conduit(s) must be carefully split so that all working cables are not interrupted. If conduit(s) are concrete encased, such concrete must be removed as required. Any concrete encasement damaged during installation must be restored as needed.

3. **METHOD OF MEASUREMENT.** This work will be measured on a per each basis for each conduit end cut.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for INTERCEPT EXISTING CONDUIT, which price will include all necessary excavation, backfilling, and restoration of a parkway. No additional compensation will be made for removal or placement of concrete. This item will include all work necessary to bring the conduit into the manhole, handhole, or foundation, or to make the necessary connection to a new conduit. The contractor will furnish all materials for a complete installation

ITEM 164, ELBOW, PVC, 2", CAPPED, FOR DETECTOR LOOP

1. **DESCRIPTION.** This work will consist of installing a 2 inch PVC schedule 80 elbow to the end of a straight piece of 2 inch conduit and capping the open end, as shown on Standard Drawing 905.
2. **MATERIAL.** The elbow will be of polyvinyl chloride with a wall thickness classifying it as schedule 80. The PVC conduit must meet the requirements of Material Specification 1533.
3. **INSTALLATION.** The conduit must be installed on the end of a 2 inch conduit as shown on Standard Drawing 905, or as shown on the plans or as directed by the Engineer. The conduit will be glued to the straight piece. The elbow must be positioned so that the open end faces straight up. A cap must be installed on the open end and glued.
4. **METHOD OF MEASUREMENT.** This work will be measured per each elbow installed, and must include the cap.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for ELBOW, PVC, CAPPED, FOR DETECTOR LOOP, which price will be payment in full for furnishing and installing the elbow and cap, complete.

DRAWING
905

August 8, 2006

ITEM 167, ELBOW, PVC, 2", FOR PEDESTRIAN POST

1. **DESCRIPTION.** This work will consist of installing an elbow to the end of a straight piece of conduit to be used for the wireway for a pedestrian push button post.
2. **MATERIAL.** The elbow will be two inch (2") polyvinyl chloride with a wall thickness classifying it as schedule 80. The elbow will have a twenty-four inch (24") radius. The PVC conduit must meet the requirements of Material Specification 1533.
3. **INSTALLATION.** The conduit must be installed on the end of a horizontal two inch (2") conduit as shown on the plans or as directed by the Engineer. The conduit will be glued to the straight piece. The elbow must be positioned so that the open end faces straight up and is in the correct position in the center of the proposed post. The exposed portion of the elbow must be at least 2 inches above the finished sidewalk. This may require a straight piece of conduit of sufficient length to be glued to the top of the elbow.
4. **METHOD OF MEASUREMENT.** This work will be measured per each elbow installed. Concrete sidewalk, trenching, and backfill will be measured under separate items.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price, per each, for ELBOW, PVC, FOR PEDESTRIAN POST, which price will be payment in full for furnishing and installing the elbow, complete.

March 5, 2008

ITEM 168, GUARD POST

1. **DESCRIPTION.** This item will consist of furnishing and installing a bollard to be used as a guard post to protect street light or traffic signal equipment in the right-of-way.

2. **MATERIAL.** Materials shall be according to the following Articles of Division 1000 – Materials of the Standards Specifications:

	Article/Section
Portland Cement Concrete.....	1020
Steel Pipe.....	1006.18
Waterborne Acrylic Paint.....	1008.04

3. The bollard will be made of ASTM 53 steel. The outer surface will be powder coated at the factory to the color specified. The bollard must have an outside diameter of 6 inches. The steel must be 3 gauge at a minimum. The bollard will be six foot six inches in length.

4. **INSTALLATION.** A hole must be augered for the bollard, which will allow at least 3 inches of concrete to surround the bollard when installed. The bollard must be installed in concrete to a depth of three feet. The bollard will be set plumb. The top 42" of the bollard will be exposed above grade. The bollard must be filled with concrete. At the top of the bollard the concrete will be rounded off to shed water. The exposed concrete on the top must be painted to match the bollard.

5. **METHOD OF MEASUREMENT.** This item will be measured per each guard post installed, complete.

6. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price per each GUARD POST installed, which will include all labor and material necessary to install the bollard, any concrete required, and any cleanup and disposal necessary.

Aug 17, 2014

ITEM 170, FOUNDATION PLATE IN VAULTED WALK

1. **DESCRIPTION.** This work will consist of furnishing and installing two steel plates; one under and one on top of a vaulted walk and securing them to the structure, for the purpose of supporting a street light pole or a traffic signal pole.
2. **MATERIAL.** The steel plates must be formed of low alloy, high strength steel, which, after fabrication will possess an ultimate tensile strength of not less than 70000 psi and a yield strength of not less than 50000 psi, in accordance with ASTM A595, Grade C, ASTM A588, or ASTM A606. The base plates must be anywhere from 1 to 1.75 inches thick and must be sized to accommodate the bolt circle, bolt size, and pole size. The threaded rods, washers, and nuts must meet the requirements of Material Specification 1467. The threaded rods, washers, and nuts must be sized to accommodate the pole size and the depth of the vault roof, as shown on the plans or as directed by the Engineer.
3. **CONSTRUCTION.** Only a structurally sound vault roof can be used to support a street light pole or traffic signal pole. If the sidewalk is not part of the structural roof it must be removed in the area where the pole is to be placed. Four holes will be core drilled in the vault roof to accommodate the anchor rods. A hole will be core drilled at the proper location to accommodate any conduit. The size will be as shown on the plans or as designated by the Engineer. Both steel plates will be drilled to have holes which will match the core drilled holes in the vault roof. A steel plate will be placed on the bottom side of the roof and a steel plate will be placed on the top of the roof. The plates will be secured with properly sized threaded rods. The bottom nuts must be welded to the rods. The top washers and nuts will be tightened. There must be enough extension on the rods to accommodate restoration of the sidewalk depth and to allow double nutting of the pole. The sidewalk must be restored in the area disturbed with a proper expansion joint around the pole base.
4. **METHOD OF MEASUREMENT.** This item will be measured per each plated foundation installed.
5. **BASIS OF PAYMENT.** Payment will be made for each plated foundation installed in place. All necessary restoration of the vault roof and the sidewalk to their original conditions will be included in the unit price. This work will be paid for at the contract unit price for FOUNDATION PLATE IN VAULTED WALK, which payment will be in full for installing the plated foundation complete in place.

ITEM 171, CONCRETE FOUNDATION, 24" DIAMETER, IN VAULTED WALK

1. **DESCRIPTION.** The foundation will be a poured in place concrete structure used for structurally supporting street light poles or traffic signal poles, and installed in a vaulted walk.
2. **MATERIAL.** Concrete must meet the requirements of Article 1020 of the Standard Specifications for Class SI concrete. Reinforcement bars must meet the requirements of Section 1006.10 of the Standard Specifications. Anchor rods must meet the requirements of Material Specification 1467 and the ground rod must meet the requirements of Material Specification 1465. Conduit will be PVC meeting the requirements of Material Specification 1533.
3. **CONSTRUCTION.** Every foundation will be installed at the location designated and in the manner herein specified or as indicated and directed by the Resident Engineer.

The twenty-four inch diameter foundation must have a rebar cage as described in Drawing Number 818. The cage must be one foot shorter than the length of the foundation. The bolt circle will be 15 inches with 1 1/4 inch anchor rods as shown on Standard Drawing 818. The foundation will be installed in the vaulted walk area as shown in Standard Drawing 812. The foundation must be keyed to the retaining wall by methods approved by the Engineer. The vault floor must be removed where necessary and the area excavated for the depth of the foundation. The existing vault roof and sidewalk will be restored so that the walkway and roof are structurally safe and waterproof. Care must be taken to install a level foundation and to ensure adequate anchor rod projections for double-nut installation. The foundation will be centered back from the face of the curb in accordance with dimensions shown on construction plans, or as directed by the Engineer. Foundation raceways will consist of large radius conduit elbow(s) in quantity, size and type specified on the construction plans, or as directed by the Engineer. The elbow ends above ground will be capped with standard conduit bushings. The Contractor will furnish anchor rods, hardware, conduit elbow(s) and all other material shown on applicable foundation construction drawings. Depth of foundation will be as required. The foundation top must be chamfered 3/4 of an inch. A proper expansion joint must be installed between the sidewalk and the foundation.

Anchor rods must be set in accordance with applicable construction plans so that when the pole is mounted on the foundation, the street lighting mast arm will be properly oriented as indicated on the construction plans. The anchor rods will be set by means of a metal template which must be submitted for approval before any foundation work is begun. The template must hold the rods vertical, and in proper position.

4. **METHOD OF MEASUREMENT.** This item will be measured per each foot of the foundation depth installed.

5. **BASIS OF PAYMENT.** Payment will be made for the foundation installed in place, including elbows, in accordance with construction drawings, construction plans and these specifications. All necessary removal and restoration of the vault floor, the vault roof, and the sidewalk, will be included in the unit price. All excavation of earth and any fill required will also be part of this pay item. This work will be paid for at the contract unit price per foot for CONCRETE FOUNDATION, 24 INCH DIAMETER, IN VAULTED WALK, which payment will be in full for installing the foundation complete in place.

MATERIAL SPECIFICATION
1465
1467

DRAWING
812
818

May 23, 2001

Item 171
Page 2

ITEM 173, HANDHOLE, FIBERGLASS

1. **DESCRIPTION.** This work will consist of furnishing and installing a non-metallic handhole in a parkway or sidewalk, as an access point for street light cable splices.
2. **MATERIAL.** The box and cover must be composed of a material such as fiberglass, polyethylene, or, polyvinylchloride, or other approved material. The box will be 17 inches deep, 12 inches wide and 20 inches long. There will be no bottom. The cover must be secured to the box with one or two hex head vinyl bolts. The bolts will be recessed in the cover to provide a flush surface. The box and cover will be of the color specified. The color pigment must be in the resin and integral to the material. The entire assembly must be able to withstand normal loading and weathering as found in parkway or sidewalk situations. All materials will be warranted for a period of one year after acceptance.
3. **METHOD OF CONSTRUCTION.** Each handhole must be installed at the location specified on the plans or as directed by the Engineer. The area where the handhole is to be placed must be properly excavated. All disposable material must be properly disposed of per Section 202.03 of the Standard Specifications. Each handhole must be set on a bed of loose stone not less than six inches deep. If backfill is required, dirt will be used and the parkway will be restored to grade. Sidewalk will be removed and replaced as needed, and will be paid for separately.
4. **METHOD OF MEASUREMENT.** This item will be for each handhole installed, complete.
5. **BASIS OF PAYMENT.** Each handhole will be counted as one unit for payment. The item will be paid for at the contract unit price for each HANDHOLE, FIBERGLASS, which will be payment in full for all work necessary to install the handhole.

May 18, 2001

ITEM 174, CONCRETE FOUNDATION FOR 100KVA TRANSCLOSURE

1. **GENERAL.** The Contractor will install a concrete foundation for a 100KVA transclosure, as shown on City of Chicago Standard Drawing Number 680.
2. **MATERIAL.** Concrete will be Portland cement concrete, SI Class, meeting the requirements of Article 1020 of the Standard Specifications. Conduit will be galvanized rigid steel meeting the requirements of Material Specification 1462.
3. **CONSTRUCTION.** The contractor will install the concrete foundation as shown on Drawing 680. Work under this item will be performed in accordance with Article 800 of the Standard Specifications.

The foundation must have a minimum thickness of at least eight inches (8") with a minimum six inch (6") gravel bed. The elbow ends above ground will be capped with standard conduit bushings. The Contractor must furnish hardware, conduit elbows, and all other material shown on the foundation construction drawing.

All excavation and restoration of parkway will be included in this item. If the foundation is in sidewalk, an expansion joint will be required between the sidewalk and the foundation.

4. **METHOD OF MEASUREMENT.** This work will be measured as each for each unit installed complete.
5. **BASIS OF PAYMENT.** Unit price will include cost of all material and labor required to install this foundation, as per applicable construction plans and these specifications. The conduit elbows will be considered as part of the foundation and will not be paid for as a separate item or as part of the conduit laterals leading to the foundation. All necessary excavation and restoration of parkway to the original condition will be included in the unit price. Any sidewalk removal will be paid for as a separate pay item. However, any restoration of sidewalk will be considered as part of this item, including any expansion joint between the sidewalk and the foundation. This work will be paid for at the Contract Unit Price of EACH for CONCRETE FOUNDATION FOR 100KVA TRANSCLOSURE.

MATERIAL SPECIFICATION
1462

DRAWING
680

ITEM 190, COILABLE CONDUIT, HDPE #40, DIRECTIONAL BORING, 1.25", with 3TC CABLE

ITEM 190A, COILABLE CONDUIT, HDPE # 80, DIRECTIONAL BORING, 1.25", with 3TC CABLE

ITEM 192A, COILABLE CONDUIT, HDPE #80, DIRECTIONAL BORING, 2", with 3TC CABLE

ITEM 193, COILABLE CONDUIT, HDPE #40, DIRECTIONAL BORING, 1.25"

ITEM 193A, COILABLE CONDUIT, HDPE #80, DIRECTIONAL BORING, 1.25"

ITEM 195, COILABLE CONDUIT, HDPE #40, DIRECTIONAL BORING, 2"

ITEM 195A, COILABLE CONDUIT, HDPE #80, DIRECTIONAL BORING, 2"

ITEM 196, COILABLE CONDUIT, HDPE #40, DIRECTIONAL BORING, 3"

ITEM 196A, COILABLE CONDUIT, HDPE #80, DIRECTIONAL BORING, 3"

1. DESCRIPTION

This work will consist of the installation of flexible conduit along and/or across roadways by the directional boring method. The conduit will be for street lighting or traffic signal cable. When specified, the coilable conduit will come with cable pre-installed in the conduit.

2. MATERIALS

All conduits must be coilable high strength polyethylene conforming to the applicable requirements of Material Specification 1533 and to the National Electrical Manufacturers Association, Standard TC7. The conduit must also meet the requirements of ASTM-D1248, Type III, Grade PE34, Category 5, Class C, and the requirements of Section 1088.01(c) of the Standard Specifications. The average wall thickness of the schedule 40 conduit must be .15 inches. The average wall thickness of the schedule 80 conduit must be .2 inches. The nominal inside diameter of each conduit must equal the designated conduit size.

Cable must meet the requirements of Material Specification 1534. The cable will consist of three separate conductors twisted together. Two conductors must be #6 AWG, and one conductor must be #8 AWG.

3. CONSTRUCTION REQUIREMENTS

The Contractor will be responsible for obtaining all necessary permits from the Chicago Department of Transportation (CDOT) for work in the public way. The Contractor will provide necessary notification to the Chicago Utility Alert Network (CUAN) 48 hours before planned work in the public way. The Contractor will organize a CUAN meet at the work site for the purpose of identifying all underground obstructions. The contractor will be responsible for any and all damage caused to existing facilities, both private and public, including

Bureau of Electricity infrastructure.

The Contractor will open excavations for conduit access, the location of underground obstructions (find holes), and the pulling back of conduit, as necessary to perform the work. The excavations must be properly protected to insure that vehicular and pedestrian traffic are not endangered. Traffic lane blockage must be minimized and the intersection and roadway must be kept safe at all times during the installation work.

The top of the conduit or duct must be installed a minimum of thirty inches (30") below grade. Grade will mean the street surface level or the top of parkway. The contractor will later pick-up and extend the conduit to manholes, hand holes, foundations, etcetera as required by the plans or as directed by the Resident Engineer.

Conduit will be cleaned of dirt, debris, bentonite or other foreign materials by the use of a swab or mandrel. If cable is not to be installed immediately, a 1/4" polyethylene pull line will be installed in each conduit.

Any excavation will be backfilled as soon as possible after the installation of the conduit. Soil excavated may only be used for backfilling when approved by the Engineer. Backfill will be a fine or crushed screening aggregate material meeting the requirements of Section 1003.04 of the Standard Specifications. Cinders, rocks, or other inappropriate materials will not be permitted to be used as backfill material. Backfill material will be deposited in the excavation in layers not to exceed six inches (6") in depth, and must be thoroughly compacted with a mechanical tamper before the next layer is deposited in the excavation.

Excavations which are to remain open will be covered with steel plates, minimum 2" thickness for sidewalks and 1" thickness for streets, and will be secured in place as directed by the Engineer. Any costs involved will be considered incidental.

The Contractor will remove all excavated material, except that which is acceptable for backfilling, from the job site. Spoil will be disposed of according to Section 202.03 of the Standard Specifications.

Sidewalk removal and replacement and pavement removal and replacement, if necessary to accomplish the directional boring, will be done as separate pay items.

The contractor will directional bore and install the proper sizes of conduit as

indicated on the plans provided by the Bureau of Electricity. The contractor must follow the plans and directional bore and install conduit from point to point as indicated. Conduit will be installed and p-lined and any excavations for find holes etcetera must be restored to original condition including pavement restoration, sidewalk restoration, and parkway restoration. Failure to accomplish point to point installation or to properly restore excavations will result in non-payment for that particular point-to -point installation.

4. METHOD OF MEASUREMENT

This item will be paid for the number of lineal feet bored with conduit installed from point to point, measured in place. The length will be the distance horizontally from point to point. No vertical distances will be measured or applied.

5. BASIS OF PAYMENT

This work will be paid for at the contract unit price per lineal foot for the type and number of conduits specified, measured with conduit in place, for COILABLE CONDUIT INSTALLATION BY DIRECTIONAL BORING. Such price will include the cost of all conduit, conduit fittings, excavations, furnishing and placing all required backfill material, restoration of all find holes, plating and protection of all end holes when required, disposal of all surplus excavated material, and any trenching and backfill made for the purpose of placing conduit. Restoration of all pavements and sidewalks will be paid for separately.

August 8, 2006

Item 193 to196

Page 3

ITEM 197, TRENCH AND BACKFILL TO FACILITATE A DIRECTIONAL CHANGE IN CONDUIT

1. **DESCRIPTION** This work will consist of excavating a pit, installing HDPE Schedule #40 conduit sized as required for the project (but no larger than 2 inch inside diameter), intercepting existing conduit, and connecting the conduit to the existing conduit at either end. The pit will then be properly backfilled. The purpose is to facilitate a change of direction in the conduit without installing a handhole. This work must meet all applicable requirements of Article 800 of IDOT's Standard Specifications for Road and Bridge Construction (Standard Specifications).
2. **MATERIAL**. Screenings must meet the requirements of Section 1003.04 of the Standard Specifications. High Density Polyethylene (HDPE) conduit must conform to the requirements of Material Specification 1533, to the requirements of the National Electrical Manufacturers Association (NEMA) Publication TC7, and to Section 1088.01 of the Standard Specifications.
3. **CONSTRUCTION REQUIREMENTS**. Work under this item must be performed in accordance with Article 800 of the Standard Specifications. The pit must be a minimum of four feet by four feet (4X4) and not be less than 36 inches deep to provide thirty inches (30") of cover over the conduit. The bottom of the pit must be tamped, and the trench inspected by the Resident Engineer before conduit is installed.

The conduit must be bent to place it for connection to existing conduit at either end of the pit. The contractor must exercise care in installing the conduit to ensure that it is smooth and free of sharp bends or kinks. Crushed or deformed conduit will not be accepted. All conduit ends, both the installed conduit and the conduit being intercepted, must be flush. All conduit must be properly joined. All conduit and fittings must be free from burrs and rough edges. Threadless couplings may be used for splicing existing conduit. All fittings, splices, etcetera will be considered incidental to this pay item.

The pit must be backfilled as soon as possible after the installation of the conduit. Any material excavated from the pit that in the opinion of the Resident Engineer is satisfactory backfill, may be used for backfill above the layer of screenings. Limestone screenings must be used to fill the bottom of the trench to a depth of one foot above the top of the conduit. Cinders, rocks, or other inappropriate materials will not be permitted to be used as backfilling material. Backfilling material, beginning with limestone screenings must be deposited in the trench in layers not to exceed six inches (6") in depth, and must be thoroughly compacted with a mechanical tamper before the next layer is deposited in the trench. All trenches for conduit must be backfilled as per this specification. Unsuitable material must be disposed of according to the requirements of Section 202.03 of the Standard

Specifications.

4. **METHOD OF MEASUREMENT.** This work will be measured on a per each basis. All work will be included: trench and backfill, conduit, fittings, pvc cement, etcetera.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each, with duct in place, for TRENCH AND BACKFILL TO FACILITATE DIRECTIONAL CHANGE IN CONDUIT. Such price will include the cost of all excavation, furnishing and placing all backfill material, disposal of all surplus excavated material, installing conduit, connecting conduit at both ends, fittings, pvc cement, etcetera. If sidewalk, driveway pavement, or pavement must be removed and replaced, such work will be paid for separately.

MATERIAL SPECIFICATION
1533

November 5, 2009

ITEM 203, POLE, STEEL, ANCHOR BASE, 8-1/2" DIAMETER, 7 GAUGE, 32' - 6"

ITEM 204, POLE, STEEL, ANCHOR BASE, 8-1/2" DIAMETER, 3 GAUGE, 32' - 6"

1. **DESCRIPTION.** This item will consist of furnishing, installing and setting plumb a steel anchor base pole to which equipment may be attached for the extension of the City street light and traffic signal systems.
2. **MATERIAL.** The material of the pole must meet the requirements of Specification 1447.
3. **INSTALLATION.** The pole will be installed on a parapet wall where the anchor rods have been integrated into the wall and are at the proper bolt circle. Double nut construction as shown on Drawing 837 must be used. Double nut construction provides the proper ventilation, as well as providing a way to plumb the pole. Any exposed portions of anchor rods extending above the nuts which interfere with the installation of the bolt covers must be cut off with a saw to provide the necessary clearance. The excess must not be burned off. The pole will be set secure, properly orientated, and plumb using the nuts and washers provided with the anchor bolts. The bolt covers, handhole cover, and pole cap must be securely attached.

The contractor will utilize non-abrasive slinging materials and will otherwise exercise due care in erecting the pole and mast arm to minimize any possible damage to the finish. When necessary, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed, complete. It will not include the luminaire arm or the luminaire, which will be separately measured.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for a POLE, STEEL, ANCHOR BASE, 32'-6", which will be payment in full for furnishing and installing the pole complete in place. Light standard foundations and anchor rods will not be included in this pay item but will be paid for separately, as will the mast arms, and luminaires.

MATERIAL SPECIFICATION
1447

DRAWING
762
763
837

April 12, 2001

ITEM 205, POLE STEEL, ANCHOR BASE, 10" DIAMETER, 7 GAUGE, 34'-6"
 ITEM 206, POLE STEEL, ANCHOR BASE, 10" DIAMETER, 3 GAUGE, 34'-6"
 ITEM 207, POLE STEEL, ANCHOR BASE, 11" DIAMETER, 3 GAUGE, 34'-6"
 ITEM 208, POLE STEEL, ANCHOR BASE, 12.5" DIAMETER, 3 GAUGE, 34'-6"

1. **DESCRIPTION.** This item will consist of furnishing, installing, and setting plumb a steel anchor base pole to which equipment may be attached for the extension of the City street light and traffic signal systems.
2. **MATERIAL.** The material of the pole must meet the requirements of Material Specification 1447.
3. **INSTALLATION.** The pole must be installed on the concrete foundation designed for the particular pole usage as indicated on the plans or as directed by the Engineer. Double nut construction must be used as shown on Drawing 837. Double nut construction provides the proper ventilation, as well as providing a way to plumb the pole. Any exposed portions of anchor rods extending above the nuts which interfere with the installation of the bolt covers must be cut off to provide the necessary clearance. The excess must not be burned off. The pole must be set secure, properly orientated, and plumb using the nuts and washers provided with the anchor bolts. The bolt covers, handhole cover, and pole cap must be securely attached.

The contractor will utilize non-abrasive slinging materials and will otherwise exercise due care in erecting the pole and mast arm to minimize any possible damage to the finish. When necessary, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed, complete with anchor bolt covers, pole cap, and handhole cover.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for a POLE, STEEL, ANCHOR BASE, 34'-6", which will be payment in full for furnishing and installing the pole complete in place. Light standard foundations, mast arms, and luminaires will not be included in this pay item but will be paid for separately.

MATERIAL SPECIFICATION	DRAWING
1447	837 827
	808 824

April 12, 2001

ITEM 209, POLE, STEEL, 35', EMBEDDED, 7 GAUGE
ITEM 210, POLE, STEEL, 35', EMBEDDED, 3 GAUGE

1. **DESCRIPTION.** This work will consist of furnishing and installing a steel pole of the size specified. The pole will be embedded in the ground, and will be used to support street light or traffic signal equipment.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1319 and Standard Drawing 916.
3. **INSTALLATION.** A hole must be augered for the pole. The pole must be embedded 6'4" below grade or to a depth as directed by the Engineer. The pole must be set plumb. The backfill must be tamped and compacted around the pole in 6 inch layers. Any debris must be removed and properly disposed of according to Section 202.03 of the Standard Specifications.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for POLE, STEEL, EMBEDDED of the size specified, which price will include all labor and material necessary to install the pole.

MATERIAL
1319

DRAWING
916

May 18, 2001

ITEM 211, POLE, WOOD, 40 FOOT, EMBEDDED

1. **DESCRIPTION.** This work will consist of furnishing and installing a wood pole as shown on the plans or as directed by the Engineer. The pole will be used to support street light or traffic signal equipment.
2. **MATERIAL.** The wood pole must be 40 feet in length and meet the requirements of Section 1069.01(d) of the Standard Specifications.
3. **INSTALLATION.** A hole must be augered for the pole. The pole must be embedded to a depth of 8 feet and set plumb. The backfill must be tamped and compacted around the pole in 6 inch layers. Any debris must be removed and properly disposed of according to Section 202.03 of the Standard Specifications.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each POLE, WOOD, 40 FOOT, EMBEDDED, which price will include all labor and material necessary to install the pole.

May 18, 2001

ITEM 212, POLE, EMBEDDED, RELOCATE COMPLETE

1. **DESCRIPTION.** This work will consist of the removal from one location and the reinstallation at another location of an existing embedded pole with attached electrical equipment, and the restoration of the disturbed area as specified on the plans or as directed by the Engineer.
2. **GENERAL REQUIREMENTS.** The electrical pole to be moved will be disassembled as required or left with electrical equipment intact, as directed by the Engineer. The pole must be transported with care to prevent damage. The area of the pole removal must be restored to like condition of the area surrounding the removed pole. Removal will include all incidental work and items associated with the pole as directed by the Engineer. A hole must be augered for the installation. The pole must be embedded to a depth of 5'4", or as directed by the Engineer. The pole must be set plumb and be properly orientated with respect to the arm and luminaire. The backfill must be tamped and compacted around the pole in 6 inch layers. Any debris must be removed and properly disposed of according to Section 202.03 of the Standard Specifications.
3. **METHOD OF MEASUREMENT.** Electrical poles to be relocated will be measured for payment by each unit removed and reinstalled.
4. **BASIS OF PAYMENT.** Electrical pole relocation, including site restoration, will be paid for at the contract unit price for each POLE, EMBEDDED, RELOCATE COMPLETE, which price will be payment in full for all labor, equipment, materials, and incidental work necessary to remove and reinstall the pole and for the restoration of the site as specified. Disposal, if necessary and disposal fees are to be considered incidental and not paid for separately. No additional cost will be involved for relocating the pole with attached electrical equipment, or for any dis-assembly and re-assembly.

May 21, 2001

ITEM 213, POLE, ANCHOR BASE, RELOCATE COMPLETE

1. **DESCRIPTION.** This work will consist of the removal from one location and the reinstallation at another location of an existing anchor base pole and attached street light equipment as specified on the plans or as directed by the Engineer.
2. **GENERAL REQUIREMENTS.** The electrical pole to be moved will be disassembled as required or left with electrical equipment attached, as directed by the Engineer. The pole must be transported with care to prevent damage. Removal will include all incidental work and items associated with the pole as directed by the Engineer. The pole will be installed on another foundation using double-nut installation. The pole must be set plumb and be properly orientated with respect to the arm and luminaire.
3. **METHOD OF MEASUREMENT.** Electrical poles to be relocated will be measured for payment by each unit removed and reinstalled.
4. **BASIS OF PAYMENT.** Electrical pole relocation will be paid for at the contract unit price for each POLE, ANCHOR BASE, RELOCATE COMPLETE, which price will be payment in full for all labor, equipment, materials, and incidental work necessary to remove and reinstall the pole. No additional cost will be involved in relocating the pole with attached electrical equipment. No additional cost will be involved in dis-assembly or re-assembly of the pole and associated equipment.

May 21, 2001

ITEM 214, PAINT EXISTING RESIDENTIAL POLE, ARM, and LUMINAIRE
ITEM 214A, PAINT EXISTING ARTERIAL POLE, ARM, and LUMINAIRE
ITEM 339, PAINT EXISTING CONTROLLER CABINET
ITEM 340, PAINT EXISTING TRAFFIC PEDESTAL AND TRAFFIC HEADS
ITEM 341, PAINT EXISTING TRAFFIC POLE, TRAFFIC HEADS, LUMINAIRE
ARM, and LUMINAIRE
ITEM 341A, PAINT EXISTING TRAFFIC POLE, TRAFFIC HEADS,
LUMINAIRE ARM, LUMINAIRE, and MAST ARM

1. **DESCRIPTION.** This work will consist of field painting existing steel and aluminum structures including poles and arms that support street lights and traffic control signals, controller cabinets for street lights and traffic signals, traffic signal housings, and street light luminaire housings.
2. **MATERIAL.** All paints and painting materials intended for applications specified herein must be certified by the contractor to be of highest quality, must be from the same manufacturer, and must conform to the following, as applicable:
 - a. **Naphtha.** The solvent to be used for wiping down all metallic surfaces prior to application of paint must be NAPHTHA conforming to ASTM Standard D838.
 - b. **Primer.** This paint must meet the requirements of Section 4 (composition) and Section 5 (properties) of the Steel Structures Painting Council's Paint Specification No. 25 for red iron oxide, zinc oxide, raw linseed oil and alkyd primer as outlined in Volume 2, Systems and Specifications, Third Edition.
 - c. **Intermediate Coat.** The paint must meet the same requirements as the primer except that it will contain a contrasting shade of iron oxide/ or be tinted or shaded to produce a distinct contrast of at least 10 Hunter Delta E units compared to the primer.
 - d. **Finish Coat.** This paint must meet the requirements of Section 4 (composition) and Section 5 (properties) of the Steel Structures Painting Council's Paint Specification No. 21 for lead free white or colored silicone alkyd paint, Type 1, high gloss as outlined in Volume 2, Systems and Specifications, Third Edition.
 - e. **Color.** A paint sample must be submitted for approval prior to authorization to paint. The color will be as specified by the Engineer. The sample must be in the form of a 4" by 8" color chip. The contractor must provide a field-painted sample, if requested by the Commissioner. The

field sample must be of the same type of equipment to be painted and will be chosen by the Commissioner. Color will be green, gray, black, or another color as specified.

- f. Product Data. The contractor must submit the manufacturer's technical information, label analysis, and application instructions for each material proposed for use. Each material must be listed and cross-referenced for the specific coating, finish system, and application. Each material must include the manufacturer's catalog number.

3. Delivery, Storage, and Handling. The contractor must deliver, store, and handle the paint as herein specified.

- a. The materials must arrive at the job site in the manufacturer's original, unopened packages and containers bearing the manufacturer's name label, product name, product description, manufacturer's stock number, date of manufacture, contents by volume for pigment and vehicle constituents, thinning instructions, application instructions, and color name and number.
- b. Materials to be stored should be kept in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° Fahrenheit.

4. Preparation of Surfaces.

- a. Steel Surfaces. Remove loose or scaling paint, dirt, oil grease, rust and foreign matter, as necessary, to receive paint. Wire brushing, where specified herein, must be done with an approved power tool operated from a portable power source. After wire brushing, the complete surface must be thoroughly wiped with a rag containing NAPTHA.
- b. Aluminum Surfaces. Remove loose scale and paint, dirt, oil, grease and foreign matter, as necessary, to receive paint. Wire brush surfaces, where necessary, to remove loose scale. Wire brushing, where specified herein, must be done with an approved power tool operated from a portable power source. After wire brushing, the complete surface must be thoroughly wiped with a rag containing NAPTHA.
- c. Weather Conditions. Do not apply paint coatings when temperature is below 40° F., or during periods of rain, fog, snow, or when relative humidity is above 85 %.
- d. Application Conditions. Surfaces to be painted must be clean, dry, and relatively smooth. Each paint coating must be applied smoothly and worked out evenly. Paint must be thoroughly mixed just prior to application. Thinning must be held to a minimum and must be done only

when required for proper application. Thinners to be used will be the manufacturer's recommended thinner for the paints used; mixed thoroughly to assure complete blending with the coating. Spray painting will not be permitted when wind conditions are greater than 15mph. Painting must be done as soon after cleaning as possible.

5. Detail Painting Requirements.

- a. Street Light Poles. Street light poles to be painted under these specifications are steel structures which will vary from twenty-seven (27) to thirty (30) feet in height, with average surface required to be painted of approximately forty-eight (48) square feet. Some rusting and/or bare spots will be encountered which the contractor will be required to wire-brush. The pole must be thoroughly wiped with NAPHTHA, and the finish coating applied.
- b. Mast Arm Brackets and Electrical Luminaries. Mast arms which are attached to the street light poles will consist of 2-inch steel pipe sections which will vary between eight feet (8') and fifteen feet (15') in length. Mast arms in twelve foot (12') and 15 foot (15') sizes will have a supporting strut of two inch (2") steel pipe. Surface scale and rust will be wire-brushed, and these mast arms thoroughly wiped with NAPHTHA, and finish painted.
- c. Traffic Signal Post. Aluminum and steel posts consist of five inch (5") pipe sections atop a conical base or base flange sixteen inches (16") in diameter, and will vary in height from three feet six inches (3' - 6") to twenty feet (20'). Spot scaling must be wire-brushed and the posts thoroughly wiped with NAPHTHA, and finish painted.
- d. Street Light Controllers. The control cabinets will be cast aluminum and are approximately 18" x 14" x 30" in size. They will be mounted atop a three foot six inch (3' 6") high post. The Contractor will wire-brush, as necessary, and thoroughly wipe the complete cabinet and casting with NAPHTHA, and apply a finish coating.

6. Basis of Payment.

This work will be paid for at the contract unit price each for paint existing street light or traffic equipment complete, which will be payment in full for all labor and materials necessary in painting the existing equipment.

October 6, 2006

ITEM 215, PLATE, WELD TO POLE 2-BOLT

1. **DESCRIPTION.** This item will consist of furnishing and welding a mast arm attachment plate to a street light pole for the purpose of installing a street light mast arm to support traffic signal or street lighting equipment.
2. **MATERIAL.** The plate must be made of forged steel. The plate will be as shown on Standard Drawing 659.
3. **METHOD OF CONSTRUCTION.** The orientation of the plate to position the mast arm relative to the street light mast arm will be as designated on the drawing. The plate must be positioned such that the center lines of the mast arm mounting bolt holes will be in a horizontal plane, and the face of the plate will be in a vertical plane when the pole is installed plumb. The plate must be mounted on the pole with the wire guide lip extending inside the pole and positioned at the bottom of a two (2) inch diameter mounting hole drilled in the pole. The drilled hole must be reamed or filed to remove all sharp edges which may damage cable during installation.

The plate must be electric arc welded with a continuous 3/16" fillet weld, and the voids must be filled in at the top and bottom of the plate where the welding surface is not concentric with the pole. The height of the hole in the pole will be nominally fifteen (15) feet one (1) inch above the bottom of the pole base when the plate is used for a traffic signal installation. This height will be adjusted in each installation to meet the field criteria as specified in the following paragraph and table.

The governing criteria will be that the height of the bottom of the signal being installed, whether composed of three, four, or five sections, must be a minimum of fourteen (14) feet six (6) inches above the bottom of the pole base. The rise of the mast arm specified for the installation is also a controlling factor and the hole height must be located according to the following table for the various combinations listed.

<u>Mast Arm Length</u>	<u>Hole Height 3 Sec. or 4 Sec. Head</u>	<u>Hole Height 5 Sec Head</u>
4 Ft.	15'-1"	16'-3"
8 Ft.	14'-5"	15'-7"
12 Ft.	14'-3"	15'-5"

When a twelve (12) foot mast arm is used, a second plate must be welded to the pole in the same orientation at a position thirty-two (32) inches vertically below

the first plate. When the plate is to be used for a street lighting installation for either double arming or mounting a lighting unit at a lower than normal height, the orientation and the height of the mounting hole will be as specified on the drawing.

The integrity of the weld between the mast arm support plate and the pole must be tested in the following manner. With an appropriate mast arm firmly attached to the pole, at test load of 300 pounds will be applied to the mast arm as a side pull at a point seven (7) feet from the pole. After the test, the mast arm support plate welds must be sound in all respects. This test must be performed with a time lapse of a minimum of two hours following the welding, and the test must be performed with the Resident Engineer as a witness. In the event of a failed weld, the crack may be re-welded and the pole assembly retested.

The plate must be cleaned and painted. This will not constitute a separate cost item for painting.

4. **METHOD OF MEASUREMENT.** This work will be measured per each plate installed, complete with painting.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a PLATE, WELD TO POLE, 2-BOLT which will be payment in full for furnishing and welding the plate.

DRAWING
659

April 3, 2009

ITEM 216, BASE, BALLAST HOUSING, STEEL, 7 GAUGE

1. **DESCRIPTION.** This work will consist of furnishing and installing a ballast housing on a concrete foundation, as shown on the plans or as directed by the Engineer. The foundation must have either a 10 inch or 15 inch bolt circle.
2. **MATERIAL.** The ballast housing must meet the requirements of Material Specification 1375, and Standard Drawing 785.
3. **INSTALLATION.** The ballast housing must be installed onto the foundation using the hardware provided for the foundation anchor rods. No double nutting or shims will be used.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each BASE, BALLAST HOUSING, STEEL, 7 GAUGE, which will be payment in full for furnishing and installing the base.

MATERIAL
1375

DRAWING
785

May 21, 2001

ITEM 218, MAST ARM, STEEL, 1 FOOT
ITEM 219, MAST ARM, STEEL, 4 FOOT
ITEM 220, MAST ARM, STEEL, 8 FOOT
ITEM 221, MAST ARM, STEEL, 12 FOOT
ITEM 222, MAST ARM, STEEL, 15 FOOT

1. **DESCRIPTION.** This item will consist of furnishing and installing a steel pipe mast arm of a specified length to support a street light luminaire, or other electrical equipment as required, as is shown on Drawing Numbers 661, 620, 839, and 840.
2. **MATERIAL.** The material of the mast arm must conform to the requirements of Material Specification 1450. The 4 foot arm must conform to Standard Drawing 661. The 8 foot mast arm must conform to Standard Drawing 620. The 12 foot mast arm must conform to Standard Drawing 839. The 15 foot mast arm must conform to Standard Drawing 840. The two bolt arm attachment must be equal to that shown on Standard Drawing 724. The 1 foot mast arm will be a 4 foot arm cut to the desired length.
3. **INSTALLATION.** The 1 foot, 4 foot, and 8 foot mast arms will be installed with two bolts to the mast arm attachment on the pole. The pole must have a mast arm attachment as shown in Standard Drawing 659 in order to properly mount the arm. The truss arms require 2 such mounts. The 12 foot and 15 foot truss arms will be attached with 4 bolts. Bolts will be supplied with the arm per Material Specification 1450.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed.
5. **BASIS OF PAYMENT.** This work must be paid for at the contract unit price each for a MAST ARM, STEEL, of the length specified, which will be payment in full for furnishing and installing the mast arm complete in place.

MATERIAL SPECIFICATION
1450

DRAWING
620 661 839 840
659 724

January 23, 2004

ITEM 224, LUMINAIRE, STREET LIGHT, HPS, 150 WATT, 120 VOLT, RESIDENTIAL, CRIME-FIGHTER
ITEM 225, LUMINAIRE, STREET LIGHT, HPS, 150 WATT, 240 VOLT, RESIDENTIAL, CRIME-FIGHTER
ITEM 226, LUMINAIRE, STREET LIGHT, HPS, 310 WATT, 208 VOLT, ARTERIAL, CRIME-FIGHTER
ITEM 227, LUMINAIRE, STREET LIGHT, HPS, 310 WATT, 240 VOLT, ARTERIAL, CRIME-FIGHTER
ITEM 228, LUMINAIRE, STREET LIGHT, HPS, 400 WATT, 240 VOLT, ARTERIAL, SEMI-CUTOFF
ITEM 229, LUMINAIRE, STREET LIGHT, HPS, 400 WATT, 240 VOLT, ARTERIAL CUT-OFF
ITEM 229A, LUMINAIRE, STREET LIGHT, HPS, 1000 WATT, 240 VOLT, ARTERIAL, SEMI-CUTOFF
ITEM 2973, LUMINAIRE, STREET LIGHT, HPS, 250 WATT, 240 VOLT, ALLEY, SEMI-CUTOFF
ITEM 2972, LUMINAIRE, STREET LIGHT, HPS, 250 WATT, 120/240 VOLT, RESIDENTIAL, VERTICAL BURN
ITEM 230, LUMINAIRE, FLOODLIGHT, 240 VOLT, 400 WHPS
ITEM 280, LUMINAIRE, FLOODLIGHT, 240 VOLT, 250 WHPS

1. **DESCRIPTION.** This item will consist of furnishing and installing a street lighting luminaire, complete with internal ballast, electronic starting component, and a high pressure sodium vapor lamp of the proper wattage and input voltage, on a street light mast arm attached to a street light pole, or a floodlight mounted to a post top attachment on a street light pole, and connecting the unit to either an underground cable distribution system or an aerial wire distribution system at the location shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The luminaire must meet the appropriate material specification for the lamp wattage and type of distribution specified. Items 224, 225, 226, 227, 228, 229, 229A, 2973, 2972, 230, and 280 must meet Material Specifications 1359, 1359, 1368, 1368, 1382, 1499, 1376, 1492, 1501, 1498, and 1498, respectively. Lamps for these items must meet Material Specification 1524.
3. **INSTALLATION.** The luminaire must be securely installed on the mast arm. The vertical axis of the luminaire must be in a vertical plane, and the longitudinal axis must be leveled as specified in shop drawings supplied by the manufacturer to produce the desired distribution pattern with the lamp socket secured in the required position for that distribution. Floodlights must be mounted on the pole top using a bracket supplied with this item. The bracket will be for one or two fixtures, as specified, or as directed by the Engineer. Floodlights must be aimed for proper light distribution.

For an aerial distribution system, the primary wiring to the ballast must consist of

2 1/C #12 AWG wires, with 150 degree C. irradiated polyolefin insulation, connected to the terminal board "line" terminals. They must extend through the mast arm and exit from the mast arm through the grommet in the hole provided for this purpose, and extend further forming a drip loop and connect with aerial circuit wires. Connection to the aerial circuit wires must be made with a split bolt type pressure connector for a No. 6 solid copper wire and the connection so formed must be wrapped with two layers of an approved electrical tape.

A cartridge type fuse, type KTK, rated at 10 amperes must be installed in each of the fuse holders. The primary wiring to the ballast must consist of 2 1/C No. 12 AWG wires with 150 degree C. irradiated polyefin, insulation connected to the terminal board "line" terminals. They must extend through the mast arm raceway and down the inside of the pole to the pole base where they must be spliced to the underground feeder cables. Sufficient wire must be supplied to extend the wires outside of the pole through the access handhole to permit splicing work to be performed outside the pole.

All splice methods must be approved by the Engineer before implemented. All splices, tapes and grounding connections must be inspected by the Commissioner's authorized representative before wires are permanently trained in the light pole.

Current, insulation resistance, and voltage readings must be taken and tabulated by the Contractor for each circuit. These readings are to be witnessed by the Commissioner's authorized representative. Any indication of grounds, open, or crossed conductors must be thoroughly investigated and remedied before acceptance of the installation. Line voltage must be taken at any in-line fused location, within the pole designated by the Commissioner's authorized representative. Locations and voltage must be tabulated as directed. Three (3) copies of the tabulated voltage insulation resistance, and current readings must be submitted to the Commissioner's authorized representative. Maximum voltage drop must not exceed 10% of nominal source voltage. The insulation resistance must not be less than 2 Megohms, when tested to ground with 500 volts a.c.

The Contractor must submit the manufacturer's certified test reports on all materials used on this project. Any material deemed defective must be removed and disposed of by the Contractor at his sole cost.

After the lighting installation has been completed and satisfactory current and voltage readings recorded, a field test must be made to insure that all lighting and control equipment are in proper operating condition. This field test must be witnessed by the Engineer.

The Contractor will furnish special test devices, tools and miscellaneous items that will be required for the testing of cables and control equipment, all as herein specified.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete. All wiring to the underground feeder cable, including splices, will be included in this measurement.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a LUMINAIRE, STREET LIGHT, HPS, of the proper wattage, voltage, and distribution type, which will be payment in full for furnishing, installing, connecting and testing the unit complete in place.

MATERIAL SPECIFICATION

1359 1368 1376
1382 1492 1498
1499 1501 1524

ITEM 224A-LED Aerial Inst-, INSTALLATION OF LUMINAIRE, LED, 240V, ARTERIAL, STANDARD, CUT-OFF, AERIAL

1 DESCRIPTION. This item will consist of installing a street lighting luminaire, complete with internal driver, and LED SSL luminaire of the proper wattage and input voltage, on a street light mast arm attached to a street light pole, and connecting the unit to an aerial wire distribution system at the location shown on the plans, or as directed by the Engineer.

2 INSTALLATION. The luminaire must be securely installed on the mast arm. The vertical axis of the luminaire must be in a vertical plane, and the longitudinal axis must be leveled as specified in shop drawings supplied by the manufacturer to produce the desired distribution pattern with the LEDs secured in the required position for that distribution.

For an aerial distribution system, the primary wiring to the driver must consist of 3 1/C #12 AWG wires, with 150 degree C. irradiated polyolefin insulation, connected to the terminal board "line" terminals. They must extend through the mast arm and exit from the mast arm through the grommet in the hole provided for this purpose, and extend further forming a drip loop and connect with aerial circuit wires. Connection to the aerial circuit wires must be made with a split bolt type pressure connector for a No. 6 solid copper wire and the connection so formed must be wrapped with two layers of an approved electrical tape. The ground wire must be terminated to the pole by drilling into the top of the pole and making the connection through the use of a Burndy grounding connector, or as specified by Commissioner.

A cartridge type fuse, type KTK, rated at 10 amperes must be installed in each of the fuse holders. The primary wiring to the driver must consist of 3 1/C No. 12 AWG wires with 150 degree C. irradiated polyefin, insulation connected to the terminal board "line" terminals. They must extend through the mast arm raceway and down the inside of the pole to the pole base where they must be spliced to the underground feeder cables. Sufficient wire must be supplied to extend the wires outside of the pole through the access handhole to permit splicing work to be performed outside the pole.

All splice methods must be approved by the Engineer before implemented. All splices, tapes and grounding connections must be inspected by the Commissioner's authorized representative before wires are permanently trained in the light pole.

Current, insulation resistance, and voltage readings must be taken and tabulated by the Contractor for each circuit. These readings are to be witnessed by the Commissioner's authorized representative. Any indication of grounds, open, or crossed conductors must be thoroughly investigated and remedied before acceptance of the installation. Line voltage must be taken at any in-line fused location, within the pole designated by the Commissioner's authorized representative. Locations and voltage must be tabulated as directed. Three (3) copies of the tabulated voltage insulation resistance, and current readings must be submitted to the Commissioner's authorized representative. Maximum voltage

drop must not exceed 10% of nominal source voltage. The insulation resistance must not be less than 2 Megohms, when tested to ground with 500 volts AC.

The Contractor must submit the manufacturer's certified test reports on all materials used on this project. Any material deemed defective must be removed and disposed of by the Contractor at his sole cost.

After the lighting installation has been completed and satisfactory current and voltage readings recorded, a field test must be made to insure that all lighting and control equipment are in proper operating condition. This field test must be witnessed by the Engineer.

The Contractor will furnish special test devices, tools and miscellaneous items that will be required for the testing of cables and control equipment, all as herein specified.

3. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete. All wiring to the underground feeder cable, including splices, will be included in this measurement.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for INSTALLATION OF LUMINAIRE, LED, 240V, ARTERIAL, STANDARD, CUT-OFF, AERIAL of the proper wattage, voltage, and distribution type, which will be payment in full for installing, connecting and testing the unit complete in place.

ELECTRICAL SPECIFICATION

1584

**ITEM 1089, LUMINAIRE, UNDERPASS, HPS, 250 WATT, 120 VOLT,
CLAMPED TO CTA STRUCTURE**

**ITEM 1090, LUMINAIRE, UNDERPASS, HPS, 250 WATT, 120 VOLT,
BOLTED TO CTA STRUCTURE**

1. **DESCRIPTION.** This item will consist of furnishing and installing a street lighting luminaire, complete with internal ballast, electronic starting component, fuses, and a high pressure sodium vapor lamp of the proper wattage and input voltage, onto a CTA elevated structure.
2. **MATERIAL.** The luminaire must meet Material Specification 1542. Lamps for this item must meet Material Specification 1524. All bolts, washers, and nuts must be stainless steel. Beam clamps and shock absorbers must be structurally sound. Shock absorbers will use steel springs for the mechanism. All material will be subject to approval by the engineer.
3. **INSTALLATION.** The luminaire must be securely attached to two (2) shock absorbers, which in turn, will be mounted to the bottom flange of a steel beam. The steel beam attachment will be one of two kinds: the first kind will consist of beam clamps, the second kind will consist of drilling the steel and installing bolts. In either case, the attachment must be secure, and must withstand any vibrations occurring during normal service without loosening. A metallic whip, of not more than six (6) feet, must be provided and installed from the luminaire to the nearest junction box, to provide a wireway.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete. All mounting hardware and labor will be included. Wiring from the luminaire to the controller will not be part of this item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a LUMINAIRE, UNDERPASS, HPS, 250 WATTS, 120 VOLTS, and mounting method, which will be payment in full for furnishing, installing, connecting and testing the unit complete in place.

MATERIAL SPECIFICATION

1542 1524

September 19, 2006

ITEM 228A, LUMINAIRE, STREET LIGHT, CMH, 315 WATT, 240 VOLT, ARTERIAL, SEMI-CUTOFF

1. **DESCRIPTION.** This item will consist of furnishing and installing a street lighting luminaire, complete with electronic ballast, fuses, and a ceramic metal halide lamp, on a street light mast arm attached to a street light pole, and connecting the unit to an underground cable distribution system at the location shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The luminaire must meet the Material Specification 1564. The lamp must meet Material Specification 1562I.
3. **INSTALLATION.** The luminaire must be securely installed on the mast arm. The vertical axis of the luminaire must be in a vertical plane, and the longitudinal axis must be leveled as specified in shop drawings supplied by the manufacturer to produce the desired distribution pattern with the lamp socket secured in the required position for that distribution

A cartridge type fuse, type KTK, rated at 10 amperes must be installed in each of the fuse holders. The primary wiring to the ballast must consist of 2 1/C No. 12 AWG wires with 150 degree C. irradiated polyefin, insulation connected to the terminal board "line" terminals. They must extend through the mast arm raceway and down the inside of the pole to the pole base where they must be spliced to the underground feeder cables. Sufficient wire must be supplied to extend the wires outside of the pole through the access handhole to permit splicing work to be performed outside the pole.

All splice methods must be approved by the Engineer before implemented. All splices, tapes and grounding connections must be inspected by the Commissioner's authorized representative before wires are permanently trained in the light pole.

Current, insulation resistance, and voltage readings must be taken and tabulated by the Contractor for each circuit. These readings are to be witnessed by the Commissioner's authorized representative. Any indication of grounds, open, or crossed conductors must be thoroughly investigated and remedied before acceptance of the installation. Line voltage must be taken at any in-line fused location, within the pole designated by the Commissioner's authorized representative. Locations and voltage must be tabulated as directed. Three (3) copies of the tabulated voltage insulation resistance, and current readings must be submitted to the Commissioner's authorized representative. Maximum voltage drop must not exceed 10% of nominal source voltage. The insulation resistance must not be less than 2 Megohms, when tested to ground with 500 volts a.c.

The Contractor must submit the manufacturer's certified test reports on all

materials used on this project. Any material deemed defective must be removed and disposed of by the Contractor at his sole cost.

After the lighting installation has been completed and satisfactory current and voltage readings recorded, a field test must be made to insure that all lighting and control equipment are in proper operating condition. This field test must be witnessed by the Engineer.

The Contractor will furnish special test devices, tools and miscellaneous items that will be required for the testing of cables and control equipment, all as herein specified.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete. All wiring to the underground feeder cable, including splices, will be included in this measurement.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a LUMINAIRE, STREET LIGHT, CMH, 315 WATT, 240 VOLT, SEMI-CUTOFF, which will be payment in full for furnishing, installing, connecting and testing the unit complete in place, including pole wire, splicing, fuses, and lamp.

MATERIAL SPECIFICATION

1564 1562I
1351 1464

**ITEM 231, RACK, SECONDARY AERIAL 1 WIRE
ITEM 232, RACK, SECONDARY AERIAL 2 WIRE
ITEM 233, RACK, SECONDARY AERIAL 3 WIRE**

1. Description.

This item will consist of furnishing and installing an electrical secondary rack, to which wires may be attached, on a street light pole, as shown on the plans, specified herein, or directed by the Commissioner. The secondary rack must be banded to the pole in the manner as herein described.

2. Materials.

The materials of the secondary rack must conform to the requirements of Specification 1443.

3. Installation Requirements.

The secondary rack must be banded securely to the pole at such height as to locate the upper insulating spool at six inches (6") below the top mast arm port of the pole. The banding must consist of two - 3/4 inch stainless steel bands, one each through the top and bottom clevises in the manner shown on Drawing 11940. The rack must be banded at a position 90 degrees from the central axis of the street light mast arm, or in the position of direct strain, when the pole is the line termination, and at 180 degrees from the central axis of the street light mast arm when the pole is an intermediate one in the pole line.

4. Basis of Payment.

This work will be paid for at the contract price each for a RACK, SECONDARY AERIAL 1-WIRE OR RACK, SECONDARY AERIAL 2 OR 3-WIRE, which price will be payment in full for furnishing and installing a secondary rack of the size stated on the contract plans on an existing pole. Any attachment of wires to the rack will be paid for as part of the cost of installing the wire.

MATERIAL SPECIFICATION
1443

DRAWING
11940

March 21, 1995

ITEM 234, SERVICE ENTRANCE HEAD ON A POLE TOP, 1- 1/4"
ITEM 234A, SERVICE ENTRANCE HEAD ON A POLE TOP, 2"

1. **Description.** This item will consist of furnishing and installing on top of a street light pole a pole cap which has been fitted with a conduit raceway on which a service entrance head is installed. The completed unit (pole cap, conduit, and weatherhead) will be used in the transition from underground distribution to aerial distribution in which cable from the base of the pole to the aerial distribution wires will be accommodated.
2. **Material.** The pole cap must be a cast iron pole cap meeting the requirements of the pole top described in Material Specification 1447 for the pole size of intended use. The conduit raceway must be a one foot length of galvanized rigid steel conduit of sizes 1 1/4", 1 1/2", or 2", as indicated, and which has been reamed to remove burrs and sharp edges. The service entrance head must be the equivalent of a set screw entrance fitting manufactured by the Appleton Electric Company Catalog Number EF-125 for 1 1/4" conduit, EF-150 for 1 1/2" conduit and EF-200 for 2" conduit.
3. **Assembly.** A hole must be drilled axially centered through the pole cap to accommodate the specified size of the conduit. The conduit must be welded to the cap with a continuous weld so that the threaded end of the conduit will extend three inches (3") above the top of the pole cap for attachment of the service entrance head.
4. **Installation.** The unit must be installed on the top of the pole at the location shown on the plans. The pole cap, conduit, and entrance head must be painted. This will not constitute a separate pay item.
4. **Basis of Payment.** This item will be paid for at the contract unit price each for a SERVICE ENTRANCE HEAD ON A POLE TOP" of the size conduit indicated and for the size of pole stated on the construction plans installed in place and painted will be considered payment in full for this installation.

MATERIAL SPECIFICATION
1447 1462

DRAWING
11420-A

August 14, 2006

ITEM 235, CONDUIT RISER UP POLE 2"
ITEM 236, CONDUIT RISER UP POLE 3"

1. **DESCRIPTION** - This item will consist of furnishing and installing a conduit riser topped with a weatherproof service head of the size indicated at the location shown on the plans and attached to an embedded steel pole, for the purpose of enclosing electric cables which will extend from an underground facility to the top of the pole at which point the conductors may be connected to aerial conductors or to a device located near the top of the pole.
2. **MATERIAL** - The material must meet the requirements of Material Specification 1462 for Rigid Steel Conduit, Zinc Coated.
3. **SERVICE RISER** - The galvanized rigid steel conduit riser twenty-five (25) feet long threaded at both ends must be connected at its lower end by means of a conduit coupling to a large radius elbow installed under a separate pay item. The conduit will be secured to the pole by means of three-quarter inch stainless steel banding installed at five foot intervals up the pole starting at 3 feet above grade. A service entrance head of the nominal size of the conduit must be securely attached to the upper end of the conduit. The riser will be wiped clean of dirt and foreign materials before painting, and must be painted with one coat of exterior enamel of the color specified. The complete cost of painting must be included in this item, and will be considered incidental to the installation of the riser.
4. **BASIS OF PAYMENT** - This work will be paid for at the contract unit price each for a CONDUIT RISER UP POLE, which will be payment in full for furnishing and installing the riser complete in place.

MATERIAL SPECIFICATION
1462

October 1, 1986

ITEM 237, CIRCUIT BREAKER, 1-POLE, 50 AMPERE, 600 VOLT IN STREET LIGHT CONTROLLER

ITEM 237A, CIRCUIT BREAKER, 2-POLE, 50 AMPERE, 600 VOLT IN STREET LIGHT CCONTROLLER

ITEM 238, CIRCUIT BREAKER, 1-POLE, 70 AMPERE, 600 VOLT IN STREET LIGHT CONTROLLER

1. **Description.** This item will consist of furnishing and installing a single pole or double pole thermal-magnetic circuit breaker in an existing arterial street light controller at the designated location creating a controlled power source to supply a proposed traffic signal controller or other electrical device or circuit.
2. **Material.** The material of the circuit breaker must meet the requirements of Specification 1428.
3. **Installation.** The circuit breaker must be mounted on a 3/8" thick phenolic linen base bakelite panel 3" x 8" which will be attached on the inside of the lower left hand side of the controller cabinet with 4-1/4"-20x7/8" brass screws in holes which will be drilled and tapped into the side of the cabinet for this purpose. The ends of any screws protruding through the side of cabinet wall must be filed or ground off flush with the face of the cabinet. The bakelite panel shall be set out from the wall of the controller cabinet using four 1/4" bakelite spacer washers, one at each mounting screw position.

The line side terminal of the circuit breaker must be connected to one of the line side terminals of the main circuit breaker with a 1/C - #4 - 600V - 90 degree C. - insulated copper cable trained around the cabinet in a neat and workman like manner. This cable will be a part of the installation of the circuit breaker and will not be a separate pay item. The installation and connection of the load side cables servicing the traffic signal controller will be a part of the installation of service cable and not a part of the installation of the circuit breaker.

4. **Basis of Payment.** This item will be paid for at the contract unit price each for a **CIRCUIT BREAKER IN STREET LIGHT CONTROLLER** complete in place which will constitute payment in full for furnishing, installing and making line side connections of the circuit breaker.

MATERIAL SPECIFICATION
1428

March 21, 1995

ITEM 239, FUSE, IN LINE, 10 AMPERES

1. DESCRIPTION.

This item will consist of furnishing and installing an in-line fuse to isolate faults in street light fixtures from the branch lighting circuit.

2. MATERIAL.

The material to be used is a fast acting fuse (type KTK or equal) rated for this application; installed in a water-tight, in-line fuse holder equal to a type "HEB" as manufactured by Buss Fuse Company.

3. INSTALLATION.

The incoming and outgoing branch circuit wires must be inserted into the barrel of the fuse holder and crimped with a burndy hypress of the proper size. The pole wire must be similarly connected to the other end. Both connections must be taped with a vinyl all-weather tape to insure isolation of the electrical connection. The fuse must be inserted and the fuse holder properly closed.

4. BASIS OF PAYMENT.

This work will be paid for at the contract unit price for an in-line fuse.

MATERIAL SPECIFICATION
1464

April 16,2001

ITEM 240, SERVICE INSTALLATION 100 AMP
ITEM 241, SERVICE INSTALLATION 200 AMP

1. **Description.** This work will consist of furnishing and installing a service on a Commonwealth Edison Company wood pole for either a 120 volt traffic signal service installation, or for a 240 volt street lighting service installation per City of Chicago Drawing Number 11925.

The 100 ampere installation can be used for either a 120 volt or 240 volt service. The 200 ampere installation can be used only for the 240 volt service.

2. **Service Junction Cabinet.** The cabinet must be cast from aluminum and meet all the requirements of standard drawing 11922. Its dimensions must not exceed eight (8) inches in width, eighteen (18) inches in height and nine (9) inches in depth, and it must be weatherproof. It must contain a two (2) pole disconnecting device, with bridge contacts and barrier strip, subject to approval. The disconnecting device must be rated for 200 amps and 600 volts. A suitable ground lug, subject to approval, to accommodate a 1/C #2, 1/C #4, 1/C #2/0 or 1/C #1/0 AWG stranded copper conductor must be provided. Any alternate cabinets which are considered equal to this may be considered.
3. **Cable Grip.** A one and one quarter inch (1 1/4") cable grip fitting must be installed at top of cabinet to accommodate a 3/C #2, #4, #2/0 or #1/0 AWG service cable.
4. **Service Riser.** A two (2) inch galvanized rigid steel conduit riser terminated at the bottom with a galvanized rigid steel, large radius, conduit elbow must be installed by the contractor on the Commonwealth Edison Company service pole as shown on City of Chicago Drawing Number 11925. The top of the riser must terminate in the service junction cabinet and the end of the elbow must connect to the horizontal conduit lateral leading to the control cabinet. Payment for the riser, elbow, and attachments must be included in the price bid for the complete Commonwealth Edison Company pole service junction unit. The laterals will be paid for separately under different pay items.
5. **Cable.** A sufficient length of three (3) conductor service entrance cable must be coiled at the top of the box in order to reach the Commonwealth Edison Company secondary wires for connection. The three (3) conductor service entrance cable must meet the requirements of Bureau of Electricity Specification Number 1457, or an approved equal. The black and red conductors must be connected to the disconnect device and the white conductor to the ground lug, for the 240 volt street lighting service installation. The black conductor must be connected to the disconnect, and the white to the ground lug, for the 120 volt traffic signal service installation. The red conductor must be taped and coiled inside box for future use.

6. **Cables in Service Riser.** Cables must extend continuously from the load side of the disconnect device, down the riser and elbow, and in the conduit lateral to the control cabinet. Payment for cables in riser and elbow will be included in separate pay items, and will not be considered as part of this pay item.

7. **Basis of Payment.** This work will be paid for at the contract unit price EACH for SERVICE INSTALLATION 100 AMPERE or SERVICE INSTALLATION 200 AMPERE, which price must be payment in full for furnishing and installing the service equipment complete. Any charges by the utility company to provide electrical service to the service installation will be paid for by the contractor.

MATERIAL SPECIFICATION
1457
1462

DRAWING
11922
11925

ITEM 242, CABLE, AERIAL, 3-1/C #4, WITH MESSENGER
ITEM 243, CABLE, AERIAL, 3-1/C-#2, WITH MESSENGER

1. **Description.** This item will consist of furnishing and installing an electrical cable, designed for and designated 'self supporting', consisting of two insulated color coded conductors spirally wrapped around one bare conductor. The cable will be strung between poles and attached to cable supports on these poles. The conductors will be connected to other wires or cables for the purpose of extending electric power from a Commonwealth Edison Company power pole to a City electric power pole as shown on the plans, as specified herein, or as directed by the Commissioner.
2. **Material.** The material must meet the requirements of Material Specification 1432.
3. **Installation Requirements.** The cable must be installed with a nominal tension adequate to produce sag of approximately 9 inches in a 60 ft. span. The cable must be attached to a line pole by means of a suitable clamp which holds the neutral conductor. The clamp must be supported by a clamp support device appropriate for the type of pole in use. The cable must be dead ended at the City pole, and must be dead ended at the Commonwealth Edison Company pole. Ten feet of additional cable must be coiled and attached to the Commonwealth Edison Company pole for final connections.
4. **Method of Measurement.** This work will be measured per lineal foot of cable installed.
5. **Basis of Payment.** This work will be paid for at the contract unit price per foot for furnishing and installing "CABLE, AERIAL, WITH MESSENGER" of the size indicated on the plans, which will be payment in full for furnishing and installing this cable, including cable clamps and dead end devices, which will be considered incidental to this item.

MATERIAL SPECIFICATION
1432

October 6, 2006

ITEM 244, WIRE, AERIAL, 1/C - NO. 6

1. **Description.**

This item will consist of furnishing and installing electrical wire strung between poles, attached to secondary wire racks on the poles, and connected to other wires or cables for the purpose of extending street lighting circuits as shown on the plans, as specified herein, or as directed by the Commissioner.

2. **Materials.**

The material must be single conductor #6 AWG aerial wire meeting the requirements of Material Specification 1441 for medium hard-drawn copper aerial wire.

3. **Installation Requirements.**

The wire must be installed with a nominal tension of 150 pounds to produce a sag of approximately 6 inches in an 85 foot span. Through wire must be attached to the side of the insulator away from the pole and secured with four turns of a tie wire close wrapped. Dead- ends must have two wraps of the wire around the insulator and then six close turns of the wire around the wire under tension, or by the use of an approved automatic bail dead-end device. Where necessary, wire lengths will be spliced together by means of an approved automatic wedge-type, straight line splicing device. Each splice must be given two wrappings of friction tape and coated with insulating paint. Connections to lamp leads, or other conductors not under tension, must be made with approved split-bolt connectors and wrapped with three layers of half-lapped of plastic, electrical tape and coated with insulating paint.

4. **Basis of Payment.**

This work will be paid for at the contract unit price per lineal foot for WIRE, AERIAL, 1/C #6, installed in place and connected, which price will be payment in full for furnishing, installing and connecting #6 AWG aerial line wire in place.

MATERIAL SPECIFICATION
1441

October 1, 1986

ITEM 245, ELECTRIC CABLE IN CONDUIT , 3/C #14 SHIELDED, FOR RAILROAD PREEMPT

1. **DESCRIPTION.** This work will consist of furnishing and installing electric cable as specified. The cable will be installed in underground conduit. The cable will be used for interconnecting railroad signals to intersection traffic control equipment.
2. **MATERIAL.** The interconnect cable will be a three (3) conductor #14 AWG copper cable. Each conductor will be insulated with .016 inch polyethylene. Insulation will be black, blue, and red. Each conductor must be individually shielded with #36 AWG tinned copper braid with an 85% overlap. The jacket will be black .045 inch polyethylene or polyvinylchloride. As an alternative, communication cable may be used. The communication cable will be three pair #16 AWG, and must meet the requirements of Sections 873 and 1076.04 of the Illinois Department of Transportation's "Standard Specifications for Road and Bridge Construction". If the communication cable is used, each pair will be utilized as a single conductor.
3. **CONSTRUCTION METHOD.** All cable must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced at no cost to the City.

The cable will be terminated at one end in a traffic signal controller cabinet. The cable will be terminated at the other end in the railroad signal enclosure. The cable must be installed in underground conduit. If the cable runs through handholes or manholes, it must be properly identified with permanent tags.

The cable must be pulled with a minimum of friction. Lubricants will be used to facilitate installation if deemed necessary. Bends in the cable must conform to the recommended minimum radius as outlined in the National Electric Code. No splicing of the cable will be allowed.

Cable passing through manholes must be trained and racked around the sides of the manhole into a permanent position. If racks are non-existent or in poor condition, the contractor must install racks. The material must be approved by the resident engineer. Any material and labor involved in training and racking the cable will be considered incidental to the cost of this pay item.

Cable in a handhole will have at least five feet of slack and cable in a manhole will have at least ten feet of slack.

The copper braid shields from each conductor, or shields from each pair with the drain wire if communication cable is used, will be bundled and connected to AC

minus(-) in the traffic signal cabinet. At the location of the railroad equipment termination, the shields must be stripped away from the connections to prevent shorting the conductors. Wiring must be as shown in IDOT's Standard Drawing 857006, "Supervised Railroad Interconnect Circuit".

4. **METHOD OF MEASUREMENT.** The length of cable furnished and installed will be measured as the entire length of cable; measurements being taken both vertically and horizontally, plus any slack in manholes or handholes.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for ELECTRIC CABLE 3/C #14, SHIELDED. Such price will be payment in full for furnishing, installing, terminating, and testing the cable, and will include all material, labor, and incidentals necessary to complete the work and complete an operating and working circuit as per the plans.

ITEM 246, TWIST-LOCK PHOTOCELL

1. **DESCRIPTION.** This item will consist of furnishing and installing a twist-lock photocell receptacle in a luminaire housing and furnishing and installing a twist-lock photocell. The photocell will be used to control the dusk-to-dawn operation of a street light circuit.
2. **MATERIAL.** The material of the photocell must meet the requirements of Material Specification 1471.
3. **INSTALLATION.** The photocell receptacle will be mounted to the top of the housing of a street light luminaire. The top of the housing will have a knockout intended for that purpose. Once the receptacle is properly installed, the photocell unit can be inserted. Proper operation of the photocell circuit must be verified before the installation can be considered complete.
4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed, complete with photocell unit and receptacle.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for a TWIST-LOCK PHOTOCELL, which will be payment in full for furnishing and installing the photocell complete in place. Cable from the photocell receptacle to the street light controller will be paid for as a separate item.

MATERIAL SPECIFICATION
1471

April 3, 2003

ITEM 247, ELECTRIC CABLE IN CONDUIT, 1/C #6
ITEM 250, ELECTRIC CABLE IN CONDUIT, 1/C #4
ITEM 251, ELECTRIC CABLE IN CONDUIT, 1/C #2
ITEM 252, ELECTRIC CABLE IN CONDUIT, 1/C #1/0
ITEM 254, ELECTRIC CABLE IN CONDUIT, 1/C #2/0

1. **Description.** This work will consist of furnishing and installing electric cable as specified. The cable will be installed in conduit underground.
2. **Material.** The cable must meet all requirements of Material Specification 1534 of the Chicago Department of Transportation, Division of Electrical Operations.
3. **Construction Method.** All cables must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced.

The cable must be pulled into the conduit with a minimum of dragging on the ground or pavement. This will be accomplished by means of reels mounted on jacks or other suitable devices located for unreeling cable directly into duct. Lubricants must be used to facilitate installation if deemed necessary by the contractor.

Bends in the cable will conform to the recommended minimum radii as outlined in the National Electric Code.

Cable passing through manholes must be trained and racked around the sides of the manhole into a permanent position. If racks are non-existent or in poor condition, the contractor must install racks. The material must be approved by the resident engineer. Any material and labor involved in training and racking the cable will be considered incidental to the cost of this pay item.

Where cable runs continue from manhole to manhole without tapping within a light pole, they will be continuous without splices unless authorized by the resident engineer.

All wire or cable in the distribution panels and control cabinets must be properly trained and have sufficient slack provided for any rearrangement of equipment or future additions. There must be at least two feet of slack in a street light pole base or street light controller base. A handhole must have at least five feet of slack and a manhole at least ten feet of slack.

4. **Method of Measurement.** The length of cable furnished and installed will be measured as the length of conduit plus three feet for cable entering and leaving a

light pole or street light control cabinet, plus any slack in manholes or handholes.

5. **Basis of Payment.** This work will be paid for at the contract unit price per lineal foot for ELECTRIC CABLE IN CONDUIT of the size specified. Such price will be payment in full for furnishing, installing, and testing the cable, and will include all material, labor, terminations, and incidentals necessary to complete the work as per the contract plans.

MATERIAL
1534

Item 247, 250, 251, 252, 254
Page 2

August 14, 2006

ITEM 248, INSULATED GROUND CABLE IN CONDUIT 1/C #8

1. **Description.** This item will consist of furnishing, connecting and testing the Number 8, A.W.G. insulated ground cable to provide continuous grounding for the lighting system, all as shown on the plans or as ordered by the Commissioner and as specified herein.
2. **Material.** The cable must meet the requirements of Material Specification 1534.
3. **Construction Methods.** The cable will be used to ground all steel conduits and sleeves entering manholes and at light poles where steel conduit enters and leaves the base, both conduits will be bonded to the ground lug using this cable.

The insulated ground cable furnished and installed hereunder must effectively ground all light poles, luminaires, steel conduits and fittings, and junction boxes to the ground bus.

Cable must be racked in manholes and handholes.

4. **Method of Measurement.** The actual length of ground cable furnished and installed in the work will be measured in lineal feet, including the length of slack determined by the Commissioner to be necessary for making proper connections. No allowance will be made for waste ends of cable which may have to be cut off for making splices or connections, nor will any allowance be made for bonding the cable as required.
5. **Basis of Payment.** The work under this item will be paid for at the Contract unit price per lineal foot for INSULATED GROUND CABLE IN CONDUIT 1/C #8 measured as herein specified. Any terminations or bonding will be considered incidental to this pay item.

MATERIAL SPECIFICATION
1534

August 14, 2006

ITEM 249, ELECTRIC CABLE IN CONDUIT, TRIPLEX 2 1/C NO.6,1/C NO.8

1. Description This work will consist of furnishing and installing electric cable that is triplexed. The cable must be rated at 600 volts and must consist of two number 6 conductors and one number 8 conductor. The cable will be installed in conduit underground.
2. Material The cable must meet all requirements of Material Specification 1534 of the Bureau of Electricity, City of Chicago.
3. Construction Method All cables must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced.

The cable must be pulled into the conduit with a minimum of dragging on the ground or pavement. This will be accomplished by means of reels mounted on jacks or other suitable devices located for unreeling cable directly into duct. Lubricants must be used to facilitate installation if deemed necessary by the contractor.

Bends in the cable will conform to the recommended minimum radii as outlined in the National Electric Code.

Cable passing through manholes must be trained and racked around the sides of the manhole into a permanent position. If racks are non-existent or in poor condition, the contractor must install racks. The material must be approved by the resident engineer. Any material and labor involved in training and racking the cable will be considered incidental to the cost of this pay item.

Where cable runs continue from manhole to manhole without tapping within a light pole, they will be continuous without splices unless authorized by the resident engineer.

The cable installation must be color coded so that each lead of all circuits may be easily identified and lighting units connected to the proper leg as indicated on the plans. The equipment grounding conductor (no. 8) must be color coded green.

All wire or cable in the distribution panels and control cabinets must be properly trained and have sufficient slack provided for any rearrangement of equipment or future additions.

There must be at least three feet of slack in a street light pole base or street light controller base. A handhole must have at least five feet of slack and a manhole at

least ten feet of slack.

4. Method of Measurement The length of triplex cable furnished and installed will be measured as the length of conduit plus three feet for cable entering and leaving a light pole or street light control cabinet, plus any slack in manholes or handholes.
5. Basis of Payment This work shall be paid for at the contract unit price per lineal foot for ELECTRIC CABLE IN CONDUIT, TRIPLEX, 2 1/C NO.6, 1 1/C NO.8. The price will be payment in full for furnishing, installing, and testing the cable, and will include all material, labor, terminations, and incidentals necessary to complete the work as per the contract plans.

MATERIAL

1534

ITEM 253, PULL AND REINSTALL ELECTRIC CABLE FROM CONDUIT

1. Description.

This work will consist of removing an existing electric cable from a conduit and then reinstalling it in an existing, or a new, conduit. The cable may be pulled back to an existing manhole or removed completely and stored. The cable must be reconnected at its original or new location. The conduit must be cleaned and swabbed prior to reinstallation of cable.

2. Basis of Payment.

This work will be paid for at the contract unit price per lineal foot for "Pull and Reinstall Electric Cable from Conduit," which price will be payment in full for removing, storing and reinstalling the electric cable complete. No additional payment will be allowed for reconnecting the cable. If two or more cables in a conduit are to be removed and reinstalled, each cable will be measured for payment separately. Cleaning of conduit will be paid for as a separate pay item.

August 14, 2006

ITEM 255, CABLE SPLICE, #6
ITEM 256, CABLE SPLICE, TRIPLEX CABLE (2 #6, 1 #8)
ITEM 259, CABLE SPLICE, #1/0
ITEM 260, CABLE SPLICE, #2/0

1. **DESCRIPTION.** This work will consist of splicing cables of various sizes as specified.
2. **MATERIAL.** Material must meet the requirements of Section 800 and Section 1066.06 of the Standard Specifications. All materials must be approved by the Engineer before implementation.
3. **CONSTRUCTION.** Splicing methods must meet the requirements of Section 1066.06 of the Standard Specifications. Each splice must be electrically sound, insulated as well as or better than the original cable, weatherproofed as well as or better than the original cable, and mechanically strong. Splices must be able to be un-made without destroying the cable. Splicing methods and materials must be approved by the Engineer before implementation.
4. **MEASUREMENT.** Each single conductor spliced to another single conductor will count as one unit, except for triplex cable where three splices will count as one unit for payment.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for EACH splice unit, as described in the Measurement Section, which payment will be in full for the splice.

August 14, 2006

ITEM 257, CABLE SPLICE IN CECO MANHOLE, #4
ITEM 258, CABLE SPLICE IN CECO MANHOLE, #2

1. **DESCRIPTION.** This work will consist of splicing cables of various sizes to CECO cables in a manhole.
2. **MATERIAL.** Material will meet the requirements of Section 800 and Section 1066.06 of the Standard Specifications. All materials must be approved by the Engineer before implementation.
3. **CONSTRUCTION.** Splicing methods must meet the requirements of Section 1066.06 of the Standard Specifications. Each splice must be electrically sound, insulated as well as or better than the original cable, weatherproofed as well as or better than the original cable, and mechanically strong. Splices must be able to be un-made without destroying the cable. Splicing methods and materials must be approved by the Engineer before implementation.
4. **MEASUREMENT.** Each single conductor spliced to another single conductor will count as one unit.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for EACH splice unit, as described in the Measurement Section, which payment will be in full for the splice, including all necessary material and labor.

September 19, 2006

ITEM 264, TRANSCLOSURE, 100KVA, PAD MOUNTED

1. **DESCRIPTION.** This work will consist of furnishing and installing a 100KVA transclosure, single phase, with 120 and 240 volt secondary breakers. The transclosure will be mounted on a concrete pad foundation.
2. **MATERIAL AND ASSEMBLY.** The transclosure must meet all the requirements of Material Specification 1565. The circuit breakers, single-pole and two-pole, must meet the requirements of Material Specification 1428. The photo-cell must meet the requirements of Material Specification 1471 for the button type. Ground rods must meet the requirements of Material Specification 1465. The grounding wire must be bare copper 1/0 cable.
3. **INSTALLATION.** The transclosure must be set on the concrete pad foundation and secured to the foundation using appropriate concrete anchors.

For grounding, bare copper wire, #1/0 AWG, must be attached from ground lugs in the cabinet to the grounding clamps on each ground rod, as shown on Standard Drawing 680. Ground rods must be installed as shown on Standard Drawing 680.

The installation of line cables and branch circuit cables will be performed in a neat and workmanlike manner with all cable trained around the cabinet, secured to the proper terminals and identified either by tagging of the cables, or by identification of the branch breakers, all as part of the transclosure installation and not as a separate pay item.

The lighting circuits will be placed in operation as soon as practicable with the Contractor being charged for the energy until the circuits are accepted by the City of Chicago, Bureau of Electricity. All circuits must be demonstrated to work safely and satisfactorily before acceptance.

4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a TRANSCLOSURE, 100KVA, PAD MOUNTED, and will be payment in full for furnishing and installing the transclosure, securing it to the foundation, properly wiring the primary and secondary voltages, and installing proper grounding.

MATERIAL SPECIFICATION
1428 1565 1471 1465

DRAWING
680 891 904

ITEM 265, CONTROLLER, STREET LIGHT, RESIDENTIAL, 240 VOLT

1. **DESCRIPTION.** This work will consist of furnishing and installing a cabinet onto a wood CECO pole. The cabinet will contain various electro-mechanical devices to automatically control residential street lighting circuits, and to provide protection for the equipment so controlled. The electrical control circuit will consist of a 60 amp main breaker with two 30 amp branch breakers.
2. **MATERIAL AND ASSEMBLY.** The cabinet, panel, and circuitry must meet the requirements of Material Standard 1535 and Standard Drawing 955. The service cable must meet the requirements of Material Specification 1457.
3. **INSTALLATION.** The cabinet must be mounted as shown on Standard Drawing 11925, with the exception that the millbank is to be replaced with the residential control cabinet. The fiberglass cabinet has four mounting holes in the back; two top and two bottom. The cabinet must be bolted to two (2) galvanized steel sheets; one at the top of the cabinet and one at the bottom. Each sheet must be sized to have two extensions which stick out beyond the sides of the cabinet and can be formed so that lag bolts can be inserted through the steel sheet into and through the wood pole. The steel sheets and the lag bolts must be of sufficient strength to safely mount the cabinet. This work will include mounting the cabinet to the CECO pole. This work will include all steel conduit mounted to the CECO pole. The service cable from the controller to the CECO secondary must be terminated at the controller and spliced at the other end to the CECO secondary. The street light cable must be terminated on the load side of the controller.

The lighting circuit must be placed in operation as soon as practicable with the Contractor being charged for the energy until the circuits are accepted by the City of Chicago, Bureau of Electricity.

4. **METHOD OF MEASUREMENT.** This work must include all conduit mounted to the pole, the controller with electrical components, all mounting hardware, the service cable from the controller to the CECO secondary, all cable terminations, and cable splicing. The street light cable is not included, nor is the conduit elbow adjacent to the pole.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a CONTROLLER, STREET LIGHT, RESIDENTIAL, 240 VOLT, and will be payment in full for furnishing and installing the controller complete in place.

MATERIAL SPECIFICATION

DRAWING

1535 1457

955 11925

September 20, 2006

Item 265

Page 2

ITEM 266, CONTROLLER, STREET LIGHT, RESIDENTIAL, 120 VOLT

1. **DESCRIPTION.** This work will consist of furnishing and installing a cast aluminum cabinet onto a wood CECO pole. The cabinet will contain various electro-mechanical devices to automatically control residential street lighting circuits, and to provide protection for the equipment so controlled.
2. **MATERIAL AND ASSEMBLY.** The aluminum cabinet must meet the requirements of Material Specification 1473 and Standard Drawing 893. The circuitry must meet the requirements of Standard Drawing 881. The service cable must meet the requirements of Material Specification 1457.
3. **INSTALLATION.** The cabinet must be mounted as shown on Standard Drawing 11973. This work will include all steel conduit mounted to the CECO pole. The service cable from the controller to the CECO secondary must be terminated at the controller and spliced at the other end to the CECO secondary. The street light cable must be terminated on the load side of the controller.

The lighting circuit must be placed in operation as soon as practicable with the Contractor being charged for the energy until the circuits are accepted by the City of Chicago, Bureau of Electricity.

4. **METHOD OF MEASUREMENT.** This work must include all conduit mounted to the pole, the controller with electrical components, all mounting hardware, the service cable from the controller to the CECO secondary, all cable terminations, and cable splicing. The street light cable is not included, nor is the conduit elbow adjacent to the pole.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a CONTROLLER, STREET LIGHT, RESIDENTIAL, 120 VOLT, and will be payment in full for furnishing and installing the controller complete in place.

MATERIAL SPECIFICATION
1473 1457

DRAWING
881 893 11973

September 20, 2006

ITEM 267, SERVICE CONNECTION TO CECO LINE

1. **DESCRIPTION.** This work will consist of providing a service connection from City cable to a Commonwealth Edison secondary cable. For an aerial service, this will be on a wood pole. For an underground service, this will be in a CECO manhole.
2. **INSTALLATION.** This work will consist of splicing or terminating City service cable to a Commonwealth Edison secondary cable, as directed by the Engineer. The contractor must obtain permission from Edison for the service at the required location. The contractor will inform Edison of the load required. Edison will make the connections, unless Edison gives the contractor permission to make the connections. Any costs associated with the connection will be borne by the contractor.
3. **METHOD OF MEASUREMENT.** The service connection will be counted as one unit, and will include all labor and material needed to make a successful service connection.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each SERVICE CONNECTION, which payment will be in full for providing all material and labor to make the necessary connections.

DRAWING
11925

May 21, 2001

ITEM 268, SERVICE CABLE, 3/C #2

1. **DESCRIPTION.** This work will consist of providing service cable from one wood pole to another, for the purpose of connecting a City service box or street light controller mounted on a Commonwealth Edison pole to a Commonwealth Edison secondary cable located on another pole.
2. **MATERIAL.** The cable must meet the requirements of Material Specification 1457.
3. **INSTALLATION.** This work will consist of providing a sufficient length of cable and installing the cable as shown on the plans or as directed by the Engineer.
4. **METHOD OF MEASUREMENT.** The cable will be measured per lineal foot, and will include only horizontal distances. No compensation will be made for cable sag or vertical distances.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for SERVICE CABLE, 3/C #2, which payment will be in full for providing the cable, all labor and any material needed to attach the cable to the poles.

September 21, 2006

ITEM 270, WIRE, TEMPORARY AERIAL, 2-1/C - NO. 8, ALUMINUM

1. **DESCRIPTION.**

This item will consist of furnishing and installing electrical wire strung between poles, or between luminaries, connected to other wires or cables for the purpose of extending street lighting circuits as shown on the plans, as specified herein, or as directed by the Engineer.

2. **MATERIALS.**

The cable will consist of two insulated aluminum wires twisted together. The aluminum conductor will be #8 solid conductor. The aluminum will be Class B compressed aluminum 1350-H19 meeting the requirements of ASTM B231 or B786. The insulation will be extruded cross-linked polyethylene (XLPE), 60 mils in thickness. The insulation will be black in color to be UV resistant. Cable will be rated for 90° Centigrade wet or dry. Cable must be manufactured and tested in accordance with ICEA S-105-692. Cable that is deemed as equal may be substituted.

3. **INSTALLATION REQUIREMENTS.**

The wire must be installed with a nominal tension of 150 pounds to produce a sag of approximately 6 inches in an 85 foot span. Wire must be attached to the side of the pole or to a luminaire. Any attachment must not damage the pole or luminaire. Where necessary, wire lengths will be spliced together by means of an approved automatic wedge-type, straight line splicing device. Each splice must be given two wrappings of friction tape and coated with insulating paint. Connections to lamp leads, or other conductors not under tension, must be made with approved split-bolt connectors and wrapped with three layers of half-lapped of plastic, electrical tape and coated with insulating paint.

4. **BASIS OF PAYMENT.**

This work will be paid for at the contract unit price per lineal foot for WIRE, TEMPORARY AERIAL, 2-1/C #8, ALUMINUM, installed in place and connected, which price will be payment in full for furnishing, installing and connecting #8 AWG aerial line wire in place. Any splicing, terminations, attachments, etcetera, will be considered incidental to this item.

September 20, 2006

ITEM 280A, AVIATION WARNING LIGHT, LED

1. **DESCRIPTION.** This item will consist of furnishing and installing an aviation warning light on a street light pole or mast arm attached to a street light pole and connecting the unit to either an underground cable distribution system or an aerial wire distribution system at the location shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The luminaire must be an FAA compliant type L810 red obstruction light. The light source for the warning light must be LEDs (light emitting diodes). The LEDs will emit a constant red light, which must be visible from above the light fixture from any direction. The unit must be fully self-contained with a self contained wiring compartment for splicing. The unit must be moisture proof and be able to withstand the vibrations associated with any light fixture mounted 20 to 30 feet above the ground. The fixture must be able to operate within the temperature range of -67° Fahrenheit to +131° Fahrenheit. A threaded (NPT) one (1) inch bottom hub must be provided for mounting and for a wireway. The unit will operate at 120 Volts a.c.. The fixture must have a five (5) year warranty against defects due to design, material, or workmanship. Pole wire meeting Material Specification 1351 will be used to connect the light to the field cable at the bottom of the pole. In-line fuses must meet Material Specification 1464.
3. **INSTALLATION.** The luminaire must be securely installed on the pole or mast arm. If installed on top of a pole, the pole cap must be adapted to accept the hub. The pole cap must have a one inch hole drilled through the middle. A one inch galvanized steel pipe must be welded to the cap. The weld must be smooth and free from irregularities on the inside so that wire will not be damaged. The pipe will be threaded to accept the luminaire hub. If installed on an arm, a one inch hole must be drilled in the arm at the appropriate location. A one inch galvanized steel pipe must then be welded to the arm. The luminaire will then be screwed onto the pipe. The pipe must be sufficiently long to be threaded so that the hub may be fully secured. Three (3) pole wires must be attached to the fixture and fed through the pole. At the bottom of the pole, one pole wire will be attached to the pole grounding lug. The “hot” lead will have an in-line fuse, before being spliced to the field cable. The neutral will be spliced to the field cable.

For an aerial distribution system, the wiring must extend through the pole to the mast arm and exit from the mast arm through the grommet in the hole provided for this purpose, and extend further forming a drip loop and connect with aerial circuit wires. Connection to the aerial circuit wires must be made with a split bolt type pressure connector for a No. 6 solid copper wire and the connection so formed must be wrapped with two layers of an approved electrical tape. Sufficient

wire must be supplied to extend the wires outside of the pole through the access handhole to permit splicing work to be performed outside the pole.

All splice methods must be approved by the Engineer before implemented. All splices, tapes and grounding connections must be inspected by the Commissioner's authorized representative before wires are permanently trained in the light pole.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete. All wiring to the underground feeder cable, including splices, will be included in this measurement.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a AVIATION LIGHT, LED, which will be payment in full for furnishing, installing, connecting and testing the unit complete in place.

MATERIAL SPECIFICATION
1351 1464

September 20, 2006

Item 280A
Page 2

ITEM 299, LUMINAIRE, BLUE LED BEACON

1. **DESCRIPTION.** This item will consist of furnishing and installing a LED beacon on a bridge structure as shown on the plans or as directed by the engineer.
2. **MATERIAL.** The body of the luminaire will be cast aluminum. A ¾” hub (NPT) must be at the bottom. This will act as a connection for the conduit and as the wireway. The refractor will be blue glass. The overall dimensions of the fixture must be approximately 12” in length by 6” in diameter. The refractor should be approximately 6” in length and 6” in diameter. The refractor must have a safety wire or other device that will keep it attached to the fixture when the fixture is opened.

The refractor must direct the light in the desired pattern. The light pattern will result in a viewing angle on the horizontal of 180° and a viewing of 20° on the vertical. The majority of the light must emit at these angles creating a “one-sided” light output.

The luminaire will have an array of blue LEDs with an output of not less than 260 lumens. The fixture will operate on 120 Volts A.C.. Maximum energy usage must not be greater than 25 watts. The luminaire will be designed to operate continuously without flashing. The entire LED unit with drivers must be easily removed and replaced as a unit without the use of tools.

Before construction proceeds, the unit proposed to be used must be approved by the Engineer. If an alternate is deemed to be equal to the luminaire specified, the engineer may accept it. The engineer’s decision will be final.

3. **WARRANTY.** The manufacturer must warranty the LED to be first class material throughout. The manufacturer will be responsible for any LED failure during normal and proper use within five (5) years after the date of installation. The repair or replacement of the fixture will be at the expense of the manufacturer. There will be no cost to the City.
4. **INSTALLATION.** The luminaire must be mounted to a T conduit, which in turn will be connected into the conduit system. The luminaire must be properly oriented to provide the proper light pattern. The fixture and the conduit must be secured to the structure so as to provide a secure attachment so that the fixture will not vibrate loose or be damaged during normal wear, including opening and closing the bridge. The wire must be terminated to the fixture and the entire unit made operational.

5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price per each for LUMINAIRE, BLUE LED BEACON, complete in place and operational, including the T conduit and any additional hardware, which will constitute payment in full for the furnishing and installing the luminaire and making wiring connections.

Item 299

Page 2

September 21, 2006

**ITEM 302, SIGNAL HEAD, POLYCARBONATE, 1-FACE, 3-SECTION,
ELEVATOR PLUMBIZER MOUNTED**

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic signal head of the desired type mounted on a street light mast arm using an elevator plumbizer device, as shown on Drawing Number 834.
2. **MATERIAL.** The traffic signal head must meet the requirements of Material Specification 1493 for an LED traffic signal 3 -section, 1-face signal head with polycarbonate housing. The cable must meet Material Specification 1475. The elevator plumbizer must be similar to that manufactured by Traffic Control Technologies, Inc., Catalog Number 0700229 for installation on a two inch (2") pipe mast arm, or an equivalent.
3. **INSTALLATION.** The signal will be mounted with the elevator plumbizer, as shown on Drawing Number 834, between the red and yellow sections of a three section head.

The mast arm must have a 7/16" hole drilled through both sides of the arm to accept a 3/8" through-bolt to secure the elevator plumbizer.

This hole must be drilled one and seven-eighths inch (1 7/8") from the fixture end of the mast arm, at a 90 degree angle to the axis of the mast arm, and in a direction such that the axis of the hole will be horizontal when the mast arm is mounted in position on the pole.

The contractor must provide and install a length of flexible electrical cord meeting the requirements of Material Specification 1475. The cable will be of sufficient length to extend without strain or stress from the terminal strip in the "Green" section of the signal head to the terminal strip in the junction box mounted on the pole. Both ends of the cable length must be carefully stripped of six inches (6") of jacket and one inch of insulation, and each conductor properly tinned.

The service cable from the signal heads will enter the pole through the mounting bracket and enter the long sweep elbow to terminate by attachment to the terminal strip in accordance with the terminal strip connector schematic, Bureau of Electricity Drawing Number 12268-A.

4. **METHOD OF MEASUREMENT.** This item will be measured per each signal head unit installed and connected to the junction box.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for SIGNAL HEAD, ELEVATOR PLUMBIZER MOUNTED which price will be payment in full for furnishing and installing the conventional signal head, complete and operational.

MATERIAL SPECIFICATION
1475 1493

DRAWING
834 12268A

April 24, 2001

Item 302
Page 2

ITEM 303, SIGNAL HEAD, POLYCARBONATE, LED, 3-SECTION, BRACKET MOUNTED

ITEM 304, SIGNAL HEAD, POLYCARBONATE, LED, 4-SECTION, BRACKET MOUNTED

ITEM 305, SIGNAL HEAD, POLYCARBONATE, LED, 5-SECTION, BRACKET MOUNTED

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic signal head or combination of heads on a street light pole, a traffic signal pole, or a traffic signal post as shown on the plans, as specified herein, or as directed by the Engineer. Specific installations and configurations are shown on Drawing Numbers 834 and 835, entitled "Standard Traffic Signal Mounting Details".

The type of installation will be as indicated on the plans. The number of signal faces, the number of signal sections in each signal face, any dual-indication sections, and the method of mounting will be as indicated in the plans and in the standard drawings.

Each signal face must be pointed in the direction of the approaching traffic that it is to control and must be aimed to have maximum effectiveness for an approaching driver located at a distance from the stop line equal to the normal distance traversed while stopping.

During construction and until the installation is placed in operation, all signal faces must be hooded. The hooding material must be securely fastened so it will not be disturbed by normal inclement weather or wind.

2. **MATERIAL.** The traffic signal must meet the requirements of Material Specification 1493 for LED signals. The mounting brackets must meet the requirements of Material Specification 1495.
3. **INSTALLATION.** The signals must be mounted using pole mounting brackets banded to the pole with two strips of 3/4" stainless steel banding single wrapped, one at the top and one at the bottom of the brackets, each secured with a stainless steel banding clip. The banding and clips will be coated with a baked-on black finish. The mounting configuration connecting the signals to the mounting bracket must consist polycarbonate brackets specifically made for mounting signal heads to the side of poles, to create the designated structure. When the signals are to be mounted on a square pole or flat surface, the bracket used will be bolted to the flat pole or surface using 3/8" drive studs where permissible or using a 3/8" studs in a tapped hole.

The bottom mounting bracket must be accurately located to cover an opening 1"

in diameter, for cable entrance, drilled into the pole or standard at a calculated height to position the bottom signal face at a standard height of 10 feet, or a height indicated on the plans. The opening must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the signals are in operation.

Cable. The Contractor must provide and install a length of 8/C #16 AWG, as per Specification 1475, flexible electrical cord, medium duty, of sufficient length to extend without strain or stress from the terminal strip in the "Green" section of the signal head to the terminal strip in the junction box mounted on the pole. The number of conductors in the cord, and the color coding of the conductors, must be sufficient to match the requirements of the signal head being installed, and must be connected in accordance with Specification 1493. Both ends of the cable length must be carefully stripped of six inches (6") of jacket and one inch (1") of insulation, and each conductor properly tinned. The service cable from the signal heads must enter the pole through the bottom mounting bracket and enter the long sweep elbow to terminate by attachment to the terminal strip in the junction box in accordance with connector schematic, Bureau of Electricity Drawing Number 12268-A

- 4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
- 5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each ASIGNAL HEAD, POLYCARBONATE, LED, X-SECTION, BRACKET MOUNTED@, which price will be payment in full for furnishing and installing the signal head complete, including all necessary wiring.

MATERIAL SPECIFICATION	DRAWING
1475	834 12268a
1493	835 740
1495	741

April 16, 2001

**ITEM 306, SIGNAL HEAD, OPTICALLY PROGRAMMED, LED,1-FACE,
3-SECTION, BRACKET MOUNTED**

**ITEM 307, SIGNAL HEAD, OPTICALLY PROGRAMMED, LED,1-FACE,
4-SECTION, BRACKET MOUNTED**

**ITEM 308, SIGNAL HEAD, OPTICALLY PROGRAMMED, LED,1-FACE,
5-SECTION, BRACKET MOUNTED**

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic signal head or combination of heads on a street light pole, a traffic signal pole, or a traffic signal post as shown on the plans, as specified herein, or as directed by the Engineer. Specific installations and configurations are shown on Drawing Numbers 834 and 835, entitled "Standard Traffic Signal Mounting Details".

The type of installation will be as indicated on the plans. The number of signal faces, the number of signal sections in each signal face, any dual-indication sections, and the method of mounting will be as indicated in the plans and in the standard drawings.

Each signal face must be pointed in the direction of the approaching traffic that it is to control and must be aimed to have maximum effectiveness for an approaching driver located at a distance from the stop line equal to the normal distance traversed while stopping. The signal face must be programmed in accordance with the visibility requirements of the Traffic Engineer.

During construction and until the installation is placed in operation, all signal faces must be hooded. The hooding material must be securely fastened so it will not be disturbed by normal inclement weather or wind.

2. **MATERIAL.** The traffic signal head construction must meet the requirements of Material Specification 1543 for optically programmable LED signals. The mounting brackets must meet the requirements of Material Specification 1495, unless the Engineer deems that the signal heads are too heavy for this type of bracket. The cable must meet the requirements of Material Specification 1475.
3. **INSTALLATION.** The signals must be mounted using pole mounting brackets meeting Material Specification 1495, or equivalent, banded to the pole with two strips of 3/4" stainless steel banding single wrapped, one at the top and one at the bottom of the brackets, each secured with a stainless steel banding clip. The banding and clips will have a baked-on black finish. The mounting configuration connecting the signals to the mounting bracket must consist of sections of 1 1/2" galvanized steel conduit of precise lengths, as indicated on the standard drawings or polycarbonate brackets specifically made for mounting signal heads to the side of poles, to create the designated structure, connected with cross

fittings, tees, etcetera to create the desired configuration.

When the signals are to be mounted on a square pole of flat surface, the bracket used will be bolted to the flat pole or surface using 3/8" drive studs where permissible or using 3/8" studs in tapped holes.

The bottom mounting bracket must be accurately located to cover an opening 1" in diameter, for cable entrance, drilled into the pole or standard at a calculated height to position the bottom signal face at a standard height of 10 feet, or a height indicated on the plans. The opening must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the signals are in operation.

Cable. The Contractor must provide and install a length of 8/C #16 AWG, as per Specification 1475, flexible electrical cord, medium duty, of sufficient length to extend without strain or stress from the terminal strip in the "Green" section of the signal head to the terminal strip in the junction box mounted on the pole. The number of conductors in the cord, and the color coding of the conductors, must be sufficient to match the requirements of the signal head being installed, and must be connected in accordance with Specification 1543. Both ends of the cable length must be carefully stripped of six inches (6") of jacket and one inch (1") of insulation, and each conductor properly tinned. The service cable from the signal heads must enter the pole through the bottom mounting bracket and enter the long sweep elbow to terminate by attachment to the terminal strip in the junction box in accordance with connector schematic, Bureau of Electricity Drawing Number 12268-A

The signal mounting brackets, and the tees, crosses, conduit, etcetera must be factory painted gloss black, or as specified in the plans.

4. **METHOD OF MEASUREMENT.** This work will be measured per each signal head unit installed, completely wired and operational.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each ASIGNAL HEAD, OPTICALLY PROGRAMMED, LED, 1-FACE, X-SECTION, BRACKET MOUNTED@, which price will be payment in full for furnishing and installing the signal head complete.

MATERIAL SPECIFICATION

1495

1543

1475

DRAWING

834 12268a

835 740

741

August 16, 2006

Page 2

ITEM 309, SIGNAL HEAD, POLYCARBONATE, LED, 3-SECTION, MAST ARM MOUNTED

ITEM 312, SIGNAL HEAD, OPTICALLY PROGRAMMED, LED, 3-SECTION, MAST ARM MOUNTED

ITEM 310, SIGNAL HEAD, POLYCARBONATE, LED, 4-SECTION, MAST ARM MOUNTED

ITEM 313, SIGNAL HEAD, OPTICALLY PROGRAMMED, LED, 4-SECTION, MAST ARM MOUNTED

ITEM 311, SIGNAL HEAD, POLYCARBONATE, LED, 5-SECTION, MAST ARM MOUNTED

ITEM 314, SIGNAL HEAD, OPTICALLY PROGRAMMED, LED, 5-SECTION, MAST ARM MOUNTED

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1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic signal head on a traffic signal monotube mast arm, as shown on the plans, as specified herein, or as directed by the Engineer. Specific installations and configurations are shown on Drawing 834 entitled "Standard Traffic Signal Mounting Details".

Each signal face must be pointed in the direction of the approaching traffic that it is to control and must be aimed to have maximum effectiveness for an approaching driver at a distance from the stop equal line to the normal distance traversed while stopping. The optically programmed signal face must be programmed in accordance with the visibility requirements of the Traffic Engineer.

During construction, and until the installation is placed in operation, all signal faces must be hooded. The hooding material must be securely fastened so it will not be disturbed by normal inclement weather or wind.

2. **MATERIAL.** The traffic signal head construction must meet the requirements of Material Specification 1493 for LED traffic signals. The material for a programmed LED traffic signal head must meet the Material Specification 1543. The mast arm bracket must meet the requirements of Material Specification 1463. The cable must meet the requirements of Material Specification 1475.
3. **INSTALLATION.** The signal must be mounted on the mast arm at the position indicated on the drawing in the manner shown on Drawing 834. The bracket must be banded to the mast arm with the 5/8" banding as shown on Drawing Number 834. The banding and clips must have a baked-on black finish. The bracket must be located over a hole drilled into the mast arm for the installation of cable. The hole must be reamed or filed to remove any sharp edges or burrs which might damage cable during installation, or through vibration when

the signals are in operation.

Cable. The contractor must provide and install a length of 8/C #16 flexible electrical cord, of sufficient length to extend without strain or stress from the terminal strip in the "Green" section of the signal head to the terminal strip in the junction box mounted on the pole. The number of conductors in the cord, and the color coding of the conductors, must be sufficient to match the requirements of the signal head being installed, and must be connected in accordance with Material Specification 1493 for LED traffic signals, or Material Specification 1543 for optically programmed LED traffic signals. Both ends of the cable length must be carefully stripped of six inches (6") of jacket and one inch (1") of insulation, and each conductor properly tinned. The service cable from the signal heads must enter the traffic signal mast arm through the hole from the mounting bracket, whence it will continue and enter the pole through the hole for mast arm wiring, then extend downward through the pole to enter the long sweep elbow to terminate by attachment to the terminal strip in the junction box in accordance with the terminal strip connector schematic, Bureau of Electricity Drawing Number 12268-A.

The mast arm brackets must be painted gloss black or another color as indicated in the plans.

4. **METHOD OF MEASUREMENT.** This work will be measured per each signal unit installed, completely wired and operational.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for SIGNAL HEAD or OPTICALLY PROGRAMMED SIGNAL HEAD of the type specified which price will be payment in full for furnishing and installing the signal head, or the optically programmed signal head, complete.

MATERIAL SPECIFICATION

1463 1543
1475
1493

DRAWING

834
12268A

**ITEM 315, PEDESTRIAN SIGNAL HEAD, POLYCARBONATE, LED,
BRACKET MOUNTED**

**ITEM 315A, PEDESTRIAN SIGNAL HEAD, POLYCARBONATE, LED,
COUNTDOWN, BRACKET MOUNTED**

1. **DESCRIPTION.** This item will consist of furnishing and installing a pedestrian signal on a street light pole, a traffic signal pole or a traffic signal post as shown on the plans, as specified herein, or as directed by the Engineer. The signal may be installed as a single unit on a pole or in combination with other pedestrian signals or with traffic signals of various types and sizes. Specific installations and configurations are shown on Drawing Numbers 834 and 835 entitled "Standard Traffic Signal Mounting Details".

The method of mounting will be indicated on the plans, or as directed by the engineer. Each signal face must be pointed in the direction of the marked cross-walk area for the pedestrians it is intended to control.

2. **MATERIAL.** The pedestrian signal head material must be consistent with the requirements of Bureau of Electricity Material Specification 1494. The countdown pedestrian signal must meet the requirements of Material Specification 1545. All housing units must be made of polycarbonate. The light source must be LED. Mounting hardware must meet the requirements of Material Specification 1495. Cable must meet the requirements of Material Specification 1475.

3. **INSTALLATION.** The signal must be mounted using pole mounting brackets banded to the pole with two strips of 3/4" stainless steel banding, single wrapped, one at the top and one at the bottom of the bracket, each secured with a stainless steel banding clip. The banding and clips must have a baked-on black finish. The mounting configuration connecting the signals to the mounting bracket must consist of polycarbonate brackets specifically made for mounting signal heads to the side of poles, to create the designated structure.

The bottom mounting bracket must be accurately located to cover a hole 1" in diameter for the cable entrance drilled into the pole at a height calculated to position the bottom signal face at a standard height of 10 feet, or a height indicated on the plans. The hole must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the signals are in operation.

When the pedestrian signal is attached below a traffic signal head, the separate opening for cable may be omitted to eliminate additional weakening of the pole and the pedestrian signal cord will be installed using the same opening as the

traffic signal cord.

Cable. The Contractor must provide and install a length of 8/C #16 AWG flexible electric cord, of sufficient length to extend without strain or stress from the terminal strip in the signal head to the terminal strip in the junction box mounted on the pole. The number of conductors in the cord, and the color coding of the conductors, must be sufficient to match the requirements of the signal head being installed, and must be so connected in accordance with Material Specification 1494. Both ends of the cable must be carefully stripped of six inches (6") of jacket and one inch (1") of insulation, and each conductor properly tinned. The service cord from the signal head must enter the pole through the bottom mounting bracket and enter the long sweep elbow to terminate by attachment to the terminal strip in accordance with the terminal strip connector schematic, Bureau of Electricity Drawing Number 12268-A.

During construction and until the installation is placed in operation, all signal faces must be hooded. The hooding material must be securely fastened so it will not be disturbed by inclement weather or wind

- 4. **METHOD OF MEASUREMENT.** This work will be measured per each signal unit installed, completely wired and operational.
- 5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for PEDESTRIAN SIGNAL HEAD, POLYCARBONATE, 1 FACE, LED, BRACKET MOUNTED, which price will be payment in full for furnishing and installing the signal head complete.

MATERIAL SPECIFICATION		DRAWING	
1494	1545		12268-A
1495		740	834
1475		741	835

ITEM 315B, AUDIBLE PEDESTRIAN PUSH BUTTON TRAFFIC SIGNAL STATION

1. **DESCRIPTION.** This work will consist of furnishing and installing an audible pedestrian push button station to be mounted on a traffic signal pole or post.
2. **MATERIAL.** The audible pedestrian signal station must conform to Material Specification 1553.
3. **INSTALLATION.** The contractor must follow specific manufacturer's installation instructions. The sound level and message must be programmed as directed by the Traffic Engineer. The location of the station will be as indicated on the plans. The push button station must be mounted to the pole so that the push button is at a height of 42 inches from top of sidewalk to meet the current ADA requirements. A hole must be drilled and tapped in the pole to accept a 1/4-20 stainless steel hex head bolt that will attach the station to the pole. A three-quarters-inch (3/4") to one inch (1") diameter hole must be drilled into the pole at the proper height for the cable entrance. The size of the hole will be as directed by the Engineer. The hole must be reamed or filed to remove all sharp edges or burrs which might damage the cable. A weatherproof flexible caulking must be applied between the hole in the pole and the station housing to protect the cable.
4. **METHOD OF MEASUREMENT.** This work will be measured per unit for each push button station mounted to a pole or post. Wiring will be addressed under a separate pay item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for AUDIBLE PEDESTRIAN TRAFFIC SIGNAL PUSH BUTTON STATION of the type specified, which price will be payment in full for furnishing and installing the unit complete.

MATERIAL
1553

March 5,2008

ITEM 315C, AUDIBLE PEDESTRIAN TRAFFIC SIGNAL CONTROLLER

1. **DESCRIPTION.** This work will consist of furnishing and installing an audible pedestrian traffic signal controller which will be installed in the traffic signal controller cabinet. This controller will be the interface between the traffic signal controller and the audible push button stations at the intersection.
2. **MATERIAL.** The audible pedestrian traffic signal controller must conform to Material Specification 1554.
3. **INSTALLATION.** The contractor must follow specific manufacturer's installation instructions.
4. **METHOD OF MEASUREMENT.** This work will be measured per unit for each audible traffic signal controller installed in a controller cabinet, completely wired to the traffic controller. Wiring to each station will be measured separately under a different item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for AUDIBLE PEDESTRIAN TRAFFIC SIGNAL CONTROLLER, which price will be payment in full for furnishing and installing the unit complete with all necessary connections, mounting, and adjustments required for proper operation. Wiring from the push button stations to the controller will be addressed under a separate pay item.

MATERIAL
1554

March 5, 2008

ITEM 316, JUNCTION BOX, POLE OR POST MOUNTED

1. **DESCRIPTION.** This item will consist of furnishing and installing a Junction Box on each traffic signal post, traffic signal pole, or street light pole on which a signal head is mounted, as shown on the plans, specified herein, or directed by the Engineer.
2. **MATERIAL.** The Junction Box must conform to the requirements of Material Specification Number 1407 and to Drawing Number 954. The box will contain a 20 conductor terminal strip, securely fastened to an aluminum channel. Two Number 10 stainless steel machine screws will be used to mount the channel to the junction box.
3. **INSTALLATION.** The junction box must be mounted to the side of the pole away from the roadway, or as directed by the Engineer. The center of the box must be located approximately fifty-eight inches (58") above the adjacent sidewalk. Two long sweep elbows must be attached to the box, one to the top and one to the bottom, unless otherwise directed by the Engineer. Each will be attached with four (4) #10-24x3/4" stainless steel screws. The lower long sweep elbow will be properly positioned over a hole 1 1/2 inches in diameter drilled in the pole approximately 48" above the sidewalk, for the installation of cable. Another 1 1/2 inch hole must be drilled for the upper elbow. The holes must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the signals are in operation. A stainless steel, banding bracket, Drawing Number 11984, must be attached to the center of the back of the box with a 5/16"-18 x 1" stainless steel machine screw. The entire unit must be banded to the pole with five (5) 3/4" stainless steel bands, one through the banding bracket and one each at the top and bottom of each elbow. The banding and clips must have a baked-on black finish.
4. **METHOD OF MEASUREMENT.** This work will be measured per each junction box unit installed, complete with elbow(s).
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a JUNCTION BOX, POLE OR POST MOUNTED, which price will be payment in full for furnishing and installing the junction box complete with its component parts and appurtenances. Connection of cables and wires to the terminal strip will not be part of the cost of the junction box but will be considered part of the installation of the underground cable and the installation of signal heads.

MATERIAL SPECIFICATION

DRAWING

1407

954 834
11984

April 3, 2009
Item 316 - Page 2

JUNCTION BOX, POLE OR POST MOUNTED

Revised: 10/30/2021

Material Specifications: 1407

Standard Drawings: 834, 954, 11984

Description. This item will consist of furnishing and installing a Junction Box on each traffic signal post, traffic signal pole, or street light pole on which a signal head is mounted, as shown on the plans, specified herein, or directed by the Engineer.

Materials. The Junction Box must conform to the requirements of Material Specification Number 1407 and to Drawing Number 954. The box will contain a 20-conductor terminal strip, securely fastened to an aluminum channel. Two #10 stainless steel machine screws will be used to mount the channel to the junction box.

Installation. The junction box shall be mounted to the side of the pole away from the roadway, or as directed by the Engineer. The center of the box must be located approximately fifty-eight inches (58") above the adjacent sidewalk. Two long sweep elbows must be attached to the box, one to the top and one to the bottom, unless otherwise directed by the Engineer. Each will be attached with four (4) #10-24x3/4" stainless steel screws. The lower long sweep elbow will be properly positioned over a hole 1 1/2 inches in diameter drilled in the pole approximately 48" above the sidewalk, for the installation of cable. Another 1 1/2-inch hole must be drilled for the upper elbow. The holes must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the signals are in operation. A stainless steel, banding bracket per Drawing Number 11984, must be attached to the center of the back of the box with a 5/16"-18 x 1" stainless steel machine screw. The entire unit must be banded to the pole with five (5) 3/4" stainless steel bands, one through the banding bracket and one each at the top and bottom of each elbow. The banding and clips must have a baked-on black finish.

Method of Measurement. This work will be measured per each junction box unit installed, complete with elbow(s).

Basis of Payment. This work will be paid for at the contract unit price each for a JUNCTION BOX, POLE OR POST MOUNTED, which price will be payment in full for furnishing and installing the junction box complete with its component parts and appurtenances. Connection of cables and wires to the terminal strip will not be part of the cost of the junction box but will be considered part of the installation of the underground cable and the installation of signal heads.

ITEM 317, PEDESTRIAN PUSH BUTTON

1. **DESCRIPTION.** This item will consist of furnishing and installing a push button switch and housing on a traffic signal pedestal or pole, as shown on the plans, as specified herein, or as directed by the Engineer. Specific installation data is shown on Drawing Number 834 entitled "Standard Traffic Signal Mounting Details" and on Drawing Number 963 entitled "Pedestrian Push Button Post".
2. **MATERIAL.** The push button assembly must meet the requirements of Material Specification 1517.
3. **INSTALLATION.** The push button assembly must be banded on the pole or pedestal at the mounting height shown on Drawing Number 834 or Drawing Number 963 using 3/4" stainless steel banding, one band each at the top and the bottom of the unit. The unit must be mounted on the side of the pole nearest the cross walk which the signals control, the position being at approximately 90° from the face of curb. The push button must be located at a height of 42" above sidewalk grade. A hole 3/4" to 1" in diameter must be drilled in the pole at the proper height for the installation of cable. The hole must be reamed or filed to remove any sharp edges or burrs which might damage cable during installation or through vibration when the signals are in operation.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed. Wiring will be addressed by a separate item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a "PUSH BUTTON, PEDESTRIAN, POLE OR POST MOUNTED" which price will be payment in full for furnishing and installing the push button complete with its component parts and appurtenances.

MATERIAL SPECIFICATION
1517

DRAWING
834 963

March 5, 2008

ITEM 324, PEDESTRIAN PUSH BUTTON SIGNAL POST

1. **DESCRIPTION.** This item will consist of furnishing and installing a steel post, for supporting a push button for pedestrian traffic, in a concrete sidewalk, at the location shown on the plans, or as directed by the Engineer. The post installation itself must be consistent in construction to the post shown on Drawing Number 963, "Pedestrian Push Button Post".
2. **MATERIALS.** The post will be three inch (3") galvanized rigid steel conduit meeting the requirements of Material Specification 1462. The top of the post will be threaded for a length of two inches (2"). The bottom of the post will be threaded for a length of three and one-half inches (3.5"). A threaded conduit cap will be provided for the top. The base material will consist of a three and one-half inch (3.5") length of threaded conduit coupling circumferentially welded to a base plate. The base plate will be dimensioned as shown on Standard Drawing 963. The base plate will be made of a high strength low alloy steel meeting the requirements of ASTM A595, Grade A. The post, base, and cap must be powder coated black. Post threads must not be painted. The painting method must be pre-approved by the Engineer.
3. **INSTALLATION.** A hole must be drilled into the post at the proper height and location for the pedestrian push button wiring. The post must be screwed into the base. The post may be tack welded to the base to insure the two parts do not loosen. The post and base must be mounted in the sidewalk using a minimum of ½" concrete anchors of the appropriate length. (Please note that cable must be pulled into the post before the post is mounted to the sidewalk.) The nuts on the rods must be tightened to secure the post to the sidewalk such that there is no space separating the post from the sidewalk. There must be no double nutting. The post must be plumb; the use of shims will not be permitted. The post cap must be secured by screwing into the top of the pipe. After the post is erected, the Engineer will determine if touch-up paint is required.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete with anchors, nuts, base, steel pipe, and post cap. Concrete work, wiring, and push buttons will not be included in this item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a PEDESTRIAN PUSH BUTTON SIGNAL POST, which will be payment in full for furnishing and installing the post complete in place.

MATERIAL
1462

DRAWING
963

March 5, 2008

ITEM 325, MAST ARM, STEEL, MONOTUBE, 16 FOOT
ITEM 326, MAST ARM, STEEL, MONOTUBE, 20 FOOT
ITEM 327, MAST ARM, STEEL, MONOTUBE, 26 FOOT
ITEM 328, MAST ARM, STEEL, MONOTUBE, 30 FOOT
ITEM 329, MAST ARM, STEEL, MONOTUBE, 35 FOOT
ITEM 330, MAST ARM, STEEL, MONOTUBE, 40 FOOT
ITEM 331, MAST ARM, STEEL, MONOTUBE, 44 FOOT

1. **DESCRIPTION.** This item will consist of furnishing and installing a steel, monotube, mast arm for the purpose of supporting traffic signals, and/or illuminated signs on an anchor base pole at the locations shown on the plans, or as specified or directed by the Commissioner. The length of the mast arm and the angular orientation of the arm relative to the centerline of the roadway will be as indicated on the plans.

A mast arm must be installed only on a 3 gauge pole, and the length of the mast arm will govern the minimum base diameter of the pole on which the arm is to be installed, in accordance with the following chart:

MAST ARM LENGTH (feet)	POLE BASE DIAMETER (inches)
16	10
20	10
26	10
30	11
35	12.5
40	12.5
44	12.5

2. **MATERIAL.** The mast arm must be 7gauge steel meeting the requirements of Standard Drawing 870 and Material Specification 1454.
3. **INSTALLATION.** The mast arm must be mounted on the pole at the height specified on Drawing 834, or at a different height if specified on the plans, or as directed by the Engineer. A one inch (1") diameter opening for the installation of cable must be field drilled in the pole in line with the orientation of the mast arm. The hole must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the signals are in operation. A neoprene grommet must be inserted into the finished hole prior to the installation of the cable.

Two holes must be field drilled in the pole at 180 degrees relative to the orientation of the pole for installation of locator shear pins, provided with the

back plate, to prevent rotation of the mast arm. These holes must be drilled after the mast arm is in place in order that the position of the holes will match the location of the locator bushings attached to the back half of the clamp.

All signals, signs, and electrical equipment must be attached in the correct relative position to the mast arm, with service cord in place, prepared to be installed on the pole, prior to the attachment of the mast arm to the pole. The installation of the cord in the pole must be coordinated with the attachment of the mast arm to the pole. The clamp bolts must be tightened securely so that there is no slippage of the mast arm either upward or downward to exert a vertical force on the shear pins. The end cap must be secured in place with the attachment screws provided.

The mast arm must be delivered completely finished with a factory applied black powder coat per Material Specification 1454. The contractor must utilize non-abrasive slinging materials and must otherwise exercise due care in erecting the pole and mast arm to prevent any damage to the finish.

- 4. **METHOD OF MEASUREMENT.** This work will be measured per each monotube arm installed on a traffic pole.
- 5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each MAST ARM, STEEL, MONOTUBE of the length indicated, and will be payment in full for furnishing and installing a steel mast arm in place, complete. Attachment of signals and signs will not be part of this pay item.

MATERIAL	DRAWING
1454	870
	834

August 18, 2006

ITEM 332, MAST ARM, STEEL, 4 FOOT WITH POLE PLATE
ITEM 333, MAST ARM, STEEL, 8 FOOT WITH POLE PLATE

1. **DESCRIPTION.** This item will consist of furnishing and installing a steel pipe mast arm of a specified length to support a traffic signal head, or other electrical equipment as required, as is shown on Drawing Number 834.
2. **MATERIAL.** The material of the mast arm must conform to the requirements of Material Specification 1450. The 4 foot arm must conform to Standard Drawing 661. The 8 foot mast arm must conform to Standard Drawing 620. The two bolt pole attachment must be equal to that shown on Standard Drawing 659. This must be welded to a curved piece of A36 steel, which must be able to accommodate two 3/4" steel bands; one top; one bottom. A hole must be drilled in the steel to accommodate wire. The hole must be smooth and free from burrs.
3. **INSTALLATION.** The mast arm must be installed with two bolts to the mast arm attachment. The pole must have a one inch hole drilled for cable at the location shown on the plans, or as directed by the Engineer. The mast arm attachment must be banded to the pole at the height and location shown on the plans or as directed by the Engineer. The banding must be 3/4" stainless steel.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a MAST ARM, STEEL, WITH POLE PLATE of the length specified, which will be payment in full for furnishing and installing the mast arm complete in place with mounting bracket and banding.

MATERIAL SPECIFICATION
1450

DRAWING
620 659 661

May 23, 2001

ITEM 335, TRAFFIC SIGNAL POST, ALUMINUM 15 FOOT
ITEM 336, TRAFFIC SIGNAL POST, ALUMINUM 17 FOOT
ITEM 337, TRAFFIC SIGNAL POST, ALUMINUM 20 FOOT

1. **DESCRIPTION.** This item will consist of furnishing and installing an aluminum post, for supporting a traffic signal, upon a concrete foundation, at the location shown on the plans, as specified herein, or as directed by the Engineer. The post installation itself must be consistent in construction to the post shown on Drawing Number 526 for the installation of a post for a traffic signal.
2. **MATERIALS.** The material of the post must meet the requirements of Material Specification 1385 and of Standard Drawing Number 526.
3. **INSTALLATION.** The post and base must be mounted on the foundation so that the handhole faces away from the curb. The nuts on the foundation must be tightened to secure the post to the foundation such that there is no space separating the post from the foundation. There must be no double nutting. The post must be plumb; the use of shims will not be permitted. The post cap must be secured by three 5/16-18 X3/4" hex head stainless steel set screws.

The height of the post will be as indicated on the plans.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed on a foundation, complete with bolt covers, handhole door, base casting, aluminum pipe, and post cap.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a TRAFFIC SIGNAL POST, ALUMINUM 15 FT., TRAFFIC SIGNAL POST, ALUMINUM 17 FT. or TRAFFIC SIGNAL POST, ALUMINUM 20 FT. which will be payment in full for furnishing and installing the post complete in place.

MATERIAL SPECIFICATION
1385

DRAWING
526

June 27, 2008

ITEM 338, CUT OFF POLE AND INSTALL CAP

1. **DESCRIPTION.** This item will consist of cutting a traffic signal pole down to the desired height and furnishing and installing a steel cap for the pole top. This is done when the pole will not have a luminaire arm and luminaire in the top portion.
2. **INSTALLATION.** The pole must be cut to the desired height as directed by the Engineer or as shown on the plans. Normally this will be two to three feet above where the monotube mast arm is located. A steel cap must be installed on the top of the pole and secured by three stainless steel set screws. The pole may be cut before or after the pole installation.
3. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for CUT POLE AND INSTALL CAP, which will be payment in full for all labor and material needed.

May 23, 2001

ITEM 342, VEHICLE DETECTOR AMPLIFIER, 1 - CHANNEL
ITEM 3421, VEHICLE DETECTOR AMPLIFIER, 4 - CHANNEL

1. **DESCRIPTION.** This work will consist of furnishing and installing an induction loop detector amplifier of the number of channels indicated.
2. **MATERIALS.** An induction detector amplifier must comply with the requirements of Article 1079 of the Standard Specifications and the following requirements:
 - a. The induction loop detector amplifier must be of digital design and must be capable of detecting vehicles at speeds from 2 to 80 mph.
 - b. Each channel must have three or more levels of sensitivity control and must be of sufficient sensitivity to detect the smallest licensable motor vehicle, including motorbikes.
 - c. Each channel must have three modes of operation - delay, extensions, and normal. The delay feature will be inoperative during the green interval for the approach of which the detector is located.
 - d. The induction loop detector amplifier must provide a self-tuning method for accommodating the range of sensor loop/lead-in inductance.
 - e. The induction loop detector amplifier must use a relay for output interfacing, so in failure condition the amplifier will register a continuous call to the signal controller.
3. **INSTALLATION.** The induction loop detector amplifier will be installed inside a traffic signal controller cabinet, and must be properly cabled to the controller and the appropriate detector leads.
4. **METHOD OF MEASUREMENT.** This work will be measured per each complete unit installed completely wired and operational. Each 1-channel amplifier will be considered one unit for payment. Each 4-channel amplifier will be considered one unit for payment.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for INDUCTION LOOP DETECTOR AMPLIFIER, of the proper number of channels, which price will be payment in full for furnishing and installing the vehicle detector amplifier complete, with necessary connections and adjustments for proper operations.

April 27, 2001

ITEM 343, DETECTOR LOOP

1. **DESCRIPTION.** This work will consist of saw-cutting the pavement, furnishing and installing a detector loop in the sawcut, sealing the cut, and connecting the loop wire to the lead-in cable.
2. **MATERIAL.** The wire and sealer must meet the requirements of Article 1079.02 of the Standard Specifications for Type II Detectors.
3. **INSTALLATION.** The installation of the detector loop must meet the requirements of Article 886 of the Standard Specifications, except as otherwise noted herein. The pavement must be sawcut for a rectangular 6' by 6' loop or a 6' diameter loop, or as shown on the plans, or as directed by the Engineer. On a rectangular loop, diagonal cuts or drilled holes must be made at all corners to prevent sharp bends in the wire. The sawcut must be 1/4" wide and a minimum of 2" deep depending upon the roadway surface. The bottom of the cut must be smooth. The sawcut must be extended to meet the conduit for the lead-in cable as directed and as shown on Standard Drawing Number 905. The sawcut must be continuous from the edge of the loop to and through one side of the PVC elbow.

The detector loop must be installed in the sawed slot in accordance with the manufacturer's recommendation or as shown on the plans. The slot must be clean and dry. The number of wire turns for the loop must be 3, or as recommended by the manufacturer of the induction loop amplifier.

Retainers must be added to the sawed slot to prevent the loop wires from floating during the pouring of the loop sealant. These retainers can be made from 1" pieces of vinyl tubing bent in half to form the retainer.

The wire must extend into the 2" conduit to the nearest manhole/handhole where it will be spliced into the lead-in cable.

The only splicing method for this item will be with marine type heat shrinkable tubing. Four inches of the cable jacket must be removed and one inch of the cable insulation. The bare copper will be scraped. The cable will be inserted into two irradiated polyolefin heat shrinkable tubes. The conductors will then be connected by twisting together and soldering. Rosin core solder must be used for soldering the connectors. The tubes must completely cover the soldered connection and the insulation 1" beyond all exposed copper wire on either end of the connection. The tubes should be shrunk one at a time over the soldered wires and insulation to form a watertight covering.

Before pouring the sealer, electronic instruments will be used to test the

resistance, inductance, and Quality Factor of the loop and lead-in circuit. The resistance must be a minimum of 10 megohms above ground under any conditions of weather or moisture. The loop and lead-in circuit must have an inductance between 50 and 700 microhenries. The Quality Factor must be greater than 5. The amplifier manufacturer=s recommendations, if different, must be met. The contractor must provide all necessary instruments and do all the testing in the presence of the Engineer.

The sealer must be applied according to the sealer manufacturer=s recommendations.

4. **METHOD OF MEASUREMENT.** This work will be measured in lineal feet. The measurement will be taken along the sawed slot and the 2" conduit to the manhole where the splice was made. No vertical measurements will be made. The loop will be measured once regardless of the number of wire turns.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for DETECTOR LOOP, which price will be payment in full for sawcutting, furnishing and installing loop wire, splicing, testing, and sealing the cable. Detector lead-in wire, and conduit will be paid for separately.

DRAWING
905

August 31, 2006

Item 343
Page 2

ITEM 344, FLASHING BEACON WITH DOWNLIGHT

1. **DESCRIPTION** This item will consist of furnishing and installing a flashing beacon with a down light on a permanent obstruction in the roadway, such as a viaduct column.
2. **MATERIAL**. The flashing beacon signal and downlight must meet the requirements of Standard Drawing 869. The flashing unit must be a solid-state device mounted internally in the head housing. All hardware must be approved by the Engineer before installation.
3. **INSTALLATION** The electrical equipment must be mounted to the column using banding or brackets, as approved by the Engineer. Wiring will be paid for separately.
4. **BASIS OF PAYMENT** This work will be paid for at the contract unit price each for FLASHING BEACON WITH DOWNLIGHT, which price will be payment in full for furnishing and installing the flashing beacon

DRAWING
869

October 23, 2006

ITEM 344A, FLASHING BEACON, BRACKET MOUNTED

1. **DESCRIPTION** This item will consist of furnishing and installing a flashing beacon traffic signal head on a street light pole, a traffic signal pole, or a traffic signal post, as shown on the plans. The installation should follow the configuration as shown on Drawing 834 and 835 entitled AStandard Traffic Signal Mounting Details@. The flashing beacon face must be pointed in the direction of the approaching traffic that it is to control and will be aimed to have maximum effectiveness for an approaching driver. During construction, and until the installation is placed in operation, all signal faces including flashing beacons must be hooded. The hooding material must be securely fastened so it will not be disturbed by inclement weather.
2. **SIGNAL HEAD** The flashing beacon signal head must meet the applicable requirements of Material Specification 1493 for vehicular traffic signal heads. The head will consist of one or two sections. If the head consists of one section, a 12 inch yellow LED module must be used as the signal. If the head consists of two sections, the yellow LED module must be mounted in the top section; the bottom section will have an opaque lens mounted in the face. All internal wiring and the terminal block must meet the requirements of Material Specification 1493. The brackets must meet the requirements of Material Specification 1495.
3. **FLASHER** The flashing unit must be a solid-state device mounted internally in the head housing. The flashing unit proposed must be pre-approved by the City of Chicago=s Engineer before installation. The flasher controller must meet the applicable standards of the NEMA Standards for Traffic Control Systems, TS 1.
4. **INSTALLATION** The signal must be mounted using pole mounting brackets banded to the pole with two strips of 3/4 inch stainless steel banding, one at the top and one at the bottom of the brackets, each secured with a stainless steel banding clip. The signals must be mounted using a bracket meeting the requirements of Material Specification 1495. The bottom bracket must be located over a one inch hole drilled into the pole for the installation of cable. The bottom of the traffic signal must be a minimum of ten feet from grade. The hole must be reamed or filed to remove any sharp edges or burrs which might damage cable.
5. **CABLE** The contractor must provide and install a length of #16 flexible electrical harness cable, as per Material Specification 1475, of sufficient length to extend without strain from the terminal strip in the signal head to the terminal strip in the pole mounted junction box. Both ends of the cable will be stripped of 6 inches of jacket and one inch of insulation, and each conductor properly tinned.

6. **BASIS OF PAYMENT** This work will be paid for at the contract unit price each for FLASHING BEACON, BRACKET MOUNTED, which price will be payment in full for furnishing and installing the flashing beacon, and cabling from the beacon to the junction box on the pole.

Material Specifications
1475
1493
1495

Drawing
833
834

October 23, 2006

ITEM 344B, FLASHING BEACON, MAST ARM MOUNTED

1. **DESCRIPTION** This item will consist of furnishing and installing a flashing beacon traffic signal head on a traffic signal monotube mast arm, as shown on the plans. The installation should follow the configuration as shown on Drawing 834 entitled AStandard Traffic Signal Mounting Details@. The flashing beacon face must be pointed in the direction of the approaching traffic that it is to control and must be aimed to have maximum effectiveness for an approaching driver. During construction, and until the installation is placed in operation, all signal faces including flashing beacons must be hooded. The hooding material must be securely fastened so it will not be disturbed by inclement weather.
2. **SIGNAL HEAD** The flashing beacon signal head must meet the applicable requirements of Material Specification 1493 for vehicular traffic signal heads. The head will consist of one or two sections. If the head consists of one section, a 12 inch yellow LED module must be the signal face. If the head consists of two sections, the yellow LED module must be mounted in the top section; the bottom section must have an opaque lens mounted in the face. All internal wiring and the terminal block must meet the requirements of Material Specification 1493. The mounting brackets must meet the requirements of Material Specification 1463.
3. **FLASHER** The flashing unit must be a solid-state device mounted internally in the head housing. The flashing unit proposed must be pre-approved by the City of Chicago=s Engineer before installation. The flasher must meet the requirements of the NEMA Standards for Traffic Control Systems, TS 1.
4. **INSTALLATION** The signal will be mounted on the mast arm using the mounting device at the position on the mast arm indicated on the plans, and in the manner as shown on Drawing 834. The signals must be mounted using a bracket meeting the requirements of Material Specification 1463. The bracket must be banded to the mast arm with 5/8 inch stainless steel banding. The bracket must be located over a hole drilled into the mast arm for the installation of cable. The hole shall be reamed or filed to remove any sharp edges or burrs which might damage cable.
5. **CABLE** The contractor must provide and install a length of #16 flexible electrical harness cable, as per Material Specification 1475, of sufficient length to extend without strain from the terminal strip in the signal head to the terminal strip in the pole mounted junction box. Both ends of the cable must be stripped of 6 inches of jacket and one inch of insulation, and each conductor properly tinned.

6. **BASIS OF PAYMENT** This work will be paid for at the contract unit price each for FLASHING BEACON, MAST ARM MOUNTED, which price will be payment in full for furnishing and installing the flashing beacon, and cabling the beacon from the signal head to the junction box.

Material Specifications

1463

1475

1493

Drawing

834

October 23, 2006

Item 344B

Page 2

ITEM 345, FLASHING BEACON, SOLAR POWERED, BRACKET MOUNTED

1. **DESCRIPTION.** This work will consist of furnishing and installing a flashing beacon, solar powered, bracket mounted to an existing streetlight pole, complete with controller and solar panels.
2. **MATERIAL AND ASSEMBLY.** The flashing beacon, solar powered unit must be a commercially available unit manufactured by a reputable manufacturer with a history of successfully manufacturing these units for a minimum of five (5) years. The contractor must follow specific manufacturer=s installation instructions. All cable, mounting brackets, and any other items or methods needed to make the unit operational must be included. The pole and foundation will be paid for separately. The contractor will be responsible for necessary programming of the unit for specific times of operation. The unit must include a programmable timer with software, flashing unit, solar collector, back-up batteries, 24" x 48" School Zone Sign A 20 MPH WHEN FLASHING@, and a 12 inch signal with a red polycarbonate housing and an LED yellow signal unit.
3. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for FLASHING BEACON, SOLAR POWERED, BRACKET MOUNTED of the type specified, which price will be payment in full for furnishing and installing the unit complete with all necessary connections and adjustments required for proper operation.

October 23, 2006

ITEM 346, ELECTRIC CABLE IN CONDUIT, #14, 2 CONDUCTOR, SHIELDED

1. **DESCRIPTION.** This work will consist of furnishing and installing a shielded lead-in cable for a traffic loop detector or for a pedestrian push button.
2. **MATERIAL.** The cable must be rated 600 Volts, 90° Centigrade wet and dry. The cable will have soft annealed tinned copper conductors with a PVC insulation and a PVC jacket overall with an appropriate shield. The cable will be equal to that manufactured by Belden, for instrumentation/ process control tray cable, Part No. 9343, or an approved equal.
3. **INSTALLATION.** The contractor will install the detector cable from the existing traffic controller to the manhole/ hand hole or as indicated on the contract plan drawing. The contractor must splice the cable to the detector loop cable in the manhole or handhole. The other end of the cable must be terminated at the controller. For pedestrian push buttons the cable will be installed from the traffic controller to the push button, without splices or terminations in between.
4. **MEASUREMENT.** The cable will be measured per lineal horizontal foot from the location of the controller to the handhole or manhole of the splice, or to the push button pole or post location, whichever applies. Additional footage may be added for slack. Five feet of slack will be allowed for each handhole and ten feet of slack will be allowed for each manhole the cable passes through. An additional ten feet may be added at the controller and at the pedestrian pole or post.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for ELECTRIC CABLE IN CONDUIT, #14, 2C SHIELDED, which price will be payment in full for furnishing and installing the cable and performing all necessary connections to make the cable operational.

March 5, 2008

ITEM 347, ELECTRIC CABLE IN CONDUIT NO. 4, 2/C
ITEM 348, ELECTRIC CABLE IN CONDUIT NO. 14, 7/C
ITEM 349, ELECTRIC CABLE IN CONDUIT NO. 14 10/C
ITEM 350, ELECTRIC CABLE IN CONDUIT NO. 14 19/C

1. **DESCRIPTION.**

This work will consist of furnishing and installing electric cable for traffic signals of the type, size and number of conductors as specified on the plans. The cable will be rated 600 volts and comply with the following requirements.

2. **TRAFFIC SIGNAL CABLE.**

All cable must conform to the requirements of Material Specification number 1537, for Traffic Signal Cable.

3. **INSTALLATION.**

All cable must be installed in conduit, as indicated on the plans, with care to prevent damage to the insulation or cable. Suitable devices must be used in pulling the cable, and only approved lubricants should be used. All cables installed in conduit will be from the power source to the traffic signal controller cabinet, from the traffic controller cabinet to the traffic signal junction box, or from junction box to junction box. For cable terminating in a traffic signal controller cabinet or traffic signal junction box the following procedures must be followed:

a. **Controllers.**

1. Remove thirty six inches (36") of neoprene jacket.
2. Wrap vinyl electrical tape on two inches (2") of the neoprene jacket and two inches (2") on the exposed conductors.
3. Remove one inch (1") of insulation and scrape copper conductor.
4. Train cables neatly along the base and back of cabinet.
5. Connect conductors to proper terminal lugs.

b. Traffic Signal Junction Box.

1. Remove twenty four inches (24") of neoprene jacket.
2. Wrap vinyl electrical tape on two inches (2") of neoprene jacket and two inches (2") on the exposed conductors.
3. Remove one inch (1") of insulation and scrape copper conductor.
4. Train cables neatly along the side and back of the box.
5. Connect all conductors to terminal strip.

4. **CABLE SLACK.**

The length of cable slack that must be provided will be in accordance with the following schedule:

<u>Location</u>	<u>Length of Slack Cable (feet)</u>
Base of Controller	7
Detector, Junction Box	1
Base of Traffic Signal Post or Traffic Signal Pole	4
City Handhole	6
City Manhole	12
Commonwealth Edison Manhole	25

Cable slack in manholes/handholes must be trained and racked in the holes. If racks are non-existent, racks must be provided, and considered incidental and a part of this pay item.

No cable splices will be allowed for traffic signal cable, with the exception of 7 conductor interconnect cable. These splices must be indicated on the plans.

5. **METHOD OF MEASUREMENT.**

The length of measurement must be the distance horizontally measured between changes in direction, and will include cable slack. All vertical cables will not be measured for payment.

6. **BASIS OF PAYMENT.**

This work will be paid for at the contract unit price per lineal foot for ELECTRIC CABLE IN CONDUIT NO. 4, 2/C, ELECTRIC CABLE IN CONDUIT NO. 14, 7/C, ELECTRIC CABLE IN CONDUIT NO. 14 10/C, or ELECTRIC CABLE IN CONDUIT NO. 14 19/C. This price will be payment in full for furnishing, installing, connecting, splicing, and testing of cable, and will include all labor, materials, equipment, tools, and incidentals necessary to complete the work, as specified herein, and as shown on the plans.

MATERIAL SPECIFICATION
1537

September 1, 2006

Item 347, 348, 349, 350
Page 3

ITEM 351, CABLE TERMINATION #14 7/CONDUCTOR

1. **DESCRIPTION.** This item is for the termination of a seven-conductor number 14 AWG communications cable used for traffic signal interconnection between traffic controllers.
2. **MATERIAL.** The cable to be terminated must meet the requirements of Material Specification 1537 and will be provided under a separate pay item.
3. **INSTALLATION.** Cable must be terminated so as to be compatible with the requirements of the City of Chicago Material Specification 1469 for traffic controllers. Special attention should be paid to Section XVII - Interconnect Panels. All wire must be provided with lugs or other approved terminal fittings for attachment to binding posts. Each conductor must be terminated.
4. **MEASUREMENT.** Each conductor will be terminated. All seven conductors, at one end of the cable, that are terminated will count as one termination for the purposes of measuring for payment.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each CABLE TERMINATION #14 7/CONDUCTOR. The termination of all conductors at one end of the cable will be considered one unit.

September 7, 2006

ITEM 352, SPLICE CABLE IN MANHOLE, 7 CONDUCTOR

1. **DESCRIPTION.** This item will consist of splicing a 7 conductor traffic signal interconnect cable with another like cable, in a manhole. Splices must be in-line straight through splices.
2. **MATERIAL.** The material must meet the requirements of Article 1066.06 of the Standard Specifications.
3. **SPLICES.** Splices will be done when indicated in the plans or as directed by the Engineer. Splices are otherwise not allowed. The splicing procedure must be done as indicated herein and as indicated in Article 1066.06 of the Standard Specifications.

Four inches of jacket must be removed from each cable, leaving four inches of insulated wire exposed. One inch of insulation must be removed from each conductor and the copper must be scraped. The conductors may be connected either by twisting together and soldering or by use of pressure type, solderless connectors. The splice must be waterproofed by wrapping with rubber or vinyl electrical tape. Each conductor must be wrapped separately starting about 2" from the ends of the wires and working back to about 2" beyond the end of the outer jacket. Two layers of electrical tape will be used on each conductor. Two layers of friction tape must be used over the electrical tape. The entire surface of the splice should then be painted with insulating paint.

4. **MEASUREMENT.** Splicing of two ends to each other of 7 conductor cables will be measured as one splice for measurement purposes.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per SPLICE CABLE IN MANHOLE, 7 CONDUCTOR, for each 7 conductor splice made.

ITEM 353, REMOVE EXISTING TRAFFIC SIGNAL EQUIPMENT

1. **DESCRIPTION.** This work will consist of removing all the existing traffic signal equipment at the intersections listed on the plans.
2. **REMOVAL** The items to be removed will include traffic signal arms, traffic signal poles, traffic signal heads, traffic signal controllers, and all associated equipment and cable.

The traffic signal items, except for traffic signal cable, are to remain the property of the City of Chicago. The Contractor must deliver the obsolete traffic signal equipment to Division of Electrical Operations (DEO) yard at 2451 South Ashland Avenue, or as directed by the Engineer. Twenty-four-hour advance notice is necessary before delivery. The traffic signal cable must be removed and become the property of the Contractor and must be disposed of by him, outside the right-of-way, at his sole expense.

The Contractor must provide three (3) copies of a list of equipment that is to remain the property of the City, including model and serial numbers where applicable. He must also provide a copy of the contract plan, or special provisions, showing the quantities and type of equipment. The Contractor will be responsible for the condition of the traffic control equipment from the time of removal until its acceptance by a receipt drawn by the City indicating that the items have been returned.

3. **METHOD OF MEASUREMENT.** This item will be measured as one unit per project contract, or per signalized intersection, depending upon the contract conditions. The breaking down of foundations and manholes will not be considered part of this item.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract lump sum price for REMOVE EXISTING TRAFFIC SIGNAL EQUIPMENT, or lump sum per intersection depending upon the contract conditions. This price will be payment in full for removing the equipment and disposing of it as required. The salvage value of the cable retained by the Contractor must be reflected in this contract lump sum price.

October 19, 2020

ITEM 354, REMOVE EXISTING STREET LIGHTING EQUIPMENT

1. **DESCRIPTION.** This work will consist of removing all obsolete street lighting equipment at various locations shown on the plans.
2. **REMOVAL.** Street lighting poles (anchor base or embedded), ballast housing bases, mast arms, luminaires, controllers, secondary racks, cable and all related equipment are to be removed as indicated on the plans. Embedded poles will be removed by means other than burning where possible. Embedded CTA poles must be burned off at a minimum of eighteen inches below ground level.

All equipment, with the exception of the cable, will remain the property of the City of Chicago. The Contractor shall deliver the equipment to the Division of Electrical Operations facility at 24th Street and Ashland Avenue. Cable shall become the property of the Contractor and be disposed of outside the right-of-way. Twenty-four hours advance notice is necessary before delivery. Street lighting cable must be removed as indicated on the plans and become the property of the Contractor to be disposed of by him, outside the right of way, at his sole expense.

The Contractor must provide three (3) copies of a list of equipment that is to remain the property of the City, including model and serial numbers where applicable. He must also provide a copy of the contract plan or special provisions showing the quantities and type of equipment. The Contractor will be responsible for the condition of the street lighting equipment from the time of removal until the acceptance of a receipt drawn by the City indicating that the items have been returned.

3. **METHOD OF MEASUREMENT.** This work will be measured per lump sum for the project contract. Removal of manholes, foundations, and conduit will not be part of this item.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract lump sum price for REMOVE EXISTING STREET LIGHTING EQUIPMENT at the various locations shown on the plans. This price will be payment in full for removing the equipment and disposing of it as required. The salvage value of the cable retained by the Contractor must be reflected in this contract lump sum price.

Revised: August 30, 2020

ITEM 358, CONTROLLER, STREET LIGHT, BASE MOUNTED, 3 PHASE, 100 AMP

ITEM 360, CONTROLLER, STREET LIGHT, BASE MOUNTED, 3 PHASE, 200 AMP

ITEM 366, CONTROLLER, STREET LIGHT, BASE MOUNTED, 1 PHASE, 100 AMP

ITEM 369, CONTROLLER, STREET LIGHT, BASE MOUNTED, 1 PHASE, 200 AMP

1. **DESCRIPTION.** This work will consist of furnishing and installing an aluminum cabinet to be mounted on a ballast housing base, and containing various electro-mechanical devices to automatically control street lighting circuits, and to provide protection for the equipment so controlled.

The controller specified will be equated to the service capability of the Commonwealth Edison Company at the given location and to the number of circuits to be serviced as required by the plans.

2. **MATERIAL AND ASSEMBLY.** The aluminum controller cabinet and electro-mechanical control devices must meet the requirements of Material Specification 1497.

The electro-mechanical devices within the cabinet must be attached to a 3/8 inch thick phenolic, linen base, bakelite panel drilled to accommodate the various devices with allowable clearances, and secured in the cabinet with 5/16" - 18 NC x 7/8" stainless steel machine screws, as per Drawing 887(3-phase, 100amp), 883(3-phase, 200amp), 884(1 phase, 100amp), or 886(1-phase,200amp).

The circuit breakers, single-pole, two-pole, or three-pole must meet the requirements of Material Specification 1428. The remote control contactor must be as indicated on the referenced drawings.

3. **INSTALLATION.** The controller must be wired as shown on Drawing 862(100 or 200 amp, 1-phase, with 120 volt photocell), 863(100 amp, 1-phase, with 240 volt photocell), or 864(100 or 200 amp, 3-phase). For a 100 ampere controller the main circuit breaker and the contactor must each have a 100 ampere rating, and the branch circuit breakers must be as indicated on the plans. For a 200 ampere controller the main circuit breaker and the contactor must each have a 200 ampere rating, and the branch circuit breakers must be as indicated on the plans. For a three phase service, a three pole main circuit breaker and three pole contactor of the corresponding ampere rating must be installed and the branch circuit breaker ampere ratings must be as indicated on the plans.

For grounding the cabinet, a bare copper wire, #4 AWG, must be attached from the ground lug in the cabinet to the grounding clamp on the ground rod.

The cabinet must be installed on a ballast housing base, 20 inches in height secured to a concrete foundation as shown on Drawing 876(110 amp) or 880(200 amp), at the location indicated on the plans. The ballast housing base must meet the requirements of Material Specification 1375. The ballast housing must be part of this pay item. The foundation, including anchor rods, washers, and nuts will be a separate pay item.

The installation of feeder cables and branch circuit cables will be performed in a neat and workmanlike manner with all cable trained around the cabinet, secured to the proper terminals and identified either by tagging of the cables, or by identification of the branch breakers, all as part of the controller installation and not as a separate pay item.

The lighting circuit will be placed in operation as soon as practicable with the Contractor being charged for the energy until the circuits are accepted by the City of Chicago, Bureau of Electricity.

- 4. **BASIS OF PAYMENT.** This work will be charged for at the contract unit price each for a CONTROLLER, STREET LIGHT, BASE MOUNTED of the proper phase and amperage, and will be payment in full for furnishing and installing the controller complete in place.

MATERIAL SPECIFICATION
1428
1375
1497

DRAWING
736 785 862 863 864
876 880 883 884 886
887

April 3, 2009

ITEM 361, CIRCUIT BREAKER, 2 POLE, 240 VOLT

1. **DESCRIPTION.** This work will consist of furnishing and installing an additional 50 ampere, 2-pole breaker in an existing or proposed street light controller cabinet.
2. **MATERIAL.** The circuit breaker must meet the requirements of Material Specification 1428. The circuit breaker must be a 2-pole, 50 ampere, 600 volt rated breaker with an AEHD@ frame. The interrupting capacity must be 18000 amperes at 240 volts a.c. .
3. **INSTALLATION.** The circuit breaker must be mounted on the mounting panel in the controller. The panel will be cut and drilled to accept the breaker. The breaker must then be wired into the panel to create an additional branch breaker.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each CIRCUIT BREAKER, 2 POLE, 240 VOLT, which payment will be in full for providing, installing, and making operational the said circuit breaker.

September 1, 2006

ITEM 362, TRAFFIC SIGNAL HARNESS CABLE, #16, 8/C

1. **DESCRIPTION.** This item will consist of furnishing and installing cable in traffic signal poles to connect traffic signals or illuminated signs to a junction box on the pole.
2. **MATERIAL.** The cable must meet the requirements of Material Specification 1475.
3. **INSTALLATION.** The contractor must install the cable from the required signal or sign terminal strip through the pole and mast arm to the terminal strip in the junction box. The contractor must properly terminate the cable at the terminal strips as directed by the Engineer. Sufficient cable will be provided so as not to unduly strain the cable during installation, and to provide sufficient cable for easy termination.
4. **METHOD OF MEASUREMENT.** This work will be measured per lineal foot of cable installed. Cable terminations will be considered incidental to this pay item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for HARNESS CABLE, #16, 8/C, which payment will be in full for furnishing and installing the cable.

September 1, 2006

ITEM 364, TRAFFIC SIGNAL TEMPORARY CABLE

1. **DESCRIPTION.** This item will consist of furnishing and installing cable on traffic signal poles to temporarily connect traffic signals or illuminated signs to the controller.
2. **MATERIAL.** The cable must meet the requirements of Material Specification 1475.
3. **INSTALLATION.** The contractor will install the cable from the locations indicated by the Engineer or as shown on the plans, on the outside of the poles, aerially from one location to the next. The cable will be hung from the poles without damaging the poles by methods approved by the Engineer. If cable is to be run to the controller, a conduit riser with weatherhead must be provided for cable entry. The contractor must properly terminate the cable at the terminal strips, or as directed by the Engineer. Sufficient cable must be provided so as not to unduly strain the cable during installation, and to provide sufficient cable for easy termination.
4. **METHOD OF MEASUREMENT.** This work will be measured per lineal foot of cable installed. Cable terminations, and hanging of the cable from the poles will be considered incidental to this pay item.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for HARNESS CABLE, #16, 8/C, which payment will be in full for furnishing and installing the cable.

September 1, 2006

ITEM 371A, SIGN, SYMBOLIC NLT, LED ILLUMINATED, BRACKET MOUNTED

ITEM 372A, SIGN, SYMBOLIC NLT, LED ILLUMINATED, MAST ARM MOUNTED

ITEM 371B, SIGN, SYMBOLIC NRT, LED ILLUMINATED, BRACKET MOUNTED

ITEM 372B, SIGN, SYMBOLIC NRT, LED ILLUMINATED, MAST ARM MOUNTED

ITEM 371C, SIGN, SYMBOLIC DNE, LED ILLUMINATED, BRACKET MOUNTED

ITEM 372C, SIGN, SYMBOLIC DNE, LED ILLUMINATED, MAST ARM MOUNTED

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1. **DESCRIPTION.** This item will consist of furnishing and installing a single faced, illuminated, LED sign, either bracket mounted on a street light or traffic signal pole, or on a traffic post, or mounted on an overhead traffic signal arm, at the location shown on the plans or as authorized by the Engineer. The sign will be symbolic meeting the requirements of the MUTCD, as required in the plans or as directed by the Engineer.
 2. **MATERIAL.** The sign must meet the requirements of Material Specification 1518 for the particular sign specified. The mounting brackets must meet Material Specification 1463 for mast arm mounted signs. Signs mounted to the sides of poles must be mounted using 1.5" galvanized rigid steel pipe and associated fittings. The cable must meet the applicable requirements of Material Specification 1475.
 3. **INSTALLATION.** Each sign must be faced in the direction of the traffic it is intended to control. During construction and until the installation is placed in operation, the sign face must be hooded. The hooding material must be securely fastened so it will not be disturbed by inclement weather or wind. The signs will be mounted as shown on Standard Drawing 834 and 835.

The bracket mounted sign must be mounted using pole mounting brackets banded to the pole with two strips of 3/4" stainless steel banding, single wrapped, one at the top and one at the bottom of the brackets, each secured with a stainless steel banding clip. The banding and clips must have a baked-on black finish. The mounting configuration connecting the sign to the mounting bracket must consist of sections of 1 1/2" rigid steel conduit of precise lengths as indicated on the standard drawing to create the designated structure. When the sign is to be mounted on a square pole or flat surface, the bracket will be bolted to the flat pole or surface using 3/8" drive studs where permissible or using 3/8" studs in tapped holes. The bottom mounting bracket must be accurately located to cover an

opening 1" in diameter, for cable entrance, drilled into the pole or standard at a calculated height to position the bottom sign face at a standard height of fourteen feet and eight inches (14'-8"), or a height indicated on the plans. The opening must be reamed or filed to remove all sharp edges or burrs which might damage cable during installation, or through vibration when the sign is in operation.

The mast arm mounted sign must be mounted using a bracket specifically designed for the purpose. The bracket must be banded to the mast arm using two strips of 3/4" stainless steel banding, single wrapped, each secured with a stainless steel banding clip. The banding and clips must have a baked-on black finish. A one inch (1") diameter hole must be drilled in the mast arm to accept the cable. The hole must be reamed or filed to provide a smooth surface, so as not to damage the cable during installation or under normal weather conditions or from vibrations.

The Contractor must provide and install the flexible electrical harness cable. The cable must be of sufficient length to extend without strain or stress from the sign head to the terminal strip in the junction box mounted on the pole.

The harness cable from the sign must enter the pole or mast arm through the bottom mounting bracket and enter the long sweep elbow to terminate by attachment to the terminal strip in the junction box in accordance with connector schematic, Bureau of Electricity Drawing Number 12268-A.

The pole mounting bracket, and the crosses are to be factory painted by the manufacturer with baked on black enamel.

- 4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, completely wired and operational.

- 5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each SIGN, SYMBOLIC, LED ILLUMINATED, BRACKET MOUNTED or MAST ARM MOUNTED, with the symbol specified, which price will be payment in full for furnishing and installing the sign complete.

SPECIFICATIONS
1463
1475
1518

DRAWINGS
834
835
12268A

August 18, 2006

ITEM 374, CONTROLLER, TRAFFIC, 12 LOAD BAY, M CABINET
ITEM 377, CONTROLLER, TRAFFIC, 12 LOAD BAY, P CABINET
ITEM 380, CONTROLLER, TRAFFIC, 16 LOAD BAY, P CABINET

1. **DESCRIPTION.** This work will consist of furnishing and installing a traffic signal controller and associated equipment in a cabinet onto a foundation and making all necessary connections.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1469. The cabinet will be an M cabinet 50 inches high by 30 inches wide by 17 inches deep, with 12 load bays, or a P cabinet 55 inches high by 44 inches wide by 26 inches deep with 12 load bays or 16 load bays. Each load bay must include a load switch. No communications interface equipment will be included.
3. **PROCUREMENT.** The contractor must provide Request for Inspection of Material forms for traffic signal controllers and cabinets at the Preconstruction Meeting. The Bureau of Electricity will review and comment on the submitted material. The Bureau of Electricity will approve the purchase of the material from a supplier. Final material approval will be made in accordance with Bureau of Electricity specifications. The Contractor must provide proof of purchase to the Resident Engineer within seven (7) days following approval by the Bureau of Electricity or within seven (7) days of the contract Notice To Proceed, whichever is later. Payment will be withheld in accordance with the terms and conditions of this contract, until such time that the Commissioner determines the requirements are met.

The controllers and cabinets are to be delivered to the Bureau of Electricity within ninety (90) days of purchase. If the controllers and cabinets are not delivered, payment will be withheld until such time that the controllers and cabinets are delivered.

The Bureau of Electricity will notify the Contractor when the material has been inspected and approved. Within forty-eight (48) hours of notification, the Contractor will pick-up the controllers and cabinets from the Bureau. The controllers and cabinets will be stored at a facility, approved by the Commissioner, at the contractor's expense.

4. **INSTALLATION.** The controller will be programmed to provide the sequencing and timing of operation as shown on the plans. The controller must be enclosed in a housing and installed in a completely wired cabinet. The model and serial numbers of the controller must be affixed on the front of the controller housing and be readily visible.

The cabinet must be set onto a pad foundation designed specifically for the cabinet, and affixed with four bolts provided with the foundation. Electric cables inside the cabinet must be neatly trained along the base and back of the cabinet. Each conductor used must be connected individually to the proper terminal, and the spare conductors must be insulated and bound into a neat bundle. Each cable must be marked with suitable identification and recorded on a copy of the plans for the intersection and submitted to the Engineer. Signal indications for each direction must be wired to a separate circuit whether or not the signal plans call for a split movement. The absolute zero for the time-base coordinator will be set in the field by City personnel after obtaining the appropriate City time-tone reference.

When properly installed, all signals will be connected and controlled by the controller, and the sequencing and timing of the signals will be as set forth in the plans.

All conduit entrances into the cabinet must be sealed with a pliable waterproof material to restrict moisture entrance into the cabinet.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each CONTROLLER, TRAFFIC, 12 LOAD BAY, M CABINET or CONTROLLER, TRAFFIC, 12 LOAD BAY, P CABINET, or CONTROLLER, TRAFFIC, 16 LOAD BAY, P CABINET, which price will be payment in full for furnishing and installing the controller complete and operational, with all wiring and connections as specified.

December 10, 2003

ITEM 376, ATC CONTROLLER, TRAFFIC, 16 LOAD BAY, WITH UPS

1. **DESCRIPTION.** This work will consist of furnishing and installing an Advanced Transportation Controller (ATC) with a battery powered back-up system and associated equipment in a cabinet onto a foundation and making all necessary connections.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1560, “Advanced Transportation Controller and Cabinet with Uninterruptible Power Supply”. The cabinet will be a Super P cabinet 16 load bays. Each load bay must include a load switch. A battery powered uninterruptible power supply (UPS) system must be included. Communications interface equipment, if required, will be included under a separate item.
3. **PROCUREMENT.** The contractor must provide Request for Inspection of Material forms for traffic signal controllers and cabinets as requested for specific projects. The Division of Electrical Operations will review and comment on the submitted material. The Division of Electrical Operations will approve the purchase of the material from a supplier. Final material approval will be made in accordance with Chicago Department of Transportation specifications. The Contractor must provide proof of purchase to the Resident Engineer within seven (7) days following approval by the Division of Electrical Operations. Payment will be withheld in accordance with the terms and conditions of this contract, until such time that the Commissioner determines the requirements are met.

The controllers and cabinets are to be delivered to the Division of Electrical Operations within ninety (90) days of purchase. If the controllers and cabinets are not delivered, payment will be withheld until such time that the controllers and cabinets are delivered.

The Division of Electrical Operations will notify the Contractor when the material has been inspected and approved. If a railroad interconnect is involved, a representative from the Illinois Commerce Commission will also need to review and inspect the controller at the Division’s facilities. Within forty-eight (48) hours of notification, the Contractor must pick-up the controllers and cabinets from the Division. The controllers and cabinets will be stored at a facility, approved by the Commissioner, at the contractor’s expense.

4. **INSTALLATION.** The controller will be programmed to provide the sequencing and timing of operation as shown on the plans. The controller must be enclosed in a housing and installed in a completely wired cabinet. The model and serial numbers of the controller must be affixed on the front of the controller housing and be readily visible.

The cabinet must be set onto a pad foundation designed specifically for the cabinet, and affixed with bolts provided with the foundation. Electric cables inside the cabinet must be neatly trained along the base and back of the cabinet. Each conductor used must be connected individually to the proper terminal, and the spare conductors must be insulated and bound into a neat bundle. Each cable must be marked with suitable identification and recorded on a copy of the plans for the intersection and submitted to the Engineer. Signal indications for each direction must be wired to a separate circuit whether or not the signal plans call for a split movement. The absolute zero for time coordination will be set in the field by City personnel after obtaining the appropriate City time-tone reference.

When properly installed, all signals will be connected and controlled by the controller, and the sequencing and timing of the signals will be as set forth in the plans.

All conduit entrances into the cabinet must be sealed with a pliable waterproof material to restrict moisture entrance into the cabinet.

Division of Electrical Operations and Division of Safety personnel from the Chicago Department of Transportation must be present during the cutover to the new control equipment. If a railroad interconnect is part of the signal project, a representative from the Illinois Commerce Commission must be invited to be present for the cutover.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each ATC CONTROLLER, TRAFFIC, 16 LOAD BAY, WITH UPS, which price will be payment in full for furnishing and installing the controller complete and operational, with all wiring and connections as specified.

April 7, 2014

Item 376

Page 2

ITEM 380, ATC CONTROLLER, TRAFFIC, 16 LOAD BAY, P CABINET

1. **DESCRIPTION.** This work will consist of furnishing and installing an Advanced Transportation Controller (ATC) and associated equipment in a cabinet onto a foundation and making all necessary connections.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1558, "Advanced Transportation Controller and Cabinet". The cabinet will be a P cabinet 55 inches high by 44 inches wide by 26 inches deep with 16 load bays. Each load bay must include a load switch. No communications interface equipment will be included.
3. **PROCUREMENT.** The contractor must provide Request for Inspection of Material forms for traffic signal controllers and cabinets at the Preconstruction Meeting. The Division of Electrical Operations will review and comment on the submitted material. The Division of Electrical Operations will approve the purchase of the material from a supplier. Final material approval will be made in accordance with Chicago Department of Transportation specifications. The Contractor must provide proof of purchase to the Resident Engineer within seven (7) days following approval by the Division of Electrical Operations or within seven (7) days of the contract Notice To Proceed, whichever is later. Payment will be withheld in accordance with the terms and conditions of this contract, until such time that the Commissioner determines the requirements are met.

The controllers and cabinets are to be delivered to the Division of Electrical Operations within ninety (90) days of purchase. If the controllers and cabinets are not delivered, payment will be withheld until such time that the controllers and cabinets are delivered.

The Division of Electrical Operations will notify the Contractor when the material has been inspected and approved. Within forty-eight (48) hours of notification, the Contractor must pick-up the controllers and cabinets from the Division. The controllers and cabinets will be stored at a facility, approved by the Commissioner, at the contractor's expense.

4. **INSTALLATION.** The controller will be programmed to provide the sequencing and timing of operation as shown on the plans. The controller must be enclosed in a housing and installed in a completely wired cabinet. The model and serial numbers of the controller must be affixed on the front of the controller housing and be readily visible.

The cabinet must be set onto a pad foundation designed specifically for the cabinet, and affixed with four bolts provided with the foundation. Electric cables inside the cabinet must be neatly trained along the base and back of the cabinet.

Each conductor used must be connected individually to the proper terminal, and the spare conductors must be insulated and bound into a neat bundle. Each cable must be marked with suitable identification and recorded on a copy of the plans for the intersection and submitted to the Engineer. Signal indications for each direction must be wired to a separate circuit whether or not the signal plans call for a split movement. The absolute zero for time coordination will be set in the field by City personnel after obtaining the appropriate City time-tone reference.

When properly installed, all signals will be connected and controlled by the controller, and the sequencing and timing of the signals will be as set forth in the plans.

All conduit entrances into the cabinet must be sealed with a pliable waterproof material to restrict moisture entrance into the cabinet.

Division of Electrical Operations and Division of Safety personnel from the Chicago Department of Transportation must be present when the new signal equipment is put into operation.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each ATC CONTROLLER, TRAFFIC, 16 LOAD BAY, P CABINET, which price will be payment in full for furnishing and installing the controller complete and operational, with all wiring and connections as specified.

April 7, 2014

Item 380

Page 2

ITEM 381, INTERCONNECT, 7 WIRE MASTER
ITEM 381A, INTERCONNECT, 7 WIRE LOCAL

1. **DESCRIPTION.** This work will consist of furnishing and installing an interconnect panel and relays in a controller cabinet and making all the proper connections. The interconnect is for copper wire.
2. **MATERIAL.** The material must meet the requirements of Section 2.14, Communications Interface Panel, of Material Specification 1469. The master interconnect panel or the local interconnect panel must meet the requirements of the applicable parts of Section 2.14.1 (2).
3. **INSTALLATION.** The panel and relays must be installed in the cabinet and properly connected to the controller and time base coordinator, as required. The cabinet, controller, and other equipment will be supplied and installed under different pay items.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for INTERCONNECT, 7 WIRE, MASTER or LOCAL, which payment will be in full for furnishing, installing, and making operational the specified equipment.

MATERIAL
1469

May 23, 2001

ITEM 382, CONTROLLER, TRAFFIC, TEMPORARY

1. **DESCRIPTION.** This work will consist of providing a temporary traffic controller mounted to a traffic post or pole, or as directed by the Engineer. The controller must be maintained by the contractor until such time as the permanent traffic signal installation is accepted for operation.
2. **MATERIAL.** The contractor must supply a controller cabinet, and all necessary equipment to operate the traffic signals according to the sequencing and timing required in the plans, or as directed by the Engineer.
3. **INSTALLATION.** The contractor will install the cabinet to a post or pole using whatever methods are necessary to secure the cabinet. The contractor must completely wire the controller, so that the intersection becomes fully functional.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each CONTROLLER, TRAFFIC, TEMPORARY, which payment will be in full for furnishing, installing, and making operational the specified electrical equipment. The cabinet and controller will remain the property of the contractor.

May 23, 2001

ITEM 385, CONCRETE PEDESTAL BLOCK

1. **DESCRIPTION.** This work will consist of providing a temporary concrete block for mounting a traffic pedestal with traffic signals. The traffic signals will be fed by overhead cable.
2. **MATERIAL.** The contractor must supply a 3 foot by 3 foot by 3 foot block of concrete. To accommodate a traffic pedestal, 3/4" by 30" anchor rods meeting the requirements of Material Specification 1457 and Standard Drawing 844 must be installed in the concrete in a 13" bolt circle. The anchor rods must have 3.5" of thread exposed to mount the pedestal. All washers and nuts must be supplied.
3. **INSTALLATION.** The contractor will install the block as shown on the plans or as directed by the Engineer. Drawing 835 shows a typical installation. The block will be part of a temporary traffic signal installation.
4. **METHOD OF MEASUREMENT.** This work will consist of providing and placing the block only. All other work associated with the traffic signals will be covered by other items.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each CONCRETE PEDESTAL BLOCK, which payment will be in full for furnishing and installing the block. The block will remain the property of the contractor.

May 23, 2001

ITEM 386, MAINTENANCE OF EXISTING TRAFFIC SIGNAL INSTALLATION

1. **DESCRIPTION.** This work will consist of maintaining an existing traffic signal installation that has been designated to remain in operation during construction of the new traffic signals. If during the course of construction, it becomes necessary to use temporary aerial cable to keep the intersection functioning, this work will be performed at no additional cost. However, the need for temporary traffic signals and controllers will be paid for under separate items, as shown on the plans or as directed by the Engineer.
2. **MAINTENANCE PROCEDURES.** Before taking over maintenance of the existing traffic signal installation, the Contractor must arrange to make an inspection with the Engineer to determine if any corrective action needs to be done, and to mutually agree on a date for transferring maintenance. The contractor should normally begin maintaining the existing traffic signals as soon as he begins any work at the site.

The contractor will be responsible for maintaining the traffic signal installation in proper operating condition. The contractor must perform the maintenance procedures as outlined in Section 802.07 of the Standard Specifications.

The traffic controller must be maintained as outlined in Section 850.03 of the Standard Specifications.

3. **METHOD OF MEASUREMENT.** This work will be measured per week. The time frame will begin at the mutually agreed date for taking over maintenance. The time frame will end upon the issuance of a Signal Acceptance Notice from the Engineer. Before such notice is given, a final inspection must be performed with the contractor, the Engineer, and a representative from the Chicago Department of Transportation. The time frame may be measured in full weeks and fractions thereof.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per week, or fraction thereof, for MAINTENANCE OF EXISTING TRAFFIC SIGNAL INSTALLATION, which payment will be in full for maintaining the traffic signals during said time frame. If for any reason the contractor fails to properly maintain the traffic installation, leading to and requiring a response from the City maintenance forces, the cost of such a response will be charged to the contractor.

October 24, 2006

ITEM 388, TRAFFIC CONTROL AND PROTECTION

1. **DESCRIPTION.** This item will provide for barricades, signage, etcetera, for traffic protection and direction in a construction zone. This item will consist of all applicable parts of Section 701 of IDOT's Standard Specifications for Road and Bridge Construction entitled A Work Zone Traffic Control A and any related material within Section 700. Traffic protection will be as indicated in the construction plans or as directed by the engineer.
2. **BASIS OF PAYMENT.** This item will be paid for at the contract price for lump sum for TRAFFIC CONTROL AND PROTECTION, which payment will be in full for providing all necessary services.

October 24, 2006

ITEM 389, STREET NAME SIGNS

1. **DESCRIPTION.** This item will consist of furnishing, fabricating, and installing a street name sign on a traffic pole with a monotube arm as indicated on the plans, or as directed by the Engineer. The plans will indicate the location of the sign and the sign legend. The sign panel and associated hardware must meet the specifications of Section 720 - SIGN PANELS AND APPURTENANCES of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction. The signs must meet the requirements as to size, mounting hardware, and mounting location per City of Chicago Department of Transportation standard drawings for D3-1 Street Name Sign Installation, Regulatory Sign Installation on Traffic Signals and D3-1 Sign and Bracket Specs.
2. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each street name sign and must include all necessary hardware and labor to erect the sign.

DRAWINGS:

D3-1 Street Name Sign Installation

Regulatory Sign Installation on Traffic Signals

D3-1 Sign and Bracket Specs

May 23, 2001

ITEM 502, ELECTRICAL EQUIPMENT REMOVAL

1. **DESCRIPTION.** This work will consist of the removal and disposal of existing electrical equipment including, but not limited to, ballast bases, risers, racks, cross arms, cable, truss arms, and clamps as specified on the plans or as directed by the Engineer.
2. **GENERAL REQUIREMENTS.** Electrical equipment to be removed must be disassembled as required for the complete removal of the item from the work site. Removal must include all incidental work and items associated with the electrical equipment as directed by the Engineer.
3. **METHOD OF MEASUREMENT.** Electrical equipment to be removed will be measured for payment by each unit removed, with the exception of cable. Cable will be measured by the foot. Cable to be removed must be measured by horizontal distances only from point to point, and will not include slack, sag, or other vertical dimensions.
4. **BASIS OF PAYMENT.** Electrical equipment removal will be paid for at the contract unit price for each unit removed, which price will be payment in full for all labor, equipment, materials, and incidental work necessary for the complete removal, transport, disposal, and disposal fees to complete the work as specified. Cable will be paid for at the contract unit price per foot, which price will be payment in full for all labor, equipment, materials, and incidental work necessary for the complete removal, transport, disposal, and disposal fees to complete the work as specified.

This specification also applies to Items 521, 523, 524, 533, 534, 541, 542, 544, 545, 546, 547, 548, 549, 550, 557, 558, 559, 567, 568, 573, 5731, 5732, 5733, 574, 577, 578, 579, 5791, 5792, 580, 581, 5811, 582, 583, 584, 585, 586, 587, 588, 593

August 18, 2006

ITEM 504, ELECTRICAL EQUIPMENT REMOVAL AND SALVAGE

1. **DESCRIPTION.** This work will consist of the removal, salvage, and delivery of existing electrical equipment, including but not limited to light poles, arms, luminaires, signs, signals, controllers, and enclosures as specified on the plans or as directed by the Engineer. Salvaged electrical equipment must be delivered to the Division of Electrical Operations (DEO) yard at 2451 South Ashland Avenue, or as directed by the Engineer.
2. **GENERAL REQUIREMENTS.** Electrical equipment to be removed and salvaged must be disassembled as required for the complete and safe removal and transport of the item from the work site. Electrical equipment must be hoisted, loaded and secured on adequate transport with care to prevent damage. Removal will include all incidental work and items associated with the equipment as directed by the Engineer.
3. **METHOD OF MEASUREMENT.** Electrical equipment to be removed and salvaged must be measured per each unit removed and salvaged.
4. **BASIS OF PAYMENT.** Electrical equipment removal and salvage will be paid for at the contract unit price for each unit removed and salvaged, which price will be payment in full for all labor, equipment, materials, and incidental work necessary to complete the work as specified.

This specification also applies to Items 503, 504, 505, 510 to 519, 526, 526A, 528 to 531, 539, 553 to 556, 560 to 565, 569 to 572, 575, 576, 589, 590, 5910, 5911, 5920, 5921

October 5, 2020

ITEM 506, EMBEDDED POLE REMOVAL, CTA
ITEM 507, EMBEDDED POLE REMOVAL, 7 GAUGE, 33 FEET
ITEM 508, EMBEDDED POLE REMOVAL, 7 GAUGE, 35 FEET
ITEM 509, EMBEDDED POLE REMOVAL, 3 GAUGE, 35 FEET

1. **DESCRIPTION.** This work will consist of the removal, salvage, and delivery of existing embedded poles and the restoration of the disturbed area as specified on the plans or as directed by the Engineer. Salvaged poles must be delivered to the Division of Electrical Operations (DEO) yard at 2451 South Ashland Avenue, or as directed by the Engineer.
2. **GENERAL REQUIREMENTS.** Electrical poles to be removed must be disassembled as required for the complete and safe removal and transport of the item from the work site. Poles will be hoisted, loaded and secured on adequate transport with care to prevent damage. The area of the pole removal must be restored to like condition of the area surrounding the removed pole. Removal must include all incidental work and items associated with the pole as directed by the Engineer. If a CTA pole cannot be removed, it must be burned off at 18 inches below grade and disposed of in an approved manner as directed by the Engineer. The area must then be restored in an approved manner. The engineer will determine if the pole is salvageable.
3. **METHOD OF MEASUREMENT.** Electrical poles to be removed will be measured for payment by each unit removed and salvaged.
4. **BASIS OF PAYMENT.** Electrical pole removal and salvage, including site restoration, will be paid for at the contract unit price for each pole, which price will be payment in full for all labor, equipment, materials, and incidental work necessary to remove and salvage the pole and for the restoration of the site as specified. Disposal, if necessary, and disposal fees will be considered incidental and not be paid for separately.

October 10, 2020

**ITEM 536, ELECTRICAL SERVICE EQUIPMENT REMOVAL ON CECO POLE
ITEM 537, ELECTRICAL SERVICE EQUIPMENT REMOVAL ON EMBEDDED
POLE**

1. **DESCRIPTION.** This work will consist of the removal and disposal of existing electrical service equipment, except that the junction box must be salvaged and delivered to the Bureau of Electricity as specified on the plans or as directed by the Engineer. The junction box must be delivered to the Division of Electrical Operations (DEO) yard at 2451 South Ashland Avenue, or as directed by the Engineer. The remainder of the removal shall conform to the requirements of Specification 541.
2. **GENERAL REQUIREMENTS.** Electrical service equipment to be removed must be disassembled as required for the complete removal of the item from the work site. Removal will include all incidental work and items associated with the electrical equipment as directed by the Engineer. The junction box to be removed and salvaged must be disconnected from the conduit riser and cables as required for safe removal and transport. The junction box must be handled with care to prevent damage.
3. **METHOD OF MEASUREMENT.** Electrical service equipment to be removed will be measured for payment by each service unit removed. This will include disconnecting all cable from the disconnect box, the removal of the service entrance cable, removal of the disconnect box, removal of any conduit or other pole attachments, and the salvaging of the disconnect box. Removal of the cable from the disconnect box to the street light or traffic controller will not be included under this item.
4. **BASIS OF PAYMENT.** Electrical service equipment removal will be paid for at the contract unit price for each unit removed, which price will be payment in full for all labor, equipment, materials, and incidental work necessary for the complete removal, transport, disposal, and disposal fees to complete the work as specified. Removal and salvage of the junction box will be considered incidental and not paid for separately.

March 20, 2022

**ITEM 596, BREAKDOWN EXISTING HANDHOLE
ITEM 597, BREAKDOWN MANHOLE IN PARKWAY
ITEM 598, BREAKDOWN MANHOLE IN PAVEMENT**

1. **DESCRIPTION.** Work under this item will include breaking down an existing handhole or manhole and filling in the affected area to grade.
2. **DEMOLITION.** This work will consist of removing the frame and cover of an existing handhole or manhole, breaking down the handhole/manhole walls, removing large debris, and backfilling the hole with screenings or other approved material. Backfill must be installed in 6 inch layers and tamped. If the handhole/manhole is in a parkway, the hole must be filled level to the existing grade. The top six inches of fill must be of an approved soil mixture. If the handhole/manhole is in sidewalk or in pavement, the sidewalk or pavement must be restored under a different pay item. If the frame or cover is deemed re-useable by the Engineer, the frame and/or cover must be delivered to the Bureau of Electricity at a location identified by the Engineer. Any debris, including the frame and cover must be disposed of off-sight in an approved manner. The contractor will pay for all disposal fees.
3. **METHOD OF MEASUREMENT.** This work will be paid for per each manhole or handhole removed. All backfill will be considered as part of the manhole breakdown.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for BREAKDOWN EXISTING HANDHOLE, or BREAKDOWN EXISTING MANHOLE IN PARKWAY, or BREAKDOWN EXISTING MANHOLE IN PAVEMENT, which price will be payment in full for all labor and materials necessary to complete the work as described. Salvaging of the frame and cover will be considered incidental to this item.

ITEM 600, BREAKDOWN CONTROLLER FOUNDATION, TYPE A
ITEM 601, BREAKDOWN STREET LIGHT FOUNDATION
ITEM 602, BREAKDOWN FONDATION, TYPE B
ITEM 603, BREAKDOWN FOUNDATION FOR BASE MOUNTED
CONTROLLER
ITEM 604, BREAKDOWN FOUNDATION, 24 INCH DIAMETER, FIRE ALARM

1. **DECRPTION.** The work will consist of removing a concrete foundation for the specific item referenced. The foundation must be completely removed or broken down to a point three feet blow grade, disposing of the debris off-sight in an approved manner, backfilling the excavation with screenings or other approved backfill material, and reconstructing the surface area. If the foundation is in a parkway, the parkway must be properly restored with dirt to the existing level. If the foundation is in sidewalk, the sidewalk must be restored under a different pay item and will not be considered as part of this work. Debris must be disposed of according to Section 202.03 of the Standard Specifications. Backfill must meet the requirements of Section 1003.04 of the Standard Specifications.
2. **METHOD OF MEASUREMENT.** This work will be measured per each foundation removed, which will also include proper disposal and backfill.
3. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for BREAKDOWN FOUNDATION, of the type specified, which price will be payment in full for all labor and materials necessary to complete the work as described above. No additional payment will be made for backfill or disposal of debris.

ITEM 701, POLE, ALUMINUM, ARTERIAL, CONVENTIONAL, 15" BOLT CIRCLE

ITEM 702, POLE, ALUMINUM, SKYWAY, CONVENTIONAL, 11.5" BOLT CIRCLE

ITEM 703, POLE, ALUMINUM, RESIDENTIAL, CONVENTIONAL, 10" BOLT CIRCLE

1. **DESCRIPTION.** This item will consist of furnishing, installing, and setting plumb an aluminum anchor base pole to which an aluminum truss arm and a street light luminaire will be attached. The pole will be set on a separate foundation and affixed with anchor rods or bolts.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1452. In addition, the arterial pole must meet the requirements and dimensions of Standard Drawing 938. The Skyway pole must meet the requirements and dimensions of Standard Drawing 939. The residential pole must meet the requirements and dimensions of Standard Drawing 890.
3. **INSTALLATION.** The pole must be installed on a concrete foundation or a steel helix foundation designed for the particular pole usage. When using double-nut construction please follow the details as shown on Standard Drawing 837. Double nut construction provides proper ventilation, as well as providing a way to plumb the pole. When using a helix foundation, double nutting is not feasible. Any exposed portions of anchor rods extending above the nuts which interfere with the installation of the bolt covers must be cut off to provide the necessary clearance. The excess must not be burned off. The pole must be set secure and plumb using the nuts and washer provided with the foundation pay item. The bolt covers, handhole cover, and pole cap must be securely attached. The pole must be properly orientated in relation to the street, so that the truss arm will be perpendicular to the direction of the roadway.
4. **METHOD OF MEASUREMENT.** This item will be measured per unit installed, complete. Work will consist of attaching the pole to the foundation, application of nut covers and pole cap, attachment of handhole door, and plumbing of the pole.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for APOLE, ALUMINUM, ARTERIAL, CONVENTIONAL, 15" BOLT CIRCLE@, APOLE, ALUMINUM, SKYWAY, CONVENTIONAL, 11.5" BOLT CIRCLE@, or APOLE, ALUMINUM, RESIDENTIAL, CONVENTIONAL, 10" BOLT CIRCLE@, which will be payment in full for furnishing and installing the pole complete in place. The light standard foundation, truss arm, and luminaire will not be included in this pay item but will be paid for separately.

MATERIAL SPECIFICATION
1452

DRAWINGS
837 890 938 939

April 7, 2003
Item 701, 702, 703
Page 2

ITEM 701A, MAST ARM, TRUSS, ALUMINUM, ARTERIAL, 8 FOOT
ITEM 701B, MAST ARM, TRUSS, ALUMINUM, ARTERIAL, 12 FOOT
ITEM 701C, MAST ARM, TRUSS, ALUMINUM, ARTERIAL, 15 FOOT
ITEM 703A, MAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 6 FOOT
ITEM 703B, MAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 8 FOOT
ITEM 703C, MAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 12 FOOT
ITEM 703D, MAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 15 FOOT

1. **DESCRIPTION.** This item will consist of furnishing, installing and aligning an aluminum truss mast arm to which a street light luminaire will be attached. The arm will be attached by clamping methods to a conventional aluminum pole.
2. **MATERIAL.** The mast arm must meet the requirements of Material Specification 1453. The mast arm for a conventional residential or Skyway pole must meet the requirements and dimensions of Standard Drawing 943. The mast arm for a conventional arterial pole must meet the requirements of Standard Drawing 944.
3. **INSTALLATION.** The mast arm must be installed on the aluminum pole as shown on the appropriate standard drawing. The truss arm must be attached to the pole by the clamping method using the hardware provided. The pole and arm must be properly orientated in relation to the street.
4. **METHOD OF MEASUREMENT.** The item will be measured per each arm installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for a AMAST ARM, TRUSS, ALUMINUM, ARTERIAL, 8 FOOT @, AMAST ARM, TRUSS, ALUMINUM, ARTERIAL, 12 FOOT @, AMAST ARM, TRUSS, ALUMINUM, ARTERIAL, 15 FOOT @, AMAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 6 FOOT @, AMAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 8 FOOT @, AMAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 12 FOOT @, or AMAST ARM, TRUSS, ALUMINUM, RESIDENTIAL/SKYWAY, 15 FOOT @ which will be payment in full for furnishing and installing the mast arm and hardware complete in place. The light pole, foundation and luminaire will not be included in this pay item but will be paid for separately.

MATERIAL SPECIFICATION
1453

DRAWINGS
943 944

April 7, 2003

Item 701A, 701B, 701C, 703A, 703B, 703C, 703D
Page 2

ITEM 704, POLE, ALUMINUM, SKYWAY, DAVIT, 11.5" BOLT CIRCLE
ITEM 705, POLE, ALUMINUM, RESIDENTIAL, DAVIT, 10" BOLT CIRCLE
ITEM 705s, POLE, ALUMINUM, SHORT RESIDENTIAL, 10" BOLT CIRCLE
ITEM 706, POLE, ALUMINUM, ARTERIAL, DAVIT, 15" BOLT CIRCLE
ITEM 706s, POLE, ALUMINUM, SHORT ARTERIAL, 15" BOLT CIRCLE

1. **DESCRIPTION.** This item will consist of furnishing, installing and setting plumb an aluminum anchor base pole to which an aluminum davit arm and a street light luminaire will be attached. The pole will be set on a separate foundation and affixed with anchor rods or bolts.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1452. In addition, the arterial pole must meet the requirements and dimensions of Standard Drawing 941. The short arterial pole must meet the requirements and dimensions of Standard Drawing 941A. The Skyway pole must meet the requirements and dimensions of Standard Drawing 942. The residential pole must meet the requirements and dimensions of Standard Drawing 940. The short residential pole must meet the requirements and dimensions of Standard Drawing 940A.
3. **INSTALLATION.** The pole must be installed on a concrete foundation or a steel helix foundation designed for the particular pole usage. When using double-nut construction please follow the details as shown on Standard Drawing 837. Double nut construction provides proper ventilation, as well as providing a way to plumb the pole. When using a helix foundation, double nutting is not feasible. Any exposed portions of anchor rods extending above the nuts which interfere with the installation of the bolt covers must be cut off to provide the necessary clearance. The excess must not be burned off. The pole must be set secure and plumb using the nuts and washer provided with the foundation pay item. The bolt covers, and handhole cover must be securely attached. The pole must be properly orientated in relation to the street, so that the davit arm will be perpendicular to the direction of the roadway.
4. **METHOD OF MEASUREMENT.** This item will be measured per unit installed, complete. Work will consist of attaching the pole to the foundation, application of nut covers, attachment of handhole door, and plumbing of the pole.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for APOLE, ALUMINUM, SKYWAY, DAVIT, 11.5" BOLT CIRCLE@, APOLE, ALUMINUM, RESIDENTIAL, DAVIT, 10" BOLT CIRCLE@, "POLE, ALUMINUM, SHORT RESIDENTIAL, DAVIT, 10" BOLT CIRCLE", APOLE, ALUMINUM, ARTERIAL, DAVIT, 15" BOLT CIRCLE@, or "POLE, ALUMINUM, SHORT ARTERIAL, DAVIT, 15" BOLT CIRCLE", which will be payment in full for furnishing and installing the pole complete in place. Bolt

covers and the handhole door will be included as incidentals. The light standard foundation (including nuts and washers), davit arm, and luminaire will not be included in this pay item but will be paid for separately.

MATERIAL SPECIFICATION
1452

DRAWINGS
837 940 941 942
940A 941A

November 5, 2009

Page 2
Items 704, 705, 705s, 706, 706s

ITEM 705A, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 8 FOOT

ITEM 705B, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 12 FOOT

ITEM 705C, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 15 FOOT

ITEM 705D, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 180E TWIN, 8 FOOT

ITEM 705E, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 180E TWIN, 12 FOOT

ITEM 705F, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 180E TWIN, 15 FOOT

ITEM 705G, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 90E TWIN, 12 FOOT

ITEM 705H, MAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 90E TWIN, 15 FOOT

1. **DESCRIPTION.** This item will consist of furnishing, installing and aligning an aluminum davit mast arm to which a street light luminaire will be attached. The arm will be attached to an aluminum pole constructed to accept the arm. These arms are designed to fit either the residential davit pole or the Skyway davit pole.

2. **MATERIAL.** The mast arm must meet the requirements of Material Specification 1453. The mast arm for a davit residential or davit Skyway pole must meet the requirements and dimensions of Standard Drawing 945, 946, or 947, depending upon the required overall length of the arm. The davit arm will have a 4.5 inch outside diameter at the base, where it slips over the top of the pole.

3. **INSTALLATION.** The mast arm must be installed on the aluminum pole as shown on the appropriate standard drawing. The davit arm must be attached to the pole by slipping the arm over the top of the pole and securing the arm to the pole with two stainless steel hex-head bolts. Details of the installation may be found on the appropriate standard drawing. The pole and arm must be properly orientated in relation to the street.

4. **METHOD OF MEASUREMENT.** The item will be measured per each arm installed, complete.

5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for a AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 8 FOOT @, AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 12 FOOT @, AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 15 FOOT @, AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 180E TWIN, 8 FOOT @, AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 180E TWIN, 12 FOOT @, AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 180E TWIN, 15 FOOT @, AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 90E TWIN, 12 FOOT A, or AMAST ARM, DAVIT, ALUMINUM, RESIDENTIAL/SKYWAY, 90E TWIN, 15 FOOT @, which will be payment in full for furnishing and installing the mast arm and hardware complete in place. The light pole, foundation and luminaire will not be included in this pay item but will be paid for separately.

MATERIAL SPECIFICATION
1453

DRAWINGS
945 946 947

April 8, 2003

ITEM 706A, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 8 FOOT
ITEM 706B, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 12 FOOT
ITEM 706C, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 15 FOOT
ITEM 706D, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 180E TWIN, 8 FOOT
ITEM 706E, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 180E TWIN, 12 FOOT
ITEM 706F, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 180E TWIN, 15 FOOT
ITEM 706G, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 90E TWIN, 12 FOOT
ITEM 706H, MAST ARM, DAVIT, ALUMINUM, ARTERIAL, 90E TWIN, 15 FOOT

1. **DESCRIPTION.** This item will consist of furnishing, installing and aligning an aluminum davit mast arm to which a street light luminaire will be attached. The arm will be attached to an aluminum pole constructed to accept the arm. These arms are designed to fit the arterial davit pole.
2. **MATERIAL.** The mast arm must meet the requirements of Material Specification 1453. The mast arm for a davit arterial pole must meet the requirements and dimensions of Standard Drawing 948, 949, or 950, depending upon the required overall length of the arm. The davit arm will have a 6 inch outside diameter at the base, where the arm slips over the top of the pole.
3. **INSTALLATION.** The mast arm must be installed on the aluminum pole as shown on the appropriate standard drawing. The davit arm must be attached to the pole by slipping the arm over the top of the pole and securing the arm to the pole with two stainless steel hex-head bolts. Details of the installation may be found on the appropriate standard drawing. The pole and arm must be properly orientated in relation to the street.
4. **METHOD OF MEASUREMENT.** The item will be measured per each arm installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the Contract unit price each for a AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 8 FOOT @, AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 12 FOOT @, AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 15 FOOT @, AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 180E TWIN, 8 FOOT @, AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 180E TWIN, 12 FOOT @, AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 180E TWIN, 15 FOOT @, AMAST ARM, DAVIT, ALUMINUM, ARTERIAL, 90E TWIN, 12 FOOT A, or AMAST ARM,

DAVIT, ALUMINUM, ARTERIAL, 90E TWIN, 15 FOOT @, which will be payment in full for furnishing and installing the mast arm and hardware complete in place. The light pole, foundation and luminaire will not be included in this pay item but will be paid for separately.

MATERIAL SPECIFICATION
1453

DRAWINGS
948 949 950

April 8, 2003

Item 706A-706H
Page 2

ITEM 2002, VIDEO DETECTION CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic detection video camera onto a traffic signal pole, a traffic signal mast arm, or a luminaire mast arm. The camera will be part of a total detection system connected to the traffic controller.
2. **MATERIAL.** The video camera and mounting bracket must meet the requirements of Material Specification 1540.
3. **INSTALLATION.** The video camera must be mounted as indicated in the plans or as directed by the traffic engineer. If the camera is mounted to the side of the pole, a side pole mount must be used. If the camera is mounted to the top of a mast arm, a mast arm mount must be used. The camera must be affixed to the mount as per manufacturer's instructions. The mount must be attached to the pole or arm using two strips of 3/4" stainless steel banding single wrapped, each secured with a stainless steel banding clip. Alternate methods may be considered.

If the camera is to be mounted to the side of a pole, a one inch diameter hole for cable must be drilled at the proper height and location. The hole must be smooth and free of any sharp edges so that cable will not be damaged. The camera mount must be positioned directly over the hole.

If the camera is to be mounted to the top of a mast arm, a one inch hole for cable entrance must be drilled in the bottom of the arm directly below where the camera is to be mounted. The hole must be drilled in the bottom of the arm to lessen the possibility of water intrusion. The hole must be free of any sharp edges so that cable will not be damaged.

The camera must be programmed, aimed and focused as per the manufacturer's instructions to meet the requirements of the plans and the traffic engineer for the area of detection required. This work is part of this item, but cannot be accomplished until the entire video detection system is installed.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each VIDEO DETECTION CAMERA, which price will be payment in full for furnishing and installing the camera and mount complete, including all programming, focusing, and aiming.

MATERIAL SPECIFICATION
1540

November 29, 2006

Item 2002
Page 2

ITEM 2007, COAXIAL ELECTRIC CABLE IN CONDUIT FOR VIDEO

1. **DESCRIPTION.** This work will consist of furnishing and installing coaxial electric cable as specified. The cable will be installed in underground conduit and in traffic signal poles. The cable will be used for a video camera mounted on a light pole.
2. **MATERIAL.** The coaxial cable must be classified as RG 59/U. The conductor must be solid bare copper or solid bare copper coated steel. The insulation must be polyethylene or equivalent. The shield must be a bare copper braid. The jacket must be black polyvinylchloride or equivalent. The cable must be rated at 80° Centigrade and service at 30 Volts. Each end must be equipped with a male BNC connector crimped to the cable.
3. **CONSTRUCTION METHOD.** All cable must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced at no cost to the City.

The cable will be terminated at one end in a traffic signal controller cabinet at the interface panel. The cable will be terminated at the other end to female to female connector to be located in the junction box on the traffic signal pole. The cable will run in underground conduit, handholes, manholes, conduit risers, and traffic signal pole shafts.

The cable must be pulled with a minimum of friction. Lubricants will be used to facilitate installation if deemed necessary. Bends in the cable must conform to the recommended minimum radius as outlined in the National Electric Code. No splicing of the cable will be allowed.

Cable passing through manholes must be trained and racked around the sides of the manhole into a permanent position. If racks are non-existent or in poor condition, the contractor must install racks. The material must be approved by the resident engineer. Any material and labor involved in training and racking the cable will be considered incidental to the cost of this pay item.

Cable in a handhole will have at least five feet of slack and cable in a manhole will have at least ten feet of slack.

4. **METHOD OF MEASUREMENT.** The length of cable furnished and installed will be measured as the entire length of cable; measurements being taken both vertically and horizontally, plus any slack in manholes or handholes.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for COAXIAL ELECTRIC CABLE IN CONDUIT FOR VIDEO. Such

price will be payment in full for furnishing, installing, terminating, and testing the cable, and will include all material, labor, and incidentals necessary to complete the work and complete an operating and working circuit as per the plans. The BNC connectors at each end of the cable will be considered incidental to this item.

November 29, 2006

Item 2007

Page 2

ITEM 2009, ELECTRIC CABLE IN CONDUIT , 3/C #14, FOR VIDEO

1. **DESCRIPTION.** This work will consist of furnishing and installing electric cable as specified. The cable will be installed in underground conduit and in traffic signal poles. The cable will be used for power service to a video camera. e.
2. **MATERIAL.** The cable must meet the applicable requirements of Material Specification 1457 of the Bureau of Electricity, City of Chicago.
3. **CONSTRUCTION METHOD.** All cable must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced at no cost to the City.

The cable will be terminated at one end at the camera interface panel in a traffic signal controller cabinet. The cable will be terminated at the other end to a terminal strip in a junction box mounted on a traffic signal pole. The cable will run in underground conduit, handholes, manholes, and pole shafts.

The cable must be pulled with a minimum of friction. Lubricants will be used to facilitate installation if deemed necessary. Bends in the cable must conform to the recommended minimum radius as outlined in the National Electric Code. No splicing of the cable will be allowed.

Cable passing through manholes or handholes must be trained and racked around the sides of the manhole or handhole into a permanent position. If racks are non-existent or in poor condition, the contractor must install racks. The material must be approved by the resident engineer. Any material and labor involved in training and racking the cable will be considered incidental to the cost of this pay item.

Cable in a handhole will have at least five feet of slack and cable in a manhole will have at least ten feet of slack.

4. **METHOD OF MEASUREMENT.** The length of cable furnished and installed will be measured as the entire length of cable; measurements being taken both vertically and horizontally, plus any slack in manholes or handholes.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per lineal foot for ELECTRIC CABLE 3/C #14 FOR VIDEO. Such price will be payment in full for furnishing, installing, terminating, and testing the cable, and will include all material, labor, and incidentals necessary to complete the work and complete an operating and working circuit as per the plans.

MATERIAL
1457

August 14, 2006

Item 2009
Page 2

ITEM 2011, VIDEO CABLE HARNESS

1. **DESCRIPTION.** This work will consist of furnishing and installing a composite cable consisting of coaxial electric cable and an eight conductor power cable. The cable will be used as a link between a video detection camera and cable at the junction box on a traffic signal pole.
2. **MATERIAL.** The coaxial cable must be classified as RG 59/U. The conductor must be solid bare copper or solid bare copper coated steel. The insulation must be polyethylene or equivalent. The shield must be a bare copper braid. The jacket must be black polyvinylchloride or equivalent. The cable must be rated at 80° Centigrade, 75 ohms, and 30 Volts. One end must be equipped with a male BNC connector crimped to the cable. The power cable must meet the applicable requirements of Material Specification 1457. The power cable must have eight insulated copper conductors size #16 AWG in one jacket. Both cables must be terminated in a MIL-3102 16 pin male plug at the “camera” end. A female to female BNC connector must also be provided. The entire composite cable must be 60 feet in length from end to end.
3. **CONSTRUCTION METHOD.** The MIL plug must be connected to the matching plug in the camera housing. The cable must then run through the mast arm and pole to the junction box. At the junction box the power cable must be terminated at the terminal strip. The coaxial cable must be attached to the female to female connector at the junction box. All cable must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced at no cost to the City.
4. **METHOD OF MEASUREMENT.** The cable will be measured as a single unit.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for VIDEO CABLE HARNESS. Such price will be payment in full for furnishing, installing, terminating, and testing the cable, and will include all material, labor, and incidentals necessary to complete the work. and complete an operating and working circuit as per the plans.

November 29, 2006

ITEM 2012, VIDEO PROCESSOR CARD AND RACK

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic detection video processor card into a two card rack, which will be shelf mounted in a traffic signal controller cabinet. This will be part of a complete video detection system. .
2. **MATERIAL.** The detector card and rack must meet the requirements of Material Specification 1556.
3. **INSTALLATION.** The detector card must be inserted into the two card rack which will be set on a shelf in the controller cabinet. All manufacturers' instructions must be followed for installation. All connections must be properly made. Power will be supplied from the cabinet. When the entire video detection system is installed, it must be demonstrated that the detector processor is operating satisfactorily.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each VIDEO PROCESSOR CARD AND RACK, which price will be payment in full for furnishing and installing the processor card and the two card rack and making all necessary connections.

MATERIAL SPECIFICATION
1556

November 29, 2006

ITEM 2013, VIDEO PROCESSOR CARD

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic detection video processor card into a four or eight card rack, which will be shelf mounted in a traffic signal controller cabinet. This will be part of a complete video detection system. .
2. **MATERIAL.** The detector card must meet the requirements of Material Specification 1556.
3. **INSTALLATION.** The detector card must be inserted into the appropriate card rack. All manufacturers' instructions must be followed for installation. All connections must be properly made. When the entire video detection system is installed, it must be demonstrated that the detector processor is operating satisfactorily.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each VIDEO PROCESSOR CARD, which price will be payment in full for furnishing and installing the processor card and making all necessary connections.

MATERIAL SPECIFICATION
1556

November 29, 2006

ITEM 2014, VIDEO DETECTION CARD RACK, FOUR CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic detection video processor card rack. The four card rack will be shelf mounted.
2. **MATERIAL.** The detector card rack must meet the requirements of Material Specification 1556.
3. **INSTALLATION.** The detector card rack must be set on a shelf in the traffic controller cabinet. All manufacturers' instructions must be followed for installation. All connections must be properly made.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each VIDEO DETECTION CARD RACK, FOUR CAMERA, which price will be payment in full for furnishing and installing the rack and making all necessary connections.

MATERIAL SPECIFICATION
1556

November 29, 2006

ITEM 2015, VIDEO DETECTION CARD RACK, EIGHT CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic detection video processor card rack. The eight card rack will be shelf mounted.
2. **MATERIAL.** The detector card rack must meet the requirements of Material Specification 1556.
3. **INSTALLATION.** The detector card rack must be set on a shelf in the traffic controller cabinet. All manufacturers' instructions must be followed for installation. All connections must be properly made.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each VIDEO DETECTION CARD RACK, EIGHT CAMERA, which price will be payment in full for furnishing and installing the rack and making all necessary connections.

MATERIAL SPECIFICATION
1556

November 29, 2006

ITEM 2016, INTERFACE PANEL, TWO CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a camera interface panel in a traffic signal controller cabinet. This will be part of a complete video detection system. .
2. **MATERIAL.** The camera interface panel must meet the requirements of Material Specification 1557.
3. **INSTALLATION.** The panel must be mounted inside of a traffic controller cabinet on a side wall using stainless steel hardware. The panel must be set up for connection to coaxial cable and power feeds for two cameras. All manufacturers' instructions must be followed for installation.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each INTERFACE PANEL, TWO CAMERA, which price will be payment in full for furnishing and installing the panel, including all hardware.

MATERIAL SPECIFICATION
1557

November 29, 2006

ITEM 2017, INTERFACE PANEL, FOUR CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a camera interface panel in a traffic signal controller cabinet. This will be part of a complete video detection system. .
2. **MATERIAL.** The camera interface panel must meet the requirements of Material Specification 1557.
3. **INSTALLATION.** The panel must be mounted inside of a traffic controller cabinet on a side wall using stainless steel hardware. The panel must be set up for connection to coaxial cable and power feeds for four cameras. All manufacturers' instructions must be followed for installation.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each INTERFACE PANEL, FOUR CAMERA, which price will be payment in full for furnishing and installing the panel, including all hardware.

MATERIAL SPECIFICATION
1557

November 29, 2006

ITEM 2018, INTERFACE PANEL, SIX CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a camera interface panel in a traffic signal controller cabinet. This will be part of a complete video detection system. .
2. **MATERIAL.** The camera interface panel must meet the requirements of Material Specification 1557.
3. **INSTALLATION.** The panel must be mounted inside of a traffic controller cabinet on a side wall using stainless steel hardware. The panel must be set up for connection to coaxial cable and power feeds for six cameras. All manufacturers' instructions must be followed for installation.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each INTERFACE PANEL, SIX CAMERA, which price will be payment in full for furnishing and installing the panel, including all hardware.

MATERIAL SPECIFICATION
1557

November 29, 2006

ITEM 2019, INTERFACE PANEL, EIGHT CAMERA

1. **DESCRIPTION.** This item will consist of furnishing and installing a camera interface panel in a traffic signal controller cabinet. This will be part of a complete video detection system. .
2. **MATERIAL.** The camera interface panel must meet the requirements of Material Specification 1557.
3. **INSTALLATION.** The panel must be mounted inside of a traffic controller cabinet on a side wall using stainless steel hardware. The panel must be set up for connection to coaxial cable and power feeds for eight cameras. All manufacturers' instructions must be followed for installation.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each INTERFACE PANEL, EIGHT CAMERA, which price will be payment in full for furnishing and installing the panel, including all hardware.

MATERIAL SPECIFICATION
1557

November 29, 2006

ITEM 2020, VIDEO DETECTION POWER SUPPLY

1. **DESCRIPTION.** This item will consist of furnishing and installing a traffic detection video power supply in a traffic signal controller cabinet. The power supply will supply power for the detection processors.
2. **MATERIAL.** The power supply must meet the requirements of Material Specification 1556.
3. **INSTALLATION.** The power supply must be inserted into a shelf mounted rack in the controller cabinet. All manufacturers' instructions must be followed; all connections must be properly made. When the entire video detection system is installed, it must be demonstrated that the power supply is operating satisfactorily.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each VIDEO DETECTION POWER SUPPLY, which price will be payment in full for furnishing and installing the unit.

MATERIAL SPECIFICATION
1556

November 29, 2006

ITEM 2021, COAXIAL JUMPER CABLE

1. **DESCRIPTION.** This work will consist of furnishing and installing a coaxial electric cable as specified. The cable will be part of a complete video detection system. The cable will be installed between an interface panel in a traffic control cabinet to a vehicle detector card in the same cabinet.
2. **MATERIAL.** The coaxial cable must be classified as RG 59/U. The conductor must be solid bare copper or solid bare copper coated steel. The insulation must be polyethylene or equivalent. The shield must be a bare copper braid. The jacket must be black polyvinylchloride or equivalent. The cable must be rated at 80° Centigrade, 75 ohms, and service at 30 Volts. Each end must be equipped with a male BNC connector crimped to the cable. The cable must be six feet in length.
3. **CONSTRUCTION METHOD.** All cable must be installed with care to prevent damage to the cable. Any defects found in the cable must be reported to the resident engineer. Damaged cable must be replaced at no cost to the City.

The cable will be terminated at one end in a traffic signal controller cabinet at the interface panel. The cable will be terminated at the other end to a detector card in the same cabinet.

4. **METHOD OF MEASUREMENT.** The cable furnished and installed will be measured as one unit for each jumper cable installed.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for COAXIAL JUMPER CABLE. Such price will be payment in full for furnishing, installing, terminating, and testing the cable, and will include all material, labor, and incidentals necessary to complete the work and complete an operating and working circuit as per the plans. The BNC connectors at each end of the cable will be considered incidental to this item.

November 29, 2006

ITEM 2903, LOOP POLE AND BASE, 10 FOOT
ITEM 2904, EXTENDED LOOP POLE AND BASE, 16 FOOT

1. **DESCRIPTION.** This item will consist of furnishing and installing a historic light pole and base of the dimension specified, at the locations shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The ten-foot pole and base must meet the requirements of Material Specifications 1487 and 1488. The sixteen-foot pole and base must meet the requirements of Material Specification 1506. The ten-foot pole must have the appearance as that shown on Standard Drawing 911. The sixteen-foot pole must have the appearance as that shown on Standard Drawings 929 and 929A.
3. **INSTALLATION.** Installation must be according to Sections 801 and 830 of the Standard Specifications. The light pole must be set plumb on a concrete foundation using double nut construction. The nuts and washers should be part of the foundation item. The pole must be set with proper orientation of the handhole, as directed by the Engineer.

Any exposed portions of the anchor rods extending above the nuts which may interfere with setting the ornamental base must be cut off to provide the necessary clearance. The excess must not be burned off.

The base must be installed after the pole is erected. The base halves must be set around the pole shaft and secured to each other. The base must be set so that it sits evenly around the pole shaft. The base must be level and plumb so that it appears to be integral to the pole shaft. The base should sit level on the concrete foundation. Set screws will be used to keep the base from shifting about the shaft, and to attach the base to the pole as shown on Standard Drawings 911 or 929 and 929A. If the base has doors, the doors must be securely fastened to the pole base. One door must be aligned with the pole handhole when the base is properly installed.

On the sixteen-foot pole, the ornamental bracelets must be included, and will be installed as directed by the Engineer.

The contractor must utilize non-abrasive slinging materials and must otherwise exercise due care in erecting the pole to minimize any possible damage to the finish. When necessary, and approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit

installed and will include all labor and material necessary to install the pole and base on the foundation, and must include the handhole door, as well as the base doors, and all necessary hardware. On the 16-foot pole the ornamental bracelets, as shown on Standard Drawings 929 and 929A must be included. This item will not include the ornamental twin arm or the luminaire.

5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price each for LOOP POLE AND BASE or EXTENDED LOOP POLE AND BASE, which payment will be in full for furnishing and installing the pole and base in place.

MATERIAL

1487

1488

1506

DRAWINGS

911

929

929A

May 15, 2001

Item 2903, 2904

Page 2

ITEM 2905, LOOP POLE TWIN ARM ASSEMBLY

1. **DESCRIPTION.** This item will consist of furnishing and installing an ornamental twin arm onto a Loop historic style pole. The arm will mount onto the tenon of the pole. The arm itself must have two tenons for mounting two luminaires. The arm will be placed as shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The arm must meet the requirements of Material Specification 1489. The arm must have the appearance as that shown on Standard Drawing 911.
3. **INSTALLATION.** Installation will be according to Sections 801 and 830 of the Standard Specifications. The arm must be attached to the pole tenon with stainless steel set screws and orientated perpendicular to the curb-line, as directed by the Engineer.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed and will include all labor and material necessary to install the arm on the pole.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price each for LOOP POLE TWIN ARM ASSEMBLY, which payment will be in full for furnishing and installing the arm in place.

MATERIAL
1489

DRAWINGS
911

May 15, 2001

ITEM 2907, POLE RECEPTACLE

1. **DESCRIPTION.** This work will consist of furnishing and installing a 120 volt duplex outlet onto a street light pole at a location given by the Engineer or as shown on the plans.
2. **MATERIAL.** The outlet must meet the requirements of Standard Drawing 882 and must be U.L. approved. Pole wire to connect the outlet to the field cable at the base of the pole must meet Material Specification 1351.
3. **INSTALLATION.** The contractor must drill a one-inch hole for the wire in the light pole at the proper height and location, as directed by the Engineer. The hole must be free from burrs and must be smooth. A rubber grommet must be inserted in the hole. The outlet must be mounted to the pole to align with the wire hole. The outlet will be attached to the pole with 4 (1/4-20X 1 1/4") bolts. The pole must be drilled and tapped to accept the bolts. An alternate method of attachment is to use two 5/8" stainless steel bands. The attachment method used will be determined by the Engineer.

The pole wire must be run from the outlet, into and down the pole to the field cable. The pole wire will be spliced to the field cable in an acceptable and approved manner.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete and operational. All hardware and wire necessary to install the unit will be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for POLE RECEPTACLE, which price will be payment in full for furnishing and installing the unit.

MATERIAL
1351

DRAWING
882

May 16, 2001

ITEM 2908, FLORENTINE POLE, 10 FOOT
ITEM 2935, FLORENTINE POLE, 14 FOOT

1. **DESCRIPTION.** This item will consist of furnishing and installing a fluted cast aluminum florentine style light pole of the size specified, at the locations shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1459. The pole must have the appearance as that shown on Standard Drawing 873. The ten foot pole must have a ten foot shaft measured from the base to the bottom of the tenon. The ten foot pole must have an 8 inch diameter bolt circle. The fourteen foot pole must have a fourteen foot shaft measured from the pole base to the bottom of the tenon. The fourteen foot pole must have a 15 inch bolt circle.
3. **INSTALLATION.** Installation will be according to Sections 801 and 830 of the Standard Specifications. The light pole must be set plumb on a concrete foundation without using double nut construction or shims. The nuts and washers should be part of the foundation item. The pole must be set with proper orientation of the handhole, as directed by the Engineer.

Any exposed portions of the anchor rods extending above the nuts which may interfere with setting the pole must be cut off to provide the necessary clearance. The excess must not be burned off.

The contractor must utilize non-abrasive slinging materials and will otherwise exercise due care in erecting the pole to minimize any possible damage to the finish. When necessary, and approved by the Engineer, the contractor must utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed and will include all labor and material necessary to install the pole on the foundation, and must include the handhole door.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price each for FLORENTINE POLE of the specified size, which payment will be in full for furnishing and installing the pole in place.

MATERIAL
1459

DRAWINGS
873

May 15, 2001

ITEM 2910, DAVIT ARM, STEEL, STREET LIGHT, 12', 7 GAUGE, FOR 10" POLE
ITEM 2911, DAVIT ARM, STEEL, STREET LIGHT, 12', 7 GAUGE, FOR 10" POLE, DOUBLE ARM
ITEM 2912, DAVIT ARM, STEEL, STREET LIGHT, 12', 3 GAUGE, FOR 10" POLE
ITEM 2913, DAVIT ARM, STEEL, STREET LIGHT, 12', 3 GAUGE, FOR 11" POLE
ITEM 2914, DAVIT ARM, STEEL, STREET LIGHT, 12', 3 GAUGE, FOR 12.5" POLE
ITEM 2915, DAVIT ARM, STEEL, STREET LIGHT, 8', 7 GAUGE, FOR 10" POLE
ITEM 2916, DAVIT ARM, STEEL, STREET LIGHT, 8', 7 GAUGE, FOR 10" POLE, DOUBLE ARM
ITEM 2917, DAVIT ARM, STEEL, STREET LIGHT, 8', 3 GAUGE, FOR 10" POLE
ITEM 2918, DAVIT ARM, STEEL, STREET LIGHT, 8', 3 GAUGE, FOR 11" POLE
ITEM 2919, DAVIT ARM, STEEL, STREET LIGHT, 8', 3 GAUGE, FOR 12.5" POLE

1. **DESCRIPTION.** This item will consist of furnishing and installing a steel mast arm of a specified length to support a street light luminaire as required and as shown on Drawing Number 907.
2. **MATERIAL.** The mast arm must conform to the requirements of Material Specification 1527.
3. **INSTALLATION.** The mast arm will be installed on a tapered steel pole. A sleeve on the base of the arm must fit snug into the top of the pole. The arm must be fastened to the pole with two through bolts, perpendicular to each other as shown on Drawing 907. Holes must be drilled in the pole to match the holes in the arm so that the through bolts are easily installed. Set screws must then be used to level the arm. All fasteners must be stainless steel and must be sized to create a structurally sound pole and arm combination.

The contractor is responsible for touching-up all marred, scraped and chipped areas of the mast arm in accordance with the mast arm supplier's instructions. Additional payment will not be made for touch-up painting.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price

each for a DAVIT ARM of the size indicated on the plans, which will be payment in full for furnishing and installing the mast arm complete in place.

MATERIAL SPECIFICATION
1527

DRAWING
907

May 25, 2010

Item 2910, 2911, 2912, 2913, 2914, 2915, 2916, 2917, 2918, 2919
Page 2

ITEM 2920, ELECTROLIER POLE AND ARMS

1. **DESCRIPTION.** This work will consist of furnishing and installing an ornamental pole with six luminaire arms onto a foundation.
2. **MATERIAL.** The pole and arms must meet the requirements of Material Specification 1491 and Standard Drawing 914. Arms must include all mounting hardware.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 830 of the Standard Specifications. The pole must be set plumb on the foundation without the use of double nutting or shims. Nuts and washers for the anchor rods will be provided under the foundation item. The arms must be attached to the pole using stainless steel hardware.
4. **METHOD OF MEASUREMENT.** One unit will consist of one pole with six arms with pole finial attached and pole door securely attached.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each unit installed, which will be payment in full for furnishing and installing the pole and arms.

MATERIAL
1491

DRAWING
914

October 6, 2006

ITEM 2920A, ELECTROLIER LUMINAIRE, 100WHPS
ITEM 2920B, ELECTROLIER LUMINAIRE, 150WHPS

1. **DESCRIPTION.** This work will consist of furnishing and installing an ornamental luminaire onto an electrolier arm which is on an electrolier pole, and connecting the luminaire to a street light circuit.
2. **MATERIAL.** The luminaires must meet the requirements of Material Specification 1551 and Standard Drawing 914. The pole wire must meet the requirements of Material Specification 1351. The lamp will be either 100 watt or 150 watt high pressure sodium. The lamp must meet the requirements of Material Specification 1524. The fuses must meet the requirements of Material Specification 1464. The electrical components of the luminaire must match the lamp specified. The luminaire must include the lamp, all electrical components, fuses, pole wire, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 830 of the Standard Specifications. The luminaire must be attached to the arm using the stainless steel hardware supplied. The pole wire must be spliced to the appropriate field cable at the base of the pole as shown on the plans or as directed by the Engineer. The pole must be properly grounded using the green ground conductor. Splicing methods must be approved by the Engineer.
4. **METHOD OF MEASUREMENT.** One unit will consist of one luminaire attached to an arm with all wiring complete, so that the entire assembly will work when energized.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each unit installed, which will be payment in full for furnishing, installing, and wiring the luminaire.

MATERIAL		DRAWING
1351	1524	914
1551	1464	

August 15, 2006

ITEM 2921, GASLIGHT POLE

1. **DESCRIPTION.** This work will consist of furnishing and installing an ornamental pole onto a concrete foundation. The pole will have a tenon for a top mounted gaslight style luminaire. This work will be as shown on the plans or as directed by the Engineer.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1478. The pole must also meet the requirements of Standard Drawing 895.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 830 of the Standard Specifications. The pole must be set plumb on the foundation without the use of double nutting or shims. Nuts and washers for the anchor rods will be provided under the foundation item.
4. **METHOD OF MEASUREMENT.** One unit will consist of one pole and pole door securely attached.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each unit installed, which will be payment in full for furnishing and installing the pole.

MATERIAL
1478

DRAWING
895

August 14, 2006

ITEM 2921A, GASLIGHT LUMINAIRE, 50WHPS
ITEM 2921B, GASLIGHT LUMINAIRE, 150 WHPS

1. **DESCRIPTION.** This work will consist of furnishing and installing a gas light style luminaire onto the tenon of an ornamental light pole, and connecting it to a street lighting circuit. This work will be as shown on the plans or as directed by the Engineer.
2. **MATERIAL.** The luminaire must meet the requirements of Material Specification 1479. The luminaire must also meet the requirements of Standard Drawing 895. The pole wire must meet the requirements of Material Specification 1351. The lamp will be either 50 or 150 watt high pressure sodium as specified. The lamp must meet the requirements of Material Specification 1524. The electrical components of the luminaire must match the lamp specified. The fuses must meet the requirements of Material Specification 1464. The luminaire must include the lamp, all electrical components, fuses, pole wire, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 830 of the Standard Specifications. The luminaire must be attached to the pole tenon with hex head set screws. The pole wire must be spliced to the appropriate field cable at the base of the pole as shown on the plans or as directed by the Engineer. Splicing methods must be approved by the Engineer.
4. **METHOD OF MEASUREMENT.** One unit will consist of one luminaire attached to a pole and wired for operation. All wiring must be complete, so that the entire assembly will work when energized.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each unit installed, which will be payment in full for furnishing, installing, and wiring the pole and luminaire.

MATERIAL
1464
1479
1351
1524

DRAWING
895

August 14, 2006

ITEM 2921C, GASLIGHT POLE

1. **DESCRIPTION.** This work will consist of furnishing and installing an ornamental pole onto a concrete foundation. The pole will have a tenon for a top mounted gaslight style luminaire. This work will be as shown on the plans or as directed by the Engineer.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1597. The pole must also meet the requirements of Standard Drawing 895.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 830 of the Standard Specifications. The pole must be set plumb on the foundation without the use of double nutting or shims. Nuts and washers for the anchor rods will be provided under the foundation item.
4. **METHOD OF MEASUREMENT.** One unit will consist of one pole and pole door securely attached.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each unit installed, which will be payment in full for furnishing and installing the pole.

MATERIAL
1597

DRAWING
895

Nov. 14, 2014

ITEM 2921D, GASLIGHT LED LUMINAIRE

1. **DESCRIPTION.** This work will consist of furnishing and installing a gas light style luminaire onto the tenon of an ornamental light pole, and connecting it to a street lighting circuit. This work will be as shown on the plans or as directed by the Engineer.
2. **MATERIAL.** The luminaire must meet the requirements of Material Specification 1597. The luminaire must also meet the requirements of Standard Drawing 895. The pole wire must meet the requirements of Material Specification 1351. The fixture will be 70-90 watt or as specified. The fuses must meet the requirements of Material Specification 1464. The luminaire must include the driver, all electrical components, fuses, pole wire, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 830 of the Standard Specifications. The luminaire must be attached to the pole tenon with hex head set screws. The pole wire must be spliced to the appropriate field cable at the base of the pole as shown on the plans or as directed by the Engineer. Splicing methods must be approved by the Engineer.
4. **METHOD OF MEASUREMENT.** One unit will consist of one luminaire attached to a pole and wired for operation. All wiring must be complete, so that the entire assembly will work when energized.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each unit installed, which will be payment in full for furnishing, installing, and wiring the pole and luminaire.

MATERIAL
1464
1597
1351

DRAWING
895

Nov. 14, 2014

ITEM 2925, PARK POLE, CONCRETE, 13'9", WITH BASE
ITEM 2926, PARK POLE, CONCRETE, 10'0", WITH BASE
ITEM 2927, PARK POLE, BLACK CONCRETE, 10'0", WITH BASE

1. DESCRIPTION

This item will consist of furnishing and installing a cast concrete fluted light pole with a cast steel base of the size specified, at the locations shown on the plans, or as directed by the Engineer. The pole and base will be mounted to a foundation.

2. MATERIAL

The poles and bases must meet the requirements of Material Specification 1529. The pole will have the appearance as that shown on Standard Drawing 898 or 899. The base must be cast steel as shown on Standard Drawings 900 or 901. The pole will be salt and pepper in color unless specified as black.

3. INSTALLATION

Installation will be according to Section 801 of the Standard Specifications. The light pole steel base must be set plumb on a concrete foundation without using double nut construction or shims. The nuts and washers should be part of the foundation item. The pole must then be set onto the steel base with the bolts and nuts supplied with this item. The pole and base must be plumb after installation.

The contractor will utilize non-abrasive slinging materials and must otherwise exercise due care in erecting the pole to minimize any possible damage to the concrete. Any damaged or cracked poles will not be acceptable.

4. METHOD OF MEASUREMENT

This work will be measured per each unit installed and will include all labor and material necessary to install the steel base, base doors, and concrete pole on the foundation.

5. BASIS OF PAYMENT

This item will be paid for at the contract unit price each for CONCRETE POLE AND BASE of the specified size, which payment will be in full for furnishing and installing the pole and base in place.

MATERIAL

1529

August 15, 2006

DRAWINGS

898 899 900 901

**ITEM 2928, LUMINAIRE, ORNAMENTAL, ACORN, TYPE III, 150 WHPS,
FOR CONCRETE POLE**

**ITEM 2929, LUMINAIRE, ORNAMENTAL, GLOBE, 100 WHPS, FOR
CONCRETE POLE**

1. **DESCRIPTION.** This work will consist of furnishing and installing an acorn type ornamental luminaire with a Type III light distribution, or a white globe type luminaire on top of a fluted concrete pole, as specified on the plans or as directed by the Engineer. The luminaire must be complete with a 150 or 100 watt high pressure sodium lamp, integral electrical components, fuses, pole wire, and mounting hardware.
2. **MATERIALS.** Materials must meet the requirements of Bureau of Electricity Material Specifications: No. 1351 for pole wire, No. 1464 for fuses, No. 1524 for lamps, and of No. 1509 for the luminaire. The luminaire must have the general appearance of Standard Drawing 902. The entire assembly must have the appearance as shown on Standard Drawings 900 or 901.
3. **INSTALLATION.** Installation will meet all applicable requirements of Section 801 and Section 821.03 of the Standard Specifications. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The luminaire must be properly mounted to the top of the concrete pole as shown on Standard Drawing 900 or 901. The contractor must level and adjust the luminaire for proper illumination.
4. **METHOD OF MEASUREMENT.** Each luminaire, complete with lamp, components, pole wire, fuses, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit, will count as one unit. Any labor and equipment necessary must be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each LUMINAIRE, ORNAMENTAL, ACORN, TYPE III, 150 WHPS, FOR CONCRETE POLE or LUMINAIRE, ORNAMENTAL, GLOBE, 100 WHPS, FOR CONCRETE POLE, which will be payment in full for performing the work described herein. Payment will not be made until the luminaire can be shown to function properly within the street lighting circuit.

MATERIAL

1509 1464

1351 1524

DRAWING

900

901

902

August 15, 2006

ITEM 2936, TWIN ARM ASSEMBLY FOR FLORENTINE POLE

1. **DESCRIPTION.** This item will consist of furnishing and installing a twin arm onto a Florentine style pole. The arm must mount onto the tenon of the pole. The arm itself will have two tenons for mounting two luminaires. The arm must be placed as shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The arm must meet the requirements of Material Specification 1460. The arm must have the appearance as that shown on Standard Drawing 873.
3. **INSTALLATION.** Installation must meet the requirements of the applicable parts of Sections 801 and 830 of the Standard Specifications. The arm must be attached to the pole tenon with stainless steel set screws and oriented perpendicular to the curb-line or parallel to the curb-line, as directed by the Engineer.
4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed and must include all labor and material necessary to install the arm on the pole.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price each for TWIN ARM ASSEMBLY FOR FLORENTINE POLE, which payment will be in full for furnishing and installing the arm in place.

MATERIAL
1460

DRAWINGS
873

May 15, 2001

**ITEM 2939, LUMINAIRE, ORNAMENTAL, ACORN, FOR LOOP POLE,
TYPE III, 150 WHPS**

1. **DESCRIPTION.** This work will consist of furnishing and installing an acorn type ornamental luminaire with a Type III light distribution on a tenon mount, as specified on the plans or as directed by the Engineer. The luminaire must be complete with a 150 watt high pressure sodium lamp, integral electrical components, fuses, pole wire, and mounting hardware.
2. **MATERIALS.** Materials must meet the requirements of the Bureau of Electricity Material Specifications: No. 1351 for pole wire, No. 1524 for the lamp, No. 1464 for the fuses, and No. 1515 for the luminaire. The luminaire must have the general appearance of Standard Drawing 912.
3. **INSTALLATION.** Installation will meet all applicable requirements of Section 801 and Section 821.03 of the Standard Specifications. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The luminaire must be properly mounted to a 3 inch high by 3 inch diameter tenon with set screws as shown on Drawing 912. The contractor must level and adjust the luminaire for proper illumination.
4. **METHOD OF MEASUREMENT.** Each luminaire, complete with lamp, components, pole wire, fuses, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit, will count as one unit. Any labor and equipment necessary will be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each LUMINAIRE, ORNAMENTAL, ACORN, TYPE III, 150 WHPS, which will be payment in full for performing the work described herein. Payment will not be made until the luminaire can be shown to function properly within the street lighting circuit.

MATERIAL
1515
1524
1351
1464

DRAWING
912

August 15, 2006

ITEM 2975, CHICAGO 2000 BANNER ATTACHMENTS

1. **DESCRIPTION.** This item will consist of furnishing and installing banner brackets and brackets onto a Chicago 2000 fluted ornamental pole. The installation will be as directed by the engineer.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1505 and Standard Drawings 930 and 930B. The castings must be properly sized to fit the pole at the designated heights.
3. **INSTALLATION.** The banner brackets must be banded to the pole at the proper locations. The brackets must be positioned so that the banners will be perpendicular to the curblineline. The decorative bracelets must be attached after the brackets are in place. Set screws will secure the bracelets to the pole. The banner arms must be screwed into the brackets, and the arm finials screwed into the arms.

The contractor must not drill the pole or weld anything to the pole in order to secure the banner arms. The contractor must exercise due caution in installing the banner arms to minimize any possible damage to the finish.

4. **METHOD OF MEASUREMENT.** This item will be measured per pole for each complete set of banner arms installed and must include the brackets, banding, bracelets, arms, finials, and all necessary hardware.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each set for CHICAGO 2000 BANNER ATTACHMENTS, which payment will be in full for furnishing and securely attaching the banner arms to the pole. Supplying the banners and mounting the banners are not part of this item.

MATERIAL
1505

DRAWINGS
930
930B

August 15, 2006

ITEM 2977, CHICAGO 2000 MAST HEAD AND FINIAL FOR 10" POLE
ITEM 2978, CHICAGO 2000 MAST HEAD AND FINIAL FOR 11" POLE
ITEM 2979, CHICAGO 2000 MAST HEAD AND FINIAL FOR 12.5" POLE

1. **DESCRIPTION.** This item will consist of furnishing and installing an ornamental mast head and finial to the upper part of a steel light pole that has a luminaire arm and scroll already installed. The installation will be as directed by the engineer.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1505 and Standard Drawings 930 and 930C. The castings must be properly sized to fit the appropriate pole diameter.
3. **INSTALLATION.** The mast head and finial must be securely mounted to the pole and arm as shown on Standard Drawings 930 and 930C.

The contractor must exercise due caution in installing the mast head and finial to minimize any possible damage to the finish. When necessary, and when approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed and must include the mast head castings, the finial, and all necessary hardware to securely attach the mast head and finial to the pole and arm.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for CHICAGO 2000 MAST HEAD AND FINIAL, of the size indicated, which payment will be in full for furnishing and securely attaching the mast head and finial to the pole and arm.

MATERIAL
1505

DRAWINGS
930
930C

August 15, 2006

ITEM 2980, CHICAGO 2000 STREET LIGHT POLE

1. **DESCRIPTION.** This item will consist of furnishing and installing a historic gateway light pole at the locations shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1505. The pole must have the appearance as that shown on Standard Drawings 930, 930B, and 930C.
3. **INSTALLATION.** Installation will be according to the applicable parts of Sections 801 and 830 of the Standard Specifications. The light pole must be set plumb on a concrete foundation using double nut construction. The nuts and washers should be part of the foundation item. The pole must be set with proper orientation of the handhole and mast arm support, as directed by the Engineer. The mast arm support should be facing the roadway and be perpendicular to the curbline.

Any exposed portions of the anchor rods extending above the nuts which may interfere with setting the ornamental base must be cut off to provide the necessary clearance. The excess must not be burned off.

The contractor must utilize non-abrasive slinging materials and will otherwise exercise due care in erecting the pole to minimize any possible damage to the finish. When necessary, and approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed and will include all labor and material necessary to install the pole on the foundation, and will include the handhole door. The rosettes, which are welded to the pole, are an integral part of the pole and are included in this item. This item will not include the ornamental base, the arm, the luminaire, the top finial, or any decorative bracelets.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price each for CHICAGO 2000 STREET LIGHT POLE, which payment will be in full for furnishing and installing the pole in place.

MATERIAL
1505
August 15, 2006

DRAWINGS
930 930B 930C

ITEM 2981, CHICAGO 2000 LUMINAIRE ARM, 8 FOOT, WITH SCROLL

1. **DESCRIPTION.** This item will consist of furnishing and installing an ornamental luminaire arm with supporting scroll onto an ornamental fluted steel pole, or other pole as directed by the Engineer or as shown on the plans.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1514 and Standard Drawing 930.
3. **INSTALLATION.** The arm must be securely mounted to the pole by two bolts supplied under this item. The scroll must be attached to the pole and the arm with brackets as shown on Standard Drawing 930. The scroll will provide support to the arm and luminaire.

The contractor must exercise due caution in erecting the pole and mast arm to minimize any possible damage to the finish. When necessary, and when approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed and must include the arm, scroll, and all necessary hardware to attach the arm and scroll to the pole.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for CHICAGO 2000 LUMINAIRE ARM, 8 FOOT, WITH SCROLL, which payment will be in full for securely attaching the arm and scroll to the pole.

MATERIAL
1514

DRAWINGS
930

May 14, 2001

ITEM 2983, CHICAGO 2000 POLE BASE

1. **DESCRIPTION.** This item will consist of furnishing and installing an ornamental pole base to a steel light pole as directed by the Engineer or as shown on the plans.
2. **MATERIAL.** The base will be fiberglass meeting the appropriate requirements of Material Specification 1513 and Standard Drawing 930A.
3. **INSTALLATION.** The base must be installed after the steel pole is erected. The base halves must be set around the pole shaft and secured to each other. The base must be set so that it sits evenly around the pole shaft. The base must be level and plumb so that it appears to be integral with the pole shaft. The base should sit level on the concrete foundation. Set screws will be used to keep the base from shifting about the shaft, and to attach the base to the pole as shown on Standard Drawing 930A.

The contractor must exercise due caution in installing the base to minimize any possible damage to the finish. When necessary, and when approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed and must include the ornamental base and all necessary hardware to securely install the base on the foundation and around the pole shaft.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for CHICAGO 2000 POLE BASE, which payment will be in full for furnishing and securely installing the ornamental base.

MATERIAL
1513

DRAWINGS
930A

August 15, 2006

ITEM 2984, LUMINAIRE, CHICAGO 2000 PENDANT, 310 WHPS, TYPE III

1. **DESCRIPTION.** This work will consist of furnishing and installing a pendant luminaire with a teardrop refractor as specified herein, as shown on the plans or as directed by the Engineer. The luminaire must be complete with 310 watt high pressure sodium lamp, integral electrical components, fuses, arm fitter, pole wire, and mounting hardware.
2. **MATERIAL.** The luminaire must meet the requirements of Material Specification 1500 and Standard Drawing 931. The pole wire must meet the requirements of Material Specification 1351, the fuses must meet the requirements of Material Specification 1464, and the lamp must meet the requirements of Material Specification 1524.
3. **INSTALLATION.** This work will meet the applicable requirements of Sections 801 and 821 of the Standard Specifications. Each luminaire must be installed per the manufacturer's instructions. Luminaires must be securely attached to the end of a two-inch diameter pipe arm and leveled to provide the proper illumination. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The pole wire must be of sufficient length to connect the luminaire to the field cable at the base of the pole. Typical mast arm lengths will be 8 feet. Pole heights will be 32 feet.
4. **METHOD OF MEASUREMENT.** Each luminaire, complete with lamp, components, pole wire, fuses, and any appurtenances necessary, to make the luminaire function once connected into the street light circuit, will count as one unit. Any labor, and equipment necessary will be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each LUMINAIRE, CHICAGO 2000 PENDANT, 310WHPS, TYPE III, which will be payment in full for performing the work described herein. Payment will not be made until the luminaire can be shown to function properly within the street lighting circuit.

MATERIAL
1351 1464
1500 1524

DRAWING
931

August 15, 2006

ITEM 2984A, LUMINAIRE, CHICAGO 2000 PENDANT, 315 WATT CMH, TYPE III

1. **DESCRIPTION.** This work will consist of furnishing and installing a pendant luminaire with a teardrop refractor as specified herein, as shown on the plans or as directed by the Engineer. The luminaire must be complete with 315 watt ceramic metal halide lamp, integral electrical components, fuses, arm fitter, pole wire, and mounting hardware.
2. **MATERIAL.** The luminaire must meet the requirements of Material Specification 1563I and Standard Drawing 931. The pole wire must meet the requirements of Material Specification 1351, the fuses must meet the requirements of Material Specification 1464, and the lamp must meet the requirements of Material Specification 1562I.
3. **INSTALLATION.** Each luminaire must be installed per the manufacturer=s instructions. Luminaires must be securely attached to the end of a two inch diameter pipe arm and leveled to provide the proper illumination. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The pole wire must be of sufficient length to connect the luminaire to the field cable at the base of the pole. Typical mast arm lengths will be 8 feet. Pole heights will be 32 feet.
4. **METHOD OF MEASUREMENT.** Each luminaire, complete with lamp, components, pole wire, fuses, and any appurtenances necessary, to make the luminaire function once connected into the street light circuit, will count as one unit. Any labor, and equipment necessary will be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each LUMINAIRE, CHICAGO 2000 PENDANT, 315WCMH, TYPE III, which will be payment in full for performing the work described herein. Payment will not be made until the luminaire can be shown to function properly within the street lighting circuit.

MATERIAL
1563I 1351
1464 1562I

DRAWING
931

September 4, 2009

ITEM 2985, CHICAGO 2000 PEDESTRIAN 14 FOOT LIGHT POLE

1. **DESCRIPTION.** This item will consist of furnishing and installing a historic pedestrian style fourteen foot light pole at the locations shown on the plans, or as directed by the Engineer.
2. **MATERIAL.** The pole must meet the requirements of Material Specification 1504. The pole must have the appearance as that shown on Standard Drawing 928.
3. **INSTALLATION.** Installation will be according to applicable requirements of Sections 801 and 830 of the Standard Specifications. The light pole must be set plumb on a concrete foundation using double nut construction. The nuts and washers should be part of the foundation item. The pole must be set with proper orientation of the handhole, as directed by the Engineer.

Any exposed portions of the anchor rods extending above the nuts which may interfere with setting the ornamental base must be cut off to provide the necessary clearance. The excess must not be burned off.

The contractor must utilize non-abrasive slinging materials and will otherwise exercise due care in erecting the pole to minimize any possible damage to the finish. When necessary, and approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed and will include all labor and material necessary to install the pole on the foundation, and must include the handhole door. This item will not include the ornamental base or the luminaire.
5. **BASIS OF PAYMENT.** This item will be paid for at the contract unit price each for CHICAGO 2000 PEDESTRIAN 14 FOOT LIGHT POLE, which payment will be in full for furnishing and installing the pole in place.

MATERIAL
1504

DRAWINGS
928

May 15, 2001

ITEM 2986, CHICAGO 2000 PEDESTRIAN POLE BASE

1. **DESCRIPTION.** This item will consist of furnishing and installing an ornamental pole base for the fourteen foot pedestrian pole, as directed by the Engineer or as shown on the plans.
2. **MATERIAL.** The material must be fiberglass meeting the applicable requirements of Material Specification 1512 and Standard Drawing 928.
3. **INSTALLATION.** The base must be installed after the pole is erected. The base halves must be set around the pole shaft and secured to each other. The base must be set so that it sits evenly around the pole shaft. The base must be level and plumb so that it appears to be integral with the pole shaft. The base should sit level on the concrete foundation. Set screws must be used to keep the base from shifting about the shaft, and to attach the base to the pole as shown on Standard Drawing 928.

The contractor must exercise due caution in installing the base to minimize any possible damage to the finish. When necessary, and when approved by the Engineer, the contractor will utilize, at his own expense, factory approved touch-up materials and methods to restore the finish to like new appearance and durability.

4. **METHOD OF MEASUREMENT.** This item will be measured per each unit installed and must include the ornamental base and all necessary hardware to securely install the base on the foundation and around the pole shaft.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for CHICAGO 2000 PEDESTRIAN POLE BASE, which payment will be in full for furnishing and securely installing the ornamental base.

MATERIAL
1512

DRAWINGS
928

August 15, 2006

**ITEM 2987, LUMINAIRE, ORNAMENTAL, ACORN, CHICAGO 2000
PEDESTRIAN, TYPE V, 100 WHPS**

1. **DESCRIPTION.** This work will consist of furnishing and installing an acorn type ornamental luminaire with a Type V light distribution on a tenon mount, as specified on the plans or as directed by the Engineer. The luminaire must be complete with a 100 watt high pressure sodium lamp, integral electrical components, fuses, pole wire, and mounting hardware.
2. **MATERIALS.** Materials must meet the requirements of the Bureau of Electricity Material Specifications: No. 1351 for pole wire, No. 1503 for the luminaire, No. 1464 for the fuses, and No. 1524 for the lamp. The luminaire must have the general appearance of Standard Drawing 932.
3. **INSTALLATION.** Installation will meet all applicable requirements of Section 801 and Section 821.03 of the Standard Specifications. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The luminaire must be properly mounted to a 3 inch high by 3 inch diameter tenon with set screws. The contractor must level and adjust the luminaire for proper illumination.
4. **METHOD OF MEASUREMENT.** Each luminaire, complete with lamp, components, pole wire, fuses, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit, will count as one unit. Any labor and equipment necessary must be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each LUMINAIRE, ORNAMENTAL, ACORN, TYPE V, 100 WHPS, which will be payment in full for performing the work described herein. Payment will not be made until the luminaire can be shown to function properly within the street lighting circuit.

MATERIAL
1503 1464
1351 1524

DRAWING
932

August 15, 2006

ITEM 2988, LUMINAIRE, ORNAMENTAL, ACORN, FOR LOOP POLE, TYPE V, 150 WHPS

1. **DESCRIPTION.** This work will consist of furnishing and installing an acorn type ornamental luminaire with a Type V light distribution on a tenon mount, as specified on the plans or as directed by the Engineer. The luminaire must be complete with a 150 watt high pressure sodium lamp, integral electrical components, fuses, pole wire, and mounting hardware.
2. **MATERIALS.** Materials must meet the requirements of the Bureau of Electricity Material Specifications: No. 1351 for pole wire, No. 1524 for the lamp, No. 1464 for the fuses, and No. 1490 for the luminaire. The luminaire must have the general appearance of Standard Drawing 912.
3. **INSTALLATION.** Installation must meet all applicable requirements of Section 801 and Section 821.03 of the Standard Specifications. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The luminaire must be properly mounted to a 3 inch high by 3 inch diameter tenon with set screws. The contractor must level and adjust the luminaire for proper illumination.
4. **METHOD OF MEASUREMENT.** Each luminaire, complete with lamp, components, pole wire, fuses, and any appurtenances necessary, to make the luminaire function once connected to the street light circuit, must count as one unit. Any labor and equipment necessary will be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each LUMINAIRE, ORNAMENTAL, ACORN, TYPE V, 150 WHPS, which will be payment in full for performing the work described herein. Payment must not be made until the luminaire can be shown to function properly within the street lighting circuit.

MATERIAL
1490
1524
1351
1464

DRAWING
912

August 14, 2006

ITEM 2989, MID-MOUNT ARTERIAL ACORN LUMINAIRE AND ARM, SILVER

ITEM 2990, MID-MOUNT ARTERIAL ACORN LUMINAIRE AND ARM, BLACK

ITEM 2991, MID-MOUNT RESIDENTIAL ACORN LUMINAIRE AND ARM, BLACK

ITEM 2992, MID-MOUNT RESIDENTIAL ACORN LUMINAIRE AND ARM, SILVER

ITEM 2993, MID-MOUNT RESIDENTIAL LED ACORN LUMINAIRE AND ARM, SILVER

1. **DESCRIPTION.** This work will consist of furnishing and installing a mid-mount luminaire with arm onto a street light pole at approximately 16 feet from grade for an arterial street installation, 8 to 10.5 feet from grade for a residential street installation, or as directed by the Engineer or as shown on the plans. The luminaire will provide pedestrian level lighting.

2. **MATERIAL.** The luminaire for the arterial installation must meet the requirements of Material Specification 1549 and Standard Drawing 912. The arm for the arterial installation must meet Material Specification 1546 and Standard Drawing 959A. The high-pressure sodium luminaire for the residential installation must meet the requirements of Material Specification 1531 and Standard Drawing 958. The LED luminaire for the residential installation must meet the requirements of Material Specification 1568 and Standard Drawing 958. The arm for the residential installation must meet Material Specification 1546 and Standard Drawing 959. High pressure sodium lamps must meet the requirements of Material Specification 1524. Fuses must meet the requirements of Material Specification 1464. Pole wire to connect the luminaire to the field cable at the base of the pole must meet Material Specification 1351. Pole wire will be installed in the arm by the supplier before the arm is shipped to the contractor. Luminaires and arms will be factory painted either gloss black or silver.

3. **INSTALLATION.** For the arterial pole, the contractor must drill a one inch hole for the wire in the light pole at the proper height and location, as directed by the Engineer. The hole must be free from burrs and must be smooth. A rubber or nylon grommet must be inserted in the hole. The luminaire arm must be mounted to the pole to align with the wire hole. The arm will be attached to the pole with 2 (3/8-16X 1 1/4") bolts. The pole will be drilled at the proper locations and 2 rivnuts will be inserted to accept the bolts. An alternate method of attachment is to use two 5/8" stainless steel bands. The attachment method used will be determined by the Engineer.

For the residential pole, the pole will come with the holes pre-drilled, including a grommet for the wireway and 2 rivnuts.

The luminaire must be securely mounted to the arm tenon with hex head set screws. The pole wire will be run from the luminaire, through the arm, into and down the pole to the field cable. The pole wire must be spliced to the field cable in an acceptable and approved manner.

4. **METHOD OF MEASUREMENT.** This work will be measured per each unit installed, complete and operational. All hardware and wire necessary to install the unit will be included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for MID-MOUNT ACORN LUMINAIRE AND ARM, which price will be payment in full for furnishing and installing the unit.

MATERIAL				DRAWING	
1549	1546	1531		912	959
1351	1524	1464	1568	958	959A

November 10, 2009

Item 2989, 2990, 2991, 2992, 2993

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ITEM 3771, CONTROLLER, TRAFFIC, MASTER, 12 LOAD BAY, P CABINET

1. **DESCRIPTION.** This work will consist of furnishing and installing a traffic signal master controller and associated equipment in a cabinet onto a foundation and making all necessary connections.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1469. The cabinet must be a P cabinet 55 inches high by 44 inches wide by 26 inches deep, with 12 load bays. Each load bay must include a load switch. No communications interface equipment will be included under this item.
3. **INSTALLATION.** The controller must be programmed to provide the sequencing and timing of operation as shown on the plans. The controller will be a master for the traffic system, as well as controlling the local intersection. The cabinet must be set onto a pad foundation designed specifically for the cabinet, and affixed with four bolts provided with the foundation. Electric cables inside the cabinet must be neatly trained along the base and back of the cabinet. Each conductor used will be connected individually to the proper terminal, and the spare conductors will be insulated and bound into a neat bundle. Each cable must be marked with suitable identification and recorded on a copy of the plans for the intersection and submitted to the Engineer. Signal indications for each direction must be wired to a separate circuit whether or not the signal plans call for a split movement. Final offset timing of the time base coordinator must be set in the field by City personnel.

When properly installed, all signals must be connected and controlled by the controller, and the sequencing and timing of the signals must be as set forth in the plans.

All conduit entrances into the cabinet must be sealed with a pliable waterproof material to restrict moisture entrance into the cabinet.

4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each CONTROLLER, TRAFFIC, MASTER, 12 LOAD BAY, P CABINET, which price will be payment in full for furnishing and installing the controller and cabinet complete and operational, with all wiring and connections as specified.

May 22, 2001

ITEM 3781, UNINTERRUPTIBLE POWER SUPPLY ADD-ON FOR A TRAFFIC CONTROLLER

1. **DESCRIPTION.** This work will consist of furnishing and installing an uninterruptible power supply system to an existing traffic controller. The UPS will be self-contained in its own cabinet, which will be mounted to an existing cabinet in the field.
2. **MATERIAL.** The UPS must meet the requirements of Material Specification 1532.
3. **INSTALLATION.** The cabinet will be attached to the side of the existing controller cabinet as recommended by the manufacturer and as directed by the engineer. The cabinet will be mounted with six (6) hex head bolts, 1/4-20. All holes will be drilled to accommodate the specific situation. The bolts, washers, and nuts must be stainless steel. A 1.5 inch hole will be drilled into the side of the existing cabinet. A grommet will be inserted to protect the cable. The contractor must then wire the battery back-up system into the existing controller as directed. The contractor must demonstrate that the UPS is operational and will function as required.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each UNINTERRUPTIBLE POWER SUPPLY ADD-ON FOR A TRAFFIC CONTROLLER, which price will be payment in full for furnishing and installing the UPS system complete and operational with batteries, wiring, and hardware.

April 7, 2014

ITEM 3782, CONTROLLER, TRAFFIC, 12 LOAD BAY, WITH UPS
ITEM 3782A, CONTROLLER, TRAFFIC, 16 LOAD BAY, WITH UPS

1. **DESCRIPTION.** This work will consist of furnishing and installing a traffic signal controller with a battery powered back-up system and associated equipment in a cabinet onto a foundation and making all necessary connections.
2. **MATERIAL.** The material must meet the requirements of Material Specification 1536. The cabinet will be a super P cabinet 12 load bays or 16 load bays. Each load bay must include a load switch. A battery powered universal power supply (UPS) system must be included. Communications interface equipment, if required, will be included under a separate item.
3. **PROCUREMENT.** The contractor must provide Request for Inspection of Material forms for traffic signal controllers and cabinets as requested for specific projects. The Bureau of Electricity will review and comment on the submitted material. The Bureau of Electricity will approve the purchase of the material from a supplier. Final material approval will be made in accordance with Bureau of Electricity specifications. The Contractor must provide proof of purchase to the Resident Engineer within seven (7) days following approval by the Bureau of Electricity. Payment will be withheld in accordance with the terms and conditions of this contract, until such time that the Commissioner determines the requirements are met.

The controllers and cabinets are to be delivered to the Bureau of Electricity within ninety (90) days of purchase. If the controllers and cabinets are not delivered, payment will be withheld until such time that the controllers and cabinets are delivered.

The Bureau of Electricity will notify the Contractor when the material has been inspected and approved. If a railroad interconnect is involved, a representative from the Illinois Commerce Commission will also need to review and inspect the controller at the Bureau of Electricity's facilities. Within forty-eight (48) hours of notification, the Contractor will pick-up the controllers and cabinets from the Bureau. The controllers and cabinets will be stored at a facility, approved by the Commissioner, at the contractor's expense.

4. **INSTALLATION.** The controller will be programmed to provide the sequencing and timing of operation as shown on the plans. The controller must be enclosed in a housing and installed in a completely wired cabinet. The model and serial numbers of the controller must be affixed on the front of the controller housing and be readily visible.

The cabinet must be set onto a pad foundation designed specifically for the

cabinet, and affixed with bolts provided with the foundation. Electric cables inside the cabinet must be neatly trained along the base and back of the cabinet. Each conductor used must be connected individually to the proper terminal, and the spare conductors must be insulated and bound into a neat bundle. Each cable must be marked with suitable identification and recorded on a copy of the plans for the intersection and submitted to the Engineer. Signal indications for each direction must be wired to a separate circuit whether or not the signal plans call for a split movement. The absolute zero for the time-base coordinator will be set in the field by City personnel after obtaining the appropriate City time-tone reference.

When properly installed, all signals will be connected and controlled by the controller, and the sequencing and timing of the signals will be as set forth in the plans.

All conduit entrances into the cabinet must be sealed with a pliable waterproof material to restrict moisture entrance into the cabinet.

Bureau of Electricity (BOE) and Office of Emergency Management and Communications (OEMC) personnel must be present during the cutover to the new control equipment. If a railroad interconnect is part of the signal project, a representative from the Illinois Commerce Commission must be invited to be present for the cutover.

5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price for each CONTROLLER, TRAFFIC, 12 LOAD BAY, WITH UPS or CONTROLLER, TRAFFIC, 16 LOAD BAY, WITH UPS, which price will be payment in full for furnishing and installing the controller complete and operational, with all wiring and connections as specified.

July 5, 2009

Item 3782, 3782A

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ITEM 3901, FIBER OPTIC ADD-IN FOR LOCAL CONTROLLER
ITEM 3905, FIBER OPTIC ADD-IN FOR MASTER CONTROLLER
ITEM 3909, FIBER OPTIC STAR MODEM

1. **DESCRIPTION.** This work will consist of furnishing and installing a fiber optic interconnect panel, a patch panel, and fiber optic connections from the modem to the patch panel, in a controller cabinet and making all the proper connections. The interconnect is for fiber optic cable.
2. **MATERIAL.** The material must meet the requirements of Section 2.14, Communications Interface Panel, of Material Specification 1469. The local interconnect panel or the master interconnect panel must meet the requirements of the applicable parts of Section 2.14.1 (1). The panels must be internal to the controller, except for the star modem which will be mounted external to the controller housing. The patch panel must meet the requirements of Drawing 909, or equal.
3. **INSTALLATION.** The panel must be installed in the cabinet and properly connected to the controller and time base coordinator, as required. The patch panel must be properly mounted in the cabinet. All fiber optic connections must be made from the modem to the patch panel, using the fiber optic jumpers supplied under this item. The cabinet, controller, and other equipment will be supplied and installed under different pay items.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for FIBER OPTIC ADD-IN FOR LOCAL or MASTER CONTROLLER, or FIBER OPTIC STAR MODEM, which payment will be in full for furnishing, installing, and making operational the specified equipment.

MATERIAL
1469

DRAWING
909

May 23, 2001

ITEM 3913, FIBER OPTIC HYBRID CABLE IN CONDUIT

1. **DESCRIPTION.** This item is for furnishing and installing fiber optic cable in conduit or innerduct, as shown on the plans or as directed by the Engineer.
2. **MATERIAL.** The cable must meet the requirements of Material Specification 1482.
3. **INSTALLATION.** Cable must be pulled through the conduit or innerduct as shown on the plans, or as directed by the Engineer. The manufacturer's instructions must be carefully followed so as not to damage the cable. After the cable is pulled, traces must be obtained from the installed cable using an OTDR (Optical Time Division Reflectometer) to ensure that the cable was installed without damage. A bad trace will require that new cable be installed.
4. **MEASUREMENT.** The cable will be measured per foot installed and will include slack. Splicing and terminating fiber optic cable will be covered under different pay items.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per foot for FIBER OPTIC HYBRID CABLE IN CONDUIT, which price will be payment in full for furnishing and installing the cable.

MATERIAL
1482

May 23, 2001

ITEM 3917, INNERDUCT IN CONDUIT, 1 1/4 INCH

1. **DESCRIPTION.** This item is for furnishing and installing innerduct in existing conduit for the eventual placement of fiber optic cable, as shown on the plans or as directed by the Engineer.
2. **MATERIAL.** The innerduct will be nominally 1 1/4 inches in diameter and made from a flexible plastic such as polyethylene.
3. **INSTALLATION.** The innerduct must be pulled into the conduit per the manufacturer's instructions. The innerduct will be used to protect and isolate the fiber optic cable. The cable will be installed separately under a different pay item.
4. **MEASUREMENT.** The innerduct will be measured per foot installed and will include only horizontal distances as shown on the plans, or as directed by the Engineer.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per foot for INNERDUCT IN CONDUIT, 1 1/4", which payment shall be in full for furnishing and installing the innerduct.

May 23, 2001

ITEM 3921, MULTI-MODE FIBER OPTIC CABLE IN CONDUIT, WITH ST CONNECTIONS

1. **DESCRIPTION.** This item consists of furnishing and installing a length of fiber optic cable between the controller cabinet and the splice tray in the manhole, as directed by the Engineer or as required in the plans.
2. **MATERIAL.** The cable must meet the requirements for a multi-mode fiber optic pigtail cable as designated in Material Specification 1482. The cable will be 200 feet long, with ST connectors at one end of the cable.
3. **INSTALLATION.** The cable must be routed from the controller cabinet, through the conduit, and into the manhole, as shown on the plans or as designated by the Engineer. The cable must be connected to the fiber-optic patch panel in the controller cabinet using the ST connectors. Each of the eight (8) fibers must be terminated. The cable slack in the manhole must be trained and racked. The splicing of the cable in the splice tray will be done under a separate pay item.
4. **MEASUREMENT.** The fiber optic cable will be measured per each unit installed. Each unit will include 200 feet of the cable with ST connectors at one end.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price per each for MULTI-MODE FIBER OPTIC CABLE IN CONDUIT, WITH ST CONNECTIONS, which payment will be in full for furnishing and installing the cable.

DRAWING
909

MATERIAL
1482

October 24, 2006

ITEM 3925, FIBER OPTIC SPLICE, 30 - 8 FIBER, NEW
ITEM 3929, FIBER OPTIC SPLICE, 30 - 8 FIBER, EXISTING
ITEM 3933, FIBER OPTIC SPLICE, 30 - 30 FIBER, THROUGH

1. **DESCRIPTION.** This item consists of furnishing and installing a fiber optic splice tray and enclosure in a manhole and making the necessary splices of fiber optic cable, as directed by the Engineer.
2. **MATERIAL.** The splice tray and enclosure must be sized to accommodate splicing a 30-fiber cable of 6 multi-mode and 24 single mode fibers. The splice enclosure must be plastic and rated as NEMA 3R. The enclosure must be fully gasketed to provide a waterproof environment. The enclosure should be designed to reopen without damage to the enclosure, tray, or the fiber. The enclosure must be a 3M product in the 3M 2178-L/S series, or equivalent. The fiber optic splice tray must have a hinged cover and allow buffer tube entry at all four corners. The tray must accommodate the fiber bend radius. The fiber optic splice tray must be a 3M product in the 3M 2522, or 2523 series, or equivalent.
3. **INSTALLATION.** The fiber must be fusion spliced unless the Engineer approves a mechanical splice. Splicing of cable and insertion in the splice tray must be according to manufacturer's instructions.

The new fiber optic splice (30-8) will consist of splicing the 8 multi-mode fibers from the pigtail coming from the controller to 4 of the multi-mode fibers in the home run cable. Four splices will be for the incoming cable and four splices will be for the outgoing cable. The fibers to be spliced, which are color coded, will be selected by the Engineer. This will require a new splice enclosure.

The existing fiber optic splice (30-8) will consist of reestablishing an existing splice, where a problem may exist, or removing the existing pigtail and splicing a new pigtail. The existing splice enclosure will be used.

The straight through splice (30-30) will consist of taking each of the 30 fibers in the hybrid cable and splicing into another hybrid cable of the same configuration. This will require a new splice enclosure.

The cable must be inserted in the enclosure and the enclosure must be sealed as per the manufacturer's instructions. The enclosure must be installed in a manhole off the floor using the rack in the manhole.

4. **MEASUREMENT**. The fiber optic cable splice will be measured per each complete cable spliced, as specified, and must include all the individual fiber splices necessary per cable splice, plus the splice enclosure.
5. **BASIS OF PAYMENT**. This work will be paid for at the contract unit price per each for FIBER OPTIC CABLE SPLICE as specified, which payment will be in full for splicing the cable, furnishing the cable tray and enclosure, and mounting the enclosure in the manhole.

Items 3925, 3929, 3933

Page 2

October 24, 2006

ITEM 6200, REINSTALL SIGNAL HEAD, 3 SECTION, BRACKET MOUNT
ITEM 6201, REINSTALL SIGNAL HEAD, 3 SECTION, MAST ARM MOUNT
ITEM 6202, REINSTALL SIGNAL HEAD, 5 SECTION, MAST ARM MOUNT
ITEM 6203, REINSTALL SIGNAL HEAD, 5 SECTION, BRACKET MOUNT
ITEM 6204, REINSTALL PEDESTRIAN SIGNAL, 1 OR 2 SECTION, BRACKET MOUNT

1. **DESCRIPTION.** This work will consist of reinstalling a traffic signal head onto the original pole or mast arm, and reconnecting the harness cable to the junction box.
2. **INSTALLATION.** The traffic signal head will have been previously removed and stored or installed near the original installation on a temporary basis. This work must include re-installing the head on the pole or mast arm. The reinstallation will include remounting the signal head and reconnecting the harness cable to the terminal strip in the junction box. Removal from a temporary installation will be covered under a separate item.
3. **METHOD OF MEASUREMENT.** This work will be measured per each unit reinstalled, completely wired and operational.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for the unit specified, and will include all necessary labor to reinstall the signal head.

August 18, 2006

ITEM 6210, REINSTALL MAST ARM, MONOTUBE, 16 FOOT
ITEM 6211, REINSTALL MAST ARM, MONOTUBE, 20 FOOT
ITEM 6212, REINSTALL MAST ARM, MONOTUBE, 30 FOOT
ITEM 6213, REINSTALL MAST ARM, STEEL, 12 FOOT
ITEM 6231, REINSTALL MAST ARM, MONOTUBE, 26 FOOT
ITEM 6232, REINSTALL MAST ARM, MONOTUBE, 35 FOOT

1. **INSTALLATION.** This work will consist of reinstalling a mast arm for traffic signals or a mast arm for a street light luminaire onto the original pole. The mast arm will have been previously removed and stored or installed near the original installation on a temporary basis. This work will include re-installing the mast arm onto the pole. Removal from a temporary installation will be covered under a separate item.
2. **METHOD OF MEASUREMENT.** This work will be measured per each arm reinstalled.
3. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for REINSTALL MAST ARM of the size specified, and will include all necessary labor to reinstall the arm.

May 23, 2001

ITEM 6220, REINSTALL TRAFFIC SIGNAL POST, 17 FEET

1. **DESCRIPTION.** This work will consist of reinstalling a traffic signal post onto a foundation built for a traffic signal post.
2. **INSTALLATION.** The post will have been previously removed and stored or installed near the original installation on a temporary basis. This work will include re-installing the post onto a foundation. Removal from a temporary installation will be covered under a separate item.
3. **METHOD OF MEASUREMENT.** This work will be measured per each post reinstalled.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for REINSTALL TRAFFIC SIGNAL POST, of the size specified, and will include all necessary labor to reinstall the post.

May 23, 2001

ITEM 6225, REINSTALL JUNCTION BOX

1. **INSTALLATION.** This work will consist of reinstalling a traffic signal junction box onto a pole or post intended for that purpose. The junction box will have been previously removed and stored. This work will include re-installing the junction box on the original pole or post.
2. **METHOD OF MEASUREMENT.** This work will be measured per each junction box reinstalled. No cabling will be included in this item.
3. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for REINSTALL JUNCTION BOX, which payment will include all necessary material and labor to reinstall the junction box.

May 23, 2001

ITEM 6230, REINSTALL BASE MOUNTED TRAFFIC SIGNAL CONTROLLER
ITEM 6233, REINSTALL BASE MOUNTED STREET LIGHT CONTROLLER

1. **DESCRIPTION.** This work will consist of reinstalling a traffic signal or street light controller onto a foundation.
2. **INSTALLATION.** The controller and cabinet will have been previously removed and stored or installed near the original installation on a temporary basis. This work will include re-installing the controller and cabinet and making all necessary connections. Removal from a temporary installation will be covered under a separate item. Any lengths of new cable required will be covered under other pay items.
3. **METHOD OF MEASUREMENT.** This work will be measured per each controller reinstalled, and will include the cabinet and any wire connections necessary to make the controller fully functional.
4. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for REINSTALL BASE MOUNTED CONTROLLER, of the type specified, which payment will include all necessary labor to reinstall the controller. This will include all cable terminations necessary.

April 23, 2009

ACCESSIBLE PEDESTRIAN SIGNAL

Revised: 5/25/2019

Material Specifications: 1617, 1618

Standard Drawings: none

Description. This work shall consist of furnishing and installing an accessible pedestrian signal (APS) to be mounted on a traffic signal pole or post.

Materials. The APS must meet the requirements of Material Specification 1617. Cable for the APS must meet the requirements of Material Specification 1618.

Installation. The location of the APS shall be as shown on the plans or as directed by the Engineer and shall meet the requirements of the MUTCD Chapter 4, Sections 4E.08 to 4E.10.

The power supply shall be installed in the associated WALK/DONT WALK signal head compartment and be securely attached. The input wires to the power supply must be terminated to the correct terminals in the signal head. The output wires of the power supply shall be connected to the APS cable with quick disconnect plugs. The APS cable shall be properly terminated at the APS.

The APS cable is the four-conductor cable that will connect the power supply to the APS. The cable length will vary depending upon the relative location of the APS to its associated WALK/DONT WALK signal head. Care must be taken to ensure the correct wires are connected to the correct terminals. In all cases, the white wire will be the neutral and the green wire will be the ground. The cable should have sufficient slack so that there is no tension in the cable and there is enough extra cable to make or break connections easily. If the cable goes through a manhole/handhole, it must be trained along the sides.

The APS shall be located as indicated on the plans. A three-quarter inch (3/4") to one inch (1") diameter hole must be drilled into the pole at the proper height for the cable entrance. The size of the hole will be as directed by the Engineer. The hole must be reamed or filed to remove all sharp edges or burrs which might damage the cable. A weatherproof flexible caulking must be applied between the hole in the pole and the APS housing to protect the cable. The APS bracket shall be attached to the pole with 3/4" steel banding or with two stainless steel screws. The APS shall be attached to the bracket with two stainless steel screws. The height of the push-button shall be 42" above the sidewalk grade where the pedestrian will be located when at the APS, according to ADA requirements. The front face of the APS shall be parallel to the associated crosswalk. The tactile arrow shall be positioned to point toward the crosswalk.

The APS shall be programmed following the manufacturer's instructions. The sound levels and any vocal messages must be programmed as indicated on the plans or as directed by the Engineer.

A sign shall be mounted to the back-plate of the APS. The sign size and message shall be as indicated on the plans or as directed by the Engineer.

Method of Measurement. This work shall be measured per unit for each APS installed. This shall include the installation of the power supply, the installation of the APS, all wiring, providing and installing the sign, all programming, and any other necessary items and labor necessary to make the APS operational.

Basis of Payment. This work shall be paid for at the contract unit price each for ACCESSIBLE PEDESTRIAN SIGNAL of the type specified, which price will be payment in full for furnishing and installing the unit complete and operational.

CONTROLLER, RECEPTACLE, 1-PHASE, 120-240V, 100A

Revised: 10/31/2021

Material Specifications: 1375, 1428, 1606

Standard Drawings: 736, 785, 973, 974

Description. This work consists of furnishing and installing a receptacle controller cabinet with ballast housing base at the locations shown in the plans.

The controller provided shall be configured for 120/240-volt single-phase operation.

Material and Assembly. The controller cabinet and components shall meet the requirements of Material Specification 1606. Circuit breakers shall meet the requirements of Material Specification 1428. The ballast housing base shall meet the requirements of Material Specification 1375. The controller shall be wired as shown on Drawing 974. Branch circuit breakers must be as indicated on the plans. The cabinet shall be grounded with a bare copper wire, #4 AWG between the ground lug in the cabinet to the grounding clamp on the ground rod.

Installation. The cabinet shall be installed on a ballast housing base secured to a concrete foundation as shown on Drawing 973. The foundation, including anchor rods, washers, and nuts will be paid for separately.

The installation of feeder cables and branch circuit cables will be performed in a neat and workmanlike manner with all cable trained around the cabinet, secured to the proper terminals and identified either by tagging of the cables, or by identification of the branch breakers, all as part of the controller installation and not as a separate pay item.

The Contractor shall be responsible for all electrical service charges until the circuits are accepted by the City of Chicago Division of Engineering.

Basis of Payment. This work will be paid for at the contract unit price each for a CONTROLLER, RECEPTACLE, 1-PHASE, 120-240V, 100A.

CONTROLLER, STREET LIGHT, BASE MOUNTED, CONSTANT POWER, 1-PHASE, 120-240V, 200A

Revised: 10/31/2021

Material Specifications: 1375, 1428, 1606

Standard Drawings: 736, 785, 880, 983, 984

Description. This work consists of furnishing and installing a street lighting controller cabinet with ballast housing base at the locations shown in the plans.

The controller provided shall be configured for 120/240-volt single-phase operation.

Material and Assembly. The controller cabinet and components shall meet the requirements of Material Specification 1606. Circuit breakers shall meet the requirements of Material Specification 1428. The ballast housing base shall meet the requirements of Material Specification 1375. Controller components shall be laid out per Drawing 984. The controller shall be wired as shown on Drawing 983. Branch circuit breakers must be as indicated on the plans. The cabinet shall be grounded with a bare copper wire, #4 AWG between the ground lug in the cabinet to the grounding clamp on the ground rod.

Installation. The cabinet shall be installed on a ballast housing base secured to a concrete foundation as shown on Drawing 880. The foundation, including anchor rods, washers, and nuts will be paid for separately.

The installation of feeder cables and branch circuit cables will be performed in a neat and workmanlike manner with all cable trained around the cabinet, secured to the proper terminals and identified either by tagging of the cables, or by identification of the branch breakers, all as part of the controller installation and not as a separate pay item. The lighting circuit will be placed in operation as soon as practicable.

The Contractor shall be responsible for all electrical service charges until the circuits are accepted by the City of Chicago Division of Engineering.

Basis of Payment. This work will be paid for at the contract unit price each for a CONTROLLER, STREET LIGHT, BASE MOUNTED, CONSTANT POWER, 1-PHASE, 120-240V, 200A.

CONTROLLER, UNDERPASS LIGHTING, CONSTANT POWER, 1-PHASE, 120/240V, 60A

Revised: 9/10/2021

Material Specifications: none

Standard Drawings: 861A

Description. This work will consist of furnishing and installing a constant power underpass lighting controller to be mounted on a wall, column or as directed in the plans. This work shall include the appropriate brackets, beam clamps, channel, and other hardware required to mount the controller on a CTA or railroad structure, or as directed by the Engineer or as shown on the plans.

Materials. The cabinet, panel, and circuitry must meet the requirements of Standard Drawing 861A.

Installation. The cabinet must be mounted as shown in the detail in the plans.

Basis of Payment. This work will be paid for at the contract unit price each for CONTROLLER, UNDERPASS LIGHTING, CONSTANT POWER, 1-PHASE, 120/240V, 60A and will be payment in full for furnishing and installing the controller complete in place.

FURNISH AND INSTALL SIGN POLE AND BASE

Revised: 12/16/2021

Material Specifications: NONE

Standard Drawings: none

Description. This work consists of furnishing sign poles of various lengths and installation either by dig method or drill method as shown on the Contract Drawings. The poles installed using dig method shall be 11 feet and 6 inches in length and the poles installed using drill method shall be 10 feet and 6 inches in length. The cost of wedges, sleeves, pole bases and all other required hardware to install poles is incidental to the cost of items.

Sign Poles:

Materials: The material for the poles furnished must be hollow steel tubes, 2-3/8 inch outside diameter, conforming to ASTM A500 Grade B and coated for resistance to corrosion and outdoor weathering. Nominal wall thickness of pole must be 0.083". The sign pole must be formed to the size and type specified in the Contract Drawings. Holes must be drilled prior to coating to prevent indentations and dimples in the poles.

Finish: The poles must be galvanized, straight and have a smooth, black, uniform powder coating finish as specified below. The interior of the sign poles must be coated with a minimum of an 81 % zinc rich primer. The exterior of the poles must be galvanized with material conforming to MSHTO M 120 with a minimum weight of 1.00 ounces per square foot. The weight of the exterior galvanizing may be reduced to 0.65 ounces per square foot of high-grade material conforming to MSHTO M 120 if applied with a chromate conversion coating and a clear high performance organic polymer coating. Powder coating of the poles and extensions must meet the following requirements:

Color:	Black
Cure:	10 minutes @ 400° F or 20 minutes @ 350° F
Resin Type:	TGIC Polyester
Gloss:	55-65%

Pretreatment Process:

Cleaning: All parts must be cleaned utilizing spray washers and an alkaline cleaner to remove any remaining grease, dirt, or other contaminants.

Rinsing: All parts must be spray rinsed in a continuously overflowing rinse stage to remove any remaining cleaning solution.

Phosphating: All parts must be spray phosphated in a heated phosphate solution to provide a transition coating between metal and powder.

Rinse: All parts must be spray rinsed in a continuously overflowing rinse stage to remove any remaining phosphate/ sealant solution.

Powder Coating Process:

Drying: All parts must be preheated to totally eliminate moisture and prevent off gassing of casting.

Powder Coating: A premium TGIC polyester powder must be Electrostatically applied to provide a uniform coating to a thickness of 1-3 mils (1 mil minimum). To achieve proper mil thickness, the powder must be applied with one application. The vendor must be responsible for ensuring proper adhesion to the metal surface.

Curing: All parts must be heated to the exact time and temperature requirements, recommended by the powder coat material manufacturer, in precisely controlled gas ovens.

Sleeve and Locking Wedge:

Pole Sleeve (pipe socket): Material must be hollow steel tubes conforming to ASTM A500 Grade B or ASTM A501, and galvanized according to AASHTO M111, nominal wall thickness of 0.109", 2-5/8 inch inside diameter that allows for a minimum of 13-1/4 inch of sign pole to nest inside the sleeve. The overall length must be 27 inches.

Locking Wedge: Material shall be 11-gauge steel tube conforming to ASTM A500 Grade B or ASTM A501 and galvanized according to AASHTO M 111. The locking wedge shall be contoured to fit between the steel pole and the 27-inch sleeve.

Sign Pole Base:

The sign pole base furnished under this contract includes a carriage bolt, tamper-resistant nuts, and anchor bolts with nuts. The finished casting must be free from burrs, cracks, voids, or other defects.

Support Base: Twelve-inch diameter, aluminum-zinc alloy casting per ASTM A126, Class B. The casting must have the words "City of Chicago" cast in relief.

Bolt washers and nut: Stainless steel as specified in Article 1006.31(a) of the Standard Specifications. Include a 1/2" x 4" carriage bolt with two 9/16" x 1-3/8" x 1/8" flat washers and a 1/2" full height hex nylon locknut.

Anchor Bolt: Galvanized steel expansion anchors conforming to Article 1006.09 of the Standard Specifications. Anchors shall be a heavy-duty wedge type, with dimensions of 1/2" x 3-3/4" and tested for conformance with ACI 355.2 and ICC-ES AC193. Furnish three per each sign base provided.

Finish: Powder coat to minimum 1 mil thickness with satin black polyester finish.

Submittals.

Shop Drawings: Fabrication shop drawings showing the full-size layout, color, and proposed materials for poles, bases, and hardware must be submitted for approval prior to start of fabrication.

Poles: Mill certification, samples of each size of finished pole and extension. Locking wedge and sleeve: Samples of each item.

Cast Aluminum Base: Mill Certifications.

Powder Coating: Test Data; Sample; Manufacturer's Certification that material complies with the required specifications.

Galvanizing: Manufacturer's Certification for compliance with these specifications. Stainless steel bolts and nuts, anchor bolts: sample, product data sheet.

Material Acceptance: The Contractor must provide a Manufacturer's written certification that the material complies with these specifications.

Installation: All installation shall be performed in accordance with Article 720.04 of the Standard Specifications or as directed by the Commissioner.

Drill Method: The base will be secured to the concrete surface by steel expansion anchors and must be leveled by using stainless steel washers as shims at the anchor bolt locations and under the base castings. The sign pole will be installed into the cast iron base and locked in place with a carriage bolt with two flat washers and a nylon lock nut. The holes at the top of the sign pole must be aligned such that the sign to be installed will properly face the flow of traffic. Sign poles will be installed 18" from back of curb unless otherwise specified. Poles for transportation stops, e.g., bus, taxi, tour bus, or tour boat stops, must be installed 24" from the back of the curb unless otherwise noted.

Dig Method: To install a sign pole by dig method, the Contractor will first drive a base sleeve to a level with the top of the sleeve near flush to the ground. The sign pole will then be inserted into the sleeve and raised to a level with the bottom of the pole 10 to 12 inches below the ground. The sign pole will then be locked in place by driving a locking wedge between the sign pole and the base sleeve. Note: Pipe sleeve and wedge shall not be bolted together. The holes at the top of the sign pole will be properly aligned such that the sign to be installed will properly face the flow of traffic.

Warranty. The manufacturer's warranty shall cover materials and workmanship for a period of 5 years. The warranty period will begin on the date of Final Punch List Completion and Acceptance of the work.

Basis of Payment. FURNISH AND INSTALL POLE AND BASE will be paid for at the Contract Unit Price per each, which prices shall include the cost of poles, all sleeves, locking wedges, bases and all other required hardware and labor to complete the installation of poles.

INNERDUCT IN CONDUIT, 3/4" DIAMETER

Revised: 11/24/2021

Material Specifications: none

Standard Drawings: none

Description. This work will consist of furnishing and installing innerduct in a conduit for the placement of Category 5e/6 network cable.

Materials.

General:

The duct shall be a spiral ribbed plastic duct which is intended for underground use, and which can be manufactured and coiled or reeled in continuous transportable lengths and uncoiled for further processing and/or installation without adversely affecting its properties of performance.

The duct shall be made of polyvinyl chloride (PVC) which shall meet the requirements of ASTM D 3035. The innerduct material shall be composed of high-density polyethylene meeting the requirements of PE334470E/C as defined in ASTM D3350.

Submittal information shall demonstrate compliance with the details of these requirements.

Dimensions:

Duct dimensions shall conform to the standards listed in ASTM D3035, SDR-11. Submittal information shall demonstrate compliance with these requirements.

Nominal Size (Diameter)	Inside Diameter (minimum)	Outside Diameter (Average)	Wall Thickness (Min.)
0.75"	0.74"	1.050"	0.060"

Marking:

As specified in NEMA Standard Publication No. TC-7, the duct shall be clearly and durably marked at least every 10 feet with the material designation (HDPE for high density polyethylene), nominal size of the duct, and the name and/or trademark of the manufacturer.

Color:

Innerduct shall be colored Orange or as directed by the Engineer.

Installation. The innerduct shall be pulled into the conduit per the manufacturer's instructions.

Measurement. The duct shall be measured for payment in linear feet in place as described herein. Measurements shall be made in straight lines between horizontal changes in direction between the centers of the terminating points (poles, cabinets, junction boxes). Vertical measurement of the duct shall be as follows:

For runs terminating at junction boxes and/or control cabinets, the vertical measurement shall be taken from the bottom of the trench, or horizontal raceway, to a point 18-inches beyond the center of the junction box or control cabinet.

For runs terminating at poles, the vertical measure shall be taken from the bottom of the trench, or horizontal raceway, to a point 18-inch beyond the center of the light pole handhole regardless of light pole mounting method

Innerduct installed in excess of the limits describes herein shall not be paid for.

Basis of Payment. This work will be paid for at the contract unit price per foot of INNERDUCT IN CONDUIT, $\frac{3}{4}$ " DIAMETER.

ITEM 265, CONTROLLER, POLE MTD, SL, 60A

1. **DESCRIPTION.** This work will consist of furnishing and installing a street lighting controller cabinet onto a wood CECO pole. The cabinet will contain various electro-mechanical devices to automatically control residential street lighting circuits, and to provide protection for the equipment so controlled. The electrical control circuit will consist of a 60 amp main breaker with two 30 amp branch breakers.
2. **MATERIAL AND ASSEMBLY.** The cabinet, panel, and circuitry must meet the requirements of Material Standard 1535 and Standard Drawing 955. The service cable must meet the requirements of Material Specification 1457.
3. **INSTALLATION.** The cabinet must be mounted as shown on Standard Drawing 11925, with the exception that the millbank is to be replaced with the residential control cabinet. The fiberglass cabinet has four mounting holes in the back; two top and two bottom. The cabinet must be bolted to two (2) galvanized steel sheets; one at the top of the cabinet and one at the bottom. Each sheet must be sized to have two extensions which stick out beyond the sides of the cabinet and can be formed so that lag bolts can be inserted through the steel sheet into and through the wood pole. The steel sheets and the lag bolts must be of sufficient strength to safely mount the cabinet. This work will include mounting the cabinet to the CECO pole. This work will include all steel conduit & elbow mounted to the CECO pole. The service cable from the controller to the CECO secondary must be terminated at the controller and spliced at the other end to the CECO secondary. The street light cable must be terminated on the load side of the controller.

The lighting circuit must be placed in operation as soon as practicable with the Contractor being charged for the energy until the circuits are accepted by the City of Chicago, Division of Engineering.

4. **METHOD OF MEASUREMENT.** This work must include all conduit mounted to the pole, the controller with electrical components, all mounting hardware, the service cable from the controller to the CECO secondary, all cable terminations, and cable splicing. The street light cable is not included.
5. **BASIS OF PAYMENT.** This work will be paid for at the contract unit price each for a CONTROLLER, CONTROLLER, POLE MTD, SL, 60A, and will be payment in full for furnishing and installing the controller complete in place. 2" steel elbow installation will be considered incidental to this item.

MATERIAL SPECIFICATION
1535 1457

DRAWING
955 11925

LUMINAIRE, LED, ACORN, ARTERIAL

Revised: 10/31/2021

Material Specifications: 1351, 1612

Standard Drawings: 912

Description. This work will consist of furnishing and installing a LED ornamental acorn luminaire.

Materials. Luminaires shall meet the requirements of Material Specification 1612. The luminaire must have the general appearance of Standard Drawing 912. Pole wire shall meet the requirements of Material Specification 1351.

Installation. Installation must meet all applicable requirements of Sections 801 and 821.03 of the Standard Specifications. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The luminaire must be properly mounted to a 3-inch high by 3-inch diameter tenon with set screws. The contractor must level and adjust the luminaire for proper illumination.

Basis of Payment. This work will be paid for at the contract unit price per each for LUMINAIRE, LED, ACORN, ARTERIAL.

LUMINAIRE, LED, ACORN, CHICAGO 2000

Revised: 3/21/2022

Material Specifications: 1351, 1612

Standard Drawings: 932

Description. This work will consist of furnishing and installing a LED ornamental acorn luminaire.

Materials. Luminaires shall meet the requirements of Material Specification 1612. The luminaire must have the general appearance of Standard Drawing 932. Pole wire shall meet the requirements of Material Specification 1351.

Installation. Installation must meet all applicable requirements of Sections 801 and 821.03 of the Standard Specifications. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer. The luminaire must be properly mounted to a 3-inch high by 3-inch diameter tenon with set screws. The contractor must level and adjust the luminaire for proper illumination.

Basis of Payment. This work will be paid for at the contract unit price per each for LUMINAIRE, LED, ACORN, CHICAGO 2000.

LUMINAIRE, LED, COBRA HEAD, ARTERIAL

Revised: 12/1/2021

Material Specifications: 1351, 1608, 1630, 1631, 1633

Standard Drawings: none

Description. This item shall consist of furnishing and installing a LED street light luminaire of the output noted on the plans with external smart node.

Materials. Luminaires shall meet the requirements of Material Specification 1613. External smart lighting nodes shall meet the requirements of Material Specification 1608. Pole wire shall meet the requirements of Material Specification 1351.

Installation. This work shall meet the applicable requirements of Sections 801 and 821.03 of the Standard Specifications. Each luminaire shall be installed per the manufacturer's instructions. Luminaires shall be securely attached to the end of a two-inch diameter pipe arm and leveled to provide proper illumination.

Pole wiring shall be connected to the luminaire terminal block, or quick disconnect, in accordance with the Material Specifications and the manufacturer's recommendation. Pole wires shall be spliced to the field wires at the base of the pole using splicing methods approved by the Engineer, and as detailed under related special provisions. The pole wires shall be of sufficient length to connect the luminaire to the field wires at the base of the pole.

Basis of Payment. This work will be paid for at the contract unit price per each for LUMINAIRE, LED, COBRA HEAD, ARTERIAL.

LUMINAIRE, LED, TEARDROP, CHICAGO 2000

Revised: 3/11/2022

Material Specifications: 1351, 1611

Standard Drawings: 931A

Description. This work will consist of furnishing and installing a LED pendant luminaire with a teardrop refractor.

Materials. Luminaires shall meet the requirements of Material Specification 1611. The luminaire must have the general appearance of Standard Drawing 931A. Pole wire shall meet the requirements of Material Specification 1351.

Installation. Installation must meet all applicable requirements of Sections 801 and 821.03 of the Standard Specifications. Luminaires must be securely attached to the end of a two-inch diameter pipe arm and leveled to provide proper illumination. The pole wire must be spliced to the field wire at the base of the pole using splicing methods approved by the Engineer.

Basis of Payment. This work will be paid for at the contract unit price per each for LUMINAIRE, LED, TEARDROP, CHICAGO 2000.

LUMINAIRE, LED, VIADUCT

Revised: 3/11/2022

Material Specifications: 1604

Standard Drawings: 981

Description. This work will consist of furnishing and installing a viaduct luminaire with brackets, beam clamps, channel, vibration dampers, and other hardware required to mount the luminaire on a CTA or railroad structure, or as directed by the Engineer or as shown on the plans.

Materials. The luminaire must meet the requirements of Material Specification 1604 and Standard Drawing 981.

Basis of Payment. This work will be paid for at the contract unit price per each for LUMINAIRE, LED, VIADUCT.

MAINTENANCE OF STREET LIGHTING SYSTEM

Revised: 10/31/2021

Material Specifications: 1447, 1613

Standard Drawings: none

Description. This work consists of furnishing all labor, equipment, and incidental materials for maintaining existing street lighting systems owned by the Chicago Department of Transportation (CDOT) until the proposed new equipment is installed, energized, tested, and accepted for operation by CDOT.

The work shall include any necessary temporary devices to maintain existing illumination. The location and protection of devices necessary to comply with these requirements shall be subject to the approval of the Engineer. The Engineer will be the sole judge of satisfying existing illumination levels.

Any temporary wire or cable which may be required to be installed overhead between existing poles or temporary devices shall be furnished, installed, terminated, and maintained in service until the proposed lighting equipment is installed, tested and accepted for operation by the Engineer.

Existing Lighting Systems to be Maintained:

<list CDOT Edison Atlas # and Group # for controllers impacted by the work>

Materials. Materials shall be according to the following CDOT Division of Electrical Operations (DEO) Specifications and Articles of Standard Specifications Section 1000 – Materials:

Item	Requirement
(a) Cable Splicing and Termination	Standard Specifications Article 1066.06
(b) Fuse holders and Fuses	Standard Specifications Article 1065.01
(c) Pole Wire	Material Specification 1351
(d) Aerial Cable Assembly	Material Specification 1601
(e) Thermal Magnetic Circuit Breaker	Material Specification 1428
(f) Metal Light Poles	Material Specification 1447
(g) Luminaires	Standard Specifications Article 1067

Material Acceptance. The Contractor shall provide a Manufacturer's written certification that the materials comply with these specifications.

General Requirements. General requirements shall be in accordance with Section 801 of the Standard Specifications, and in accordance with Division of Electrical Operations Standards and the City of Chicago Electrical Code, except as herein modified.

The Contractor shall maintain existing lighting systems (temporary and permanent) and proposed lighting systems, as well as receptacles and other ancillary devices connected to the applicable street lighting controllers. Effective the day the Contractor starts work (including non-electrical work), the Contractor shall maintain the existing lighting equipment located within the project limits as it then exists. The Contractor shall also maintain any street lighting equipment outside of the project limits but connected to a controller situated within the project limits. The Contractor shall also maintain any street lighting equipment inside of the project limits but connected to a controller

situated outside the project limits.

The Scope of Work shall include the assumption of responsibility for the continuing operation of existing, temporary, or other lighting-systems affected by the work as may be specified elsewhere herein. Existing lighting systems, when depicted on the Plans, are intended only to indicate the general nature of the systems involved and shall not be construed as an exact representation of the field conditions. It remains the Contractor's responsibility to visit the site to confirm and ascertain the exact nature of systems to be maintained.

Preconstruction Inspection. Before performing any excavation, removal, or installation work (electrical or otherwise) at the site, the Contractor shall initiate a request for preconstruction inspection, to be held in the presence of the Engineer and a representative of the Chicago Department of Transportation Division of Electrical Operations. The request for the maintenance preconstruction shall be made no less than seven (7) calendar days prior to the desired inspection date. The maintenance preconstruction inspection shall:

- Establish details of any formal transfers of maintenance responsibility required for the construction period.
- Establish approximate locations of known lighting and/or traffic control systems, which may be affected by the work.
- Establish the condition of lighting and/or traffic control systems which may be affected by the Work.

Lighting System Maintenance Operations. To ensure a prompt response to incidents involving the integrity of the work zone street lighting devices, the Contractor shall provide a telephone number where a responsible individual can be contacted on a 24-hour-a-day basis. When the Commissioner is notified or determines a deficiency exists, (s)he will be the sole judge as to whether the deficiency is an immediate safety hazard. The Contractor shall dispatch sufficient resources within 12 hours of notification to make needed corrections of deficiencies that constitute an immediate safety hazard. Other deficiencies shall be corrected within 24 hours. If the Contractor fails to restore the required street light within the time limits specified above, the Commissioner will impose a daily monetary deduction for each 24-hour period (or portion thereof) the deficiency exists. This time period will begin with the time of notification to the Contractor and end with the Commissioner's acceptance of the below. In addition, if the Contractor fails to respond the Commissioner may correct the deficiencies and the cost thereof will be deducted from monies due or which may become due the Contractor. This corrective action will in no way relieve the Contractor of his/her contractual requirements or responsibilities.

Installation Requirements for Temporary Lighting Units. The Contractor shall furnish and install a temporary lighting unit to replace any existing lighting unit that is removed prior to the new lighting system being operational.

Temporary lighting unit shall include pole, mast arm, luminaire, and temporary wiring connections. The Contractor shall furnish and install temporary lighting units and all associated electrical equipment to ensure compliance with the applicable codes, standards, and Specifications.

The Contractor shall coordinate temporary lighting with the sequence of construction and maintenance of traffic for this Project.

The wiring on the pole shall consist of aerial electric cables and waterproof splices at each light pole.

All equipment furnished shall be functional and new in appearance and shall be maintained. The Contractor shall own all the temporary lighting equipment furnished and installed.

The Contractor shall disconnect and remove temporary lighting and all associated electrical equipment upon energizing and acceptance of the permanent lighting system.

Temporary Wiring. The Contractor shall furnish and install aerial electric cable, including messenger wire, in accordance with Section 818 of the Standard Specifications. The conductor size shall be Number 6 AWG minimum. The messenger wire shall be steel and of adequate size to support the cables from structure to structure under normal and adverse weather conditions.

The electric cables shall be secured to the steel messenger wire with binding strips continuous throughout each span of cable and shall be of adequate strength to support the size of electric cables required for this Project.

Temporary Poles. Temporary lighting poles may be used metal poles in accordance with Article 1069.01 of the Standard Specifications. Metal poles shall be similar in type, size and finish.

Temporary lighting poles may be used steel poles that comply with Division of Electrical Operations Specification Number 1447 if already owned by the Contractor and in stock.

The Contractor shall provide and remove temporary foundations for the metal poles that will be adequate to support the poles during normal and adverse weather conditions and as directed by the Engineer.

Temporary Luminaires. Each luminaire shall be a LED unit that meets the requirements of Material Specification 1613. Each luminaire shall be mast arm or bracket arm mounted on the top of the pole. Each luminaire shall be provided with a leveling surface and a leveling device and shall be capable of being tilted by plus or minus 30 degrees and rotated to any degree with respect to the supporting bracket. Each luminaire shall have a pipe arm barrier to limit the amount of inflection.

Installation. Location of cables and fixtures for temporary lighting shall be adjusted and supported to accommodate field conditions encountered, including any potential interferences with other construction or equipment to be installed.

The Contractor shall determine the exact route and location of each temporary lighting fixture and associated wiring, prior to installation.

Temporary lighting shall be installed to permit removal (without damage to other parts) of parts requiring periodic replacement or maintenance.

Temporary wiring/lighting shall be removed immediately upon acceptance of permanent lighting.

Method of Measurement. MAINTENANCE OF STREET LIGHTING SYSTEM will not be measured for payment but will be paid on a lump sum basis.

Basis of Payment. This work will be paid for the contract lump sum price for MAINTENANCE OF STREET LIGHTING SYSTEM which will be payment in full for maintaining the existing street lighting system until the proposed new equipment is installed, energized, tested, and accepted for operation by CDOT, furnishing, installing, and removing all temporary lighting units, aerial cable and ancillary equipment required to maintain the existing lighting system as described herein.

NAVIGATION LUMINAIRE, LED, CHANNEL CENTER, SUSPENDED MOUNT
NAVIGATION LUMINAIRE, LED, CHANNEL MARGIN, BASE MOUNT
NAVIGATION LUMINAIRE, LED, CHANNEL MARGIN, SUSPENDED MOUNT

Revised: 12/22/2021

Material Specifications: none

Standard Drawings: none

Description. The work shall consist of furnishing and installing navigation obstruction warning luminaires, complete with all required supports, hardware, wiring, and mounting accessories.

Materials. The Fresnel piece shall be one piece, precision molded, color impregnated, tempered glass. Astragals shall be oriented to minimize their impact on the light beam at all viewing angles.

- a. **Housing.** The housing shall be cast aluminum. Casting alloy used shall be suitable for marine environment. Construction shall be rain-tight and fully gasketed. The light assembly shall be designed for heavy-duty, long-life service. Design shall provide ready access for lamp service.

The navigation luminaire shall have a cast bronze, marine grade aluminum or brass body and be United States Coast Guard approved. Nuts, bolts, thump screws, hardware, thread rods, pipe, hangers, and mounting bases which are exterior, shall be stainless steel (300 series) or bronze. Hardware on the interior of the lamp cavity shall be stainless steel or bronze.

- b. **Lens.** The lens shall be heat-resistant Fresnel glass. Nominal lens section shall be 180 degrees. Inside lens diameter shall measure approximately 7". Outside lens diameter shall measure approximately 8". Color shall be red. Lens shall have a wide angle of divergence suitable for high mounting on bridges or structures. The angle of divergence shall not be less than 27°.
- c. **Lamp and Receptacle.** Lamp shall be medium base, 120V, 100,000-hour LED provided in a color to match the lens. Medium base receptacle shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing. Double head option adds a second lamp and receptacle. Lamps shall run simultaneously.
- d. **Stem.** Lamp fixture head and base shall be mounted on a 1 1/2" schedule 40 pipe, 1.90" O.D. Pipe material shall be stainless steel.
- e. **Mounting.** Base shall be cast of the same material as the fixture head. Light assembly shall mount via four 1/2" diameter bolts through the base, provided by installer to suit installation.
- f. **Junction Box.** A cast junction box with gasketed access cover shall be provided when specified. Junction box shall be of the same material as the fixture assembly and shall match the navigation light base footprint. Orientation of junction box shall be capable of rotation in 90-degree increments. Junction box shall provide two conduit entries, threaded for 3/4" standard pipe size.
- g. **Shock Absorber.**

The navigation luminaire shall have a cast bronze, marine grade aluminum or brass body and be United States Coast Guard approved. Nuts, bolts, thump screws, hardware, thread rods, pipe,

hangers, and mounting bases which are exterior, shall be stainless steel (300 series) or bronze. Hardware on the interior of the lamp cavity shall be stainless steel or bronze.

The luminaire shall be optically sealed, mechanically strong and easy to maintain. The luminaire shall be designed to operate on a 120VAC power supply. The lamp cavities shall be watertight and bug-proof. The lamp shall be easily accessible for re-lamping through gasketed doors which are held captive by means of hinges or a brass chain.

A LED light source shall meet or exceed United States Coast Guard Title 33 CFR 118.60 for brightness. The useful life for the LED light source shall exceed 50,000 hours and the end-of-life output shall not depreciate below 70 percent of its initial rating or a level established by the United States Coast Guard, whichever is greater. The LED array shall be mounted on a shock and vibration isolator in the center of the lens focal point.

Construction Requirements. Mounting of the luminaire shall be as recommended by the luminaire manufacturer to allow access for maintenance and re-lamping.

Method of Measurement. This work will be measured on a per each basis for each navigation light furnished and installed in place.

Basis of Payment. The work under this item shall be paid for at the contract unit price for NAVIGATION LUMINAIRE, LED, CHANNEL CENTER and NAVIGATION LUMINAIRE, LED, CHANNEL MARGIN.

SHALLOW CONDUIT PROTECTION STEEL PLATE

Revised: 3/7/2022

Material Specifications: none

Standard Drawings: none (see detail in plans)

Description: This work will consist of furnishing and installing a steel plate(s) to protect conduit and/or existing utilities at locations where a conduit depth of 30" cannot be achieved, as shown in the plan details. A minimum of 24" cover shall be provided over the steel plate.

Materials: The plate material shall be grade 304 stainless steel, in accordance with ASTM A240. The thickness shall be 0.25". The width shall be 12". Length shall be as necessary protect conduit installed shallower than 30" to avoid conflict with an existing utility or other obstacle.

Installation: The plate shall be centered over the conduit or utility to be protected.

Method of Measurement: This work will be measured for payment in lineal feet in place.

Basis of Payment: This work will be paid for at the contract unit price per lineal foot for SHALLOW CONDUIT PROTECTION STEEL PLATE.

STREET NAME SIGNS

Revised: 12/21/2021

Material Specifications: none

Standard Drawings: D3-1 Street Name Sign Installation, Regulatory Sign Installation on Traffic Signals, D3-1 Sign and Bracket Specs

Description. This item will consist of furnishing, fabricating, and installing a street name sign on a traffic pole with a monotube arm as indicated on the plans, or as directed by the Engineer. The plans will indicate the location of the sign and the sign legend. The sign panel and associated hardware must meet the specifications of Section 720 - SIGN PANELS AND APPURTENANCES of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction. The signs must meet the requirements as to size, mounting hardware, and mounting location per City of Chicago Department of Transportation standard drawings for D3-1 Street Name Sign Installation, Regulatory Sign Installation on Traffic Signals and D3-1 Sign and Bracket Specs.

Basis of Payment. This work will be paid for at the contract unit price per each street name sign and must include all necessary hardware and labor to erect the sign.

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Spec #	Description	Date	Status
1351	Pole Wire	08-27-13R	Active
1375	Base: Ballast Housing, No. 7 U.S. Standard Gauge Steel	3/11/22	Active
1385	Pedestal Base: Aluminum, For Traffic Signal Posts	08-12-13R	Active
1407	Junction Boxes: Aluminum, For Traffic Cable Termination	04-02-09R	Active
1428	Thermal-Magnetic Circuit Breaker	9/11/89	Active
1432	Self-Supporting Secondary Cable	07-31-06R	Active
1438	Bracket-Arm: Lighting, 21 inch (alley)	10/16/90	Active
1441	Cable: 1/C, 600 Volt, Aerial, #6, Weatherproof	07-31-13R	Active
1443	Secondary Rack, 2 or 3 Wire	07-11-06R	Active
1447	Pole: Steel, 34'-6", 3 or 7 gauge	1/22/20	Active
1450	Mast Arms: Luminaire, Steel, 4-8-12-15 Foot	04-20-07R	Active
1451	Cable: 1/C, 15,000 KV, EPR With PVC Jacket	08-03-06R	Active
1452	Pole: Anchor Base, Aluminum	03-19-14R	Active
1453	Mast Arm: Luminaire, Aluminum, Davit and Truss	03-14-13R	Active
1454	Mast Arm: Traffic Signal Monotube	9/25/20	Active
1457	Cable: Service Entrance, 3/C, 600 Volt	08-03-06R	Active
1458	Round Manhole Frames and Covers, 24" and 30"	03-04-14R	Active
1459	Pole: Ornamental, 14', Florentine, Aluminum	11-14-14R	Active
1460	Mast Arm: Ornamental, Florentine, Aluminum, Twin	11-14-14R	Active
1462	Conduit: Rigid Galvanized Steel & PVC Coated	11-21-14R	Active
1463	Traffic Signal Mounting Bracket, Mast Arm Mount	02-07-14R	Active
1465	Ground Rods	07-12-06R	Active

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Spec #	Description	Date	Status
1467	Anchor Rods	06-28-12R	Active
1473	Main Disconnect Box: Pole Mounted, Aluminum	02-12-10R	Active
1475	Cable: Traffic Signal, 8/C, #16, 600 Volt	09-26-06R	Active
1476	Traffic Signals: Vehicular, 8" LED	02-10-14R	Active
1478	Pole: Ornamental, Richmond, 12 Foot (gaslight)	7/18/95	Active
1482	Cable: Fiber-Optic, Hybrid, Traffic Signal	02-23-10R	Active
1484	Traffic Signals: 8" LED Yellow Flasher, 1-Section	02-06-14R	Active
1487	Pole: Ornamental, Loop	11-14-14R	Active
1488	Pole Base: Ornamental, For Loop Pole	03-06-14R	Active
1489	Luminaire Twin Arm: Ornamental, For Loop Pole and Extended Loop Pole	6/9/97	Active
1491	Pole: Ornamental, Electrolier, With Arms	10/28/97	Active
1493	Traffic Signals: Vehicular, Polycarbonate	02-06-14R	Active
1495	Traffic Signal Mounting Bracket, Polycarbonate, Pole Side Mount	02-07-14R	Active
1496	Traffic Signals: 12" LED Yellow Flasher, 2-Section	02-07-14R	Active
1504	Pole: Chicago 2000 Pedestrian 14 Foot	03-06-14R	Active
1505	Pole: Chicago 2000	07-17-06R	Active
1506	Pole: Ornamental, Extended Loop Pole	12/13/19	Active
1512	Chicago 2000 Pedestrian Pole Base	03-06-14R	Active
1513	Chicago 2000 Pole Base	03-07-14R	Active
1514	Chicago 2000 Mast Arm, 8'	03-07-14R	Active
1517	Pedestrian Push Button	08-18-06R	Active
1518	Internally Illuminated Sign	02-13-14R	Active

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Spec #	Description	Date	Status
1523	Base: Ornamental, Extended Loop Pole	03-06-14R	Active
1526	Helix Foundations	06-12-14R	Active
1527	Mast Arms: Davit, 8 Foot and 12 Foot Steel	04-30-07R	Active
1528	Precast Concrete Structures	06-06-14R	Active
1532	Uninterruptable Power Supply for Traffic Signals	9/15/03	Active
1533	Non-Metallic Conduit	11-21-14R	Active
1534	Cable: Single Conductor, Copper 600 Volt	08-05-13R	Active
1535	Residential Lighting Controller and Cabinet	9/1/06	Active
1537	Cable: Traffic Signal	08-05-13R	Active
1540	Video Detection Camera and Mount	10/30/06	Active
1541	Reinforcing Rod Steel Cages	9/16/04	Active
1543	Traffic Signal: Optically Programmed LED	02-07-14R	Active
1544	Traffic Signal: LED Lamp (Par-46) for Optically Programmable Signal	02-07-14R	Active
1545	Traffic Signal: Pedestrian Countdown LED	02-07-14R	Active
1546	Bracket Arm: Ornamental Mid-Mount	03-07-14R	Active
1558	Advanced Transportation Controller & Cabinet	12-04-14R	Active
1560	Advanced Transportation Controller, Cabinet, & UPS	1/14/21	Active
1565	Transclosure 100KVA/12KV P/120-240V S/ 1 Phase	09-22-09R	Active
1579	Handhole: Fiberglass / Frame and Cover Composite 24"	7/8/11	Active
1590	Metered Receptacle Controller	6/4/13	Active
1591	Breakaway Pole Base	3/10/14	Active
1593	Cable Anti-theft Device for Helix Foundations	02-11-15R	Active

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Spec #	Description	Date	Status
1601	Self-Supporting Aluminum Street Light Cable	10-25-16R	Active
1602	Roadway LED Luminaire - Ornamental Acorn for Residential Streets	4/9/21	Active
1604	Luminaire: LED, Viaduct/Elevated Structure Retrofit	4/10/18	Active
1606	Arterial Street Lighting Controller	10/10/17	Active
1607	Residential Street Lighting Controller	10/10/17	Active
1608	Roadway Lighting Control Smart Nodes	4/2/21	Active
1609	Luminaire: Residential, Alley, & Arterial Streets (Cobrahead)	10/20/17	Active
1610	Pole Base: Chicago 2000 Roadway Pole	10/20/17	Active
1611	Roadway LED Luminaire - Ornamental Teardrop for Arterial Streets	4/9/21	Active
1612	Roadway LED Luminaire - Ornamental Acorn for Arterial Streets	4/9/21	Active
1614	Roadway LED - Flood Light Luminaire	4/9/21	Active
1615	Outdoor Control Device Receptacle for LED Luminaire	8/20/18	Active
1616	Luminaire: Ornamental, LED Gaslight Style, I.E.S. Cutoff Type II/III Distribution	10/3/18	Active
1617	Accessible Pedestrian Signal	9/16/19	Active
1618	Cable: Flexible Cord for Accessible Pedestrian Signal	5/23/19	Active
1619	NEMA TS2-1 Advanced Transportation Controller and NEMA TS2-1 Super P Cabinet with UPS	12/20/20	Active
1620	Field Cabinet Integration Equipment and Detection Processor with Video Camera	7/20/21	Active
1621	Managed Ethernet Switch for Traffic Signals	12/20/20	Active
1622	Cellular Modem for Traffic Signals	12/20/20	Active
1623	Hemispherical Video Detection Camera System	12/20/20	Active
1624	Roadway Smart Lighting Control Access Point	4/27/21	Active
1625	Roadway Smart Lighting Control Field Service Unit	4/25/21	Active

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Spec #	Description	Date	Status
1626	Roadway Smart Lighting Control Relay	4/25/21	Active
1627	Luminaire Specification for Residential Streets - Single Sided	9/7/21	Active
1628	Luminaire Specification for Residential Streets - Staggered	9/7/21	Active
1629	Luminaire Specification for Residential Streets - Single Sided - Narrow	9/7/21	Active
1630	Luminaire Specification for Arterial Streets - Single Sided	9/7/21	Active
1631	Luminaire Specification for Arterial Streets - Staggered	9/7/21	Active
1632	Luminaire Specification for Arterial Streets - Opposite	9/7/21	Active
1633	Luminaire Specification for Alleys	9/7/21	Active
1634	Radar Speed Sign, Variable Message	11/10/19	Active
1635	Wireless Transceiver	11/10/20	Active
1636	ATC Cabinet w/ATC Controller and UPS	11/1/20	Active

**ELECTRICAL SPECIFICATION 1351
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 27, 2013**

**WIRE: SINGLE CONDUCTOR NO. 12 COPPER WITH CROSS LINKED
POLYETHYLENE INSULATION**

SUBJECT

1. This specification states the requirements for insulated wire intended for use as a conductor to connect street light luminaires to aerial distribution wires or underground distribution cables in a street lighting circuit. This wire is also known as pole wire.

GENERAL

2. (a) Specifications. The cable shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following organizations:

American Society for Testing and Materials (ASTM)
Insulated Cable Engineers Association (ICEA)
National Electric Code (NEC)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)
- (b) Acceptance. Cable not conforming to this specification will not be accepted.
- (c) Sample. If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be provided under this specification, shall be submitted to the Engineer of Electricity within fifteen (15) business days after receipt of the request.
- (d) Warranty. The manufacturer shall warrant the cable to be first class material throughout. The manufacturer will be responsible for any cable failing during normal and proper use within one (1) year after the date of installation. The manufacturer will provide replacement of any failed cable segment, from the point of normal termination to the next point of normal termination. There will be no cost to the City.

CABLE

3. (a) **Construction.** The cable shall consist of an uncoated copper conductor concentrically encased in a moisture resistant thermosetting plastic of cross linked polyethylene. The cable shall be listed with UL as Type RHW-2 or Type USE-2, and shall meet the NEC's requirements for these types of cable up to 90° C in wet or dry locations.
- (b) **Color.** Cable will be either black, red, or green.
- (c) **Marking.** The cable must be identified by a permanently inscribed legend in white lettering. The legend must have the following information at a minimum: 1/C #12AWG, 600V, XLPE, 90°, RHW-2 or USE-2, manufacturer's name, date of manufacture. The legend must be repeated at approximately eighteen inch (18") intervals parallel to the longitudinal axis of the cable.
- (d) Overall cable diameter shall be approximately 0.19 inches.

CONDUCTOR

4. (a) **Material.** Conductor shall be Number 12 AWG consisting of seven (7) strands of uncoated copper wires (.0305 inch diameter) per ASTM-B3.
- (b) **Resistivity.** Conductor shall conform to the requirements of ASTM B-33.

INSULATION

5. (a) **Type.** The insulation shall be a cross linked polyethylene compound meeting the physical and electrical requirements herein specified and the requirements of NEMA WC-70 (ICEA S-95-658).
- (b) **Thickness.** The insulation must be circular in cross section and have an average thickness of 45 mils. The thickness must not vary by more than plus or minus five percent (+/-5%).

TESTS

6. (a) General. The tests required to determine compliance with this specification must be certified by the manufacturer or an independent testing facility. Before shipment, copies of the test reports must be forwarded to the Division of Engineering for approval. The City reserves the right to reject any cable failing to meet the requirements of the tests. Tests must be made in accordance with methods in ASTM D-470.

(b) Physical Properties

Initial Values:

Tensile strength, minimum psi	2000
Elongation at rupture, minimum %	250

After Aging:

After 168 hours in an air oven at 121° +/-1°C:

Tensile strength, minimum % of initial value	80
Elongation at rupture, minimum % of initial value	80

- (c) Modulus Test. After initial conditioning period of four (4) minutes at a temperature of 150° C and at 100% elongation, the modulus must not be less than 110 pounds per square inch.
- (d) Accelerated Water Absorption Characteristics.
1. Electrical Method. After twenty-four (24) hours immersion in tap water at 75° +/- 1° C, the specific inductive capacity of the insulation must not be more than 7. After a continued fourteen (14) day immersion, the specific inductive capacity must not be more than three percent (3%) higher than the value determined at the end of the first day, nor more than two percent (2%) higher than the value determined at the end of the seventh day.
 2. Gravimetric Method. The insulation must not absorb more than five (5) milligrams of water per square inch of exposed surface area after immersion in distilled water at 70° C for a period of seven (7) days.
- (e) Electrical Characteristics. Each completed length of insulated conductor must withstand a test voltage of 3000 volts AC for a period of five (5) minutes after immersion in water for not less than six (6) hours and while still immersed. After withstanding this dielectric test, the cable must have an insulation resistance constant of not less than 25,000.

- (f) Cold Bend Test. The cable must pass the cold bend, long-time voltage test on short specimens as outlined in ASTM D-470.

PACKING

- 7. (a) Sealing. Both ends of each length of cable must be thoroughly sealed to prevent the entrance of moisture and other foreign matter.
- (b) The cable must be delivered in coils containing five hundred (500) feet each. Each coil must be packed in individual dispenser cartons. Each carton must be labeled, identifying the cable type and size, manufacturer, and date of manufacture.

**ELECTRICAL SPECIFICATION 1375
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 11, 2022**

BASE: BALLAST HOUSING, NO. 7 U.S. STANDARD GAUGE STEEL

SUBJECT

1. This specification states the requirements for ballast housing base assemblies to be installed on concrete foundations and to serve as bases for anchor base type steel poles with mast arm attached street light luminaires.

GENERAL REQUIREMENTS

2.
 - (a) Specifications. The base assemblies shall conform in detail to the requirements herein stated and to the specifications of the American Society for Testing and Materials, of which the latest published revisions will govern.
 - (b) Acceptance. Base assemblies not conforming to this specification will not be accepted.
 - (c) Drawings. The drawing mentioned herein is a drawing of the Department of Transportation. It is an integral part of this specification cooperating to state necessary requirements.
 - (d) Shop Drawing. One complete set of shop drawings of the base assembly intended to be furnished must be submitted within fifteen (15) days upon request of the Chief Procurement Officer.
 - (e) Sample. One completely assembled base of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) days after receipt of the request.

DETAIL REQUIREMENTS

3.
 - (a) Drawing. The base assembly must conform in detail to the design and dimensions shown on Drawing No. 785, dated March 25, 1977.
 - (b) Material. The steel used in the fabrication of the base assemblies must conform to ASTM A606 Type 4 for the sides and door and to ASTM A871 Grade 65 for the top, bottom and anchor plates.

- (c) Thickness. The sides and door must be No. 7 U.S. Standard Gauge; the top, bottom and Anchor Plates must be 3/4 inch plate.
- (d) Door. The door must be drilled top and bottom for, and furnished with, four (4) 1/4-20NCX3/4" button head stainless steel tamper resistant bolts for fastening top and bottom of door to base as shown on drawing No. 785. Ten (10) wrenches or drivers to fit the door bolts must be furnished with each fifty (50) base housings.
- (e) Hardware. The bolts, nuts, lock washers and anchor plates must conform to the drawing. Four (4) galvanized hex head machine bolts, four (4) galvanized hex nuts, four (4) galvanized lock washers, and two (2) 3/4" thick steel anchor plates must be furnished with each base assembly. The anchor plates must be shipped bolted to the top of the ballast housing assembly using the hardware enumerated above.
- (f) Welding. Every welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, the type of electrode and the welding methods he proposes to use in fabricating the base assembly.
- (g) Sandblasting. The door and ballast housing shall be thoroughly sand blasted to remove all scale, oil or slag prior to painting.
- (h) Dating. The top of the ballast housing base must be stamped or engraved with the year of manufacture in numerals not less than 1/2" in height.
- (i) Painting. A coat of oil-based rust-inhibiting paint shall be applied on the inside weld of the base. The complete base assembly, inside and outside, is to be given a coat of iron oxide zinc chromate primer meeting the requirements of SSPC-Paint 25.

TESTING

- 4. (a) Chemical Composition. Certified reports from the steel manufacturer must be furnished to the City upon request of the Chief Procurement Officer.
- (b) Test Specimens. Shall conform to the requirements of ASTM Specifications A871 Grade 65 and A606 Type 4.
- (c) Strength Tests. One test specimen of the metal in each order of 50 base assemblies or less shall be tested for tensile strength and elongation, in accordance with ASTM Standards.

- (d) Welding Tests. One percent (1%) of the longitudinal and circumferential welds of the base assembly shall be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. If the magnetic inspection process is used, the dry method with direct current shall be employed. All transverse welds must be magnetized by the "prod" (circular magnetization) method. Longitudinal welds may be magnetized by either circular or longitudinal magnetization.

- (e) Certificate. One certified copy of the test data sheet must be furnished to the City before delivery of the bases.

PACKING

- 5. When packed for transportation and delivery as per paragraph 3(e), the base assemblies must be thoroughly blocked or otherwise protected to prevent damage to painted surfaces.

**ELECTRICAL SPECIFICATION 1385
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 12, 2013**

**PEDESTAL WITH BASE: ALUMINUM,
FOR TRAFFIC SIGNALS**

SUBJECT

1. The specification states the requirements of an aluminum pedestal and base with handhole and door for supporting a traffic signal.

GENERAL

2. (a) Specifications. The pedestal base shall conform to the requirements herein stated, to the specifications and methods of test of the American Society for Testing and Materials (ASTM), to the requirements of the Society of Protective Coatings (SSPC), and to the requirements of the American Welding Society (AWS), of which the most recently published revisions will govern.
- (b) Acceptance. Pedestal bases not conforming to this specification will not be accepted.
- (c) Drawing. The drawing mentioned herein is a drawing of the Department of Transportation. It is an integral part of this specification cooperating to state the necessary requirements.
- (d) Workmanship. All pedestal bases must be free of casting flaws and must have neat, smooth exterior surfaces. All holes must be accurately located and drilled. The bottom surface of the base must be ground smooth.
- (e) Sample. One complete pedestal of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon receipt of a request from the Chief Procurement Officer.
- (f) Warranty. The manufacturer shall warrant the performance and construction of the traffic pedestal to meet the requirements of this specification and shall warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the traffic pedestals have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld,

or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

DETAIL REQUIREMENTS

3. (a) Design. The pedestal base must conform to the design shown on Drawing Number 526. All bases must be of the same dimensions, and all doors must be interchangeable.
- (b) Base. The base must be cast of aluminum alloy 319 meeting the requirements of ASTM B26 with a minimum wall thickness of 9/32". The handhole opening must have a recessed lip along the entire length of both sides and the bottom such that with the door in place the exterior surface of the door is flush with the exterior surface of the base. The door must have the same curvature as the base. The door must be locked in place by means of two fingers located on its top edge which bear against the inside surface of the base, and a stainless-steel Allen head locking screw which fastens to the base. The locking screw must be protected by a C-shaped drip edge protruding approximately 5/8" and concentrically encircling the screw head. The clearance between the inner surface of the drip edge and the outer surface of the screw head must be no greater than 1/8". The drip edge must encircle the screw head by a minimum of 300° with the opening in the drip edge centered at the bottom of the screw head. A continuous pipe stop must be integrally cast along the inside of the base 2.5" below the top edge.
- (c) Pedestal. The pedestal must be aluminum-alloy extruded round tube conforming to the requirements of ASTM B221, alloy 6063-T6. Its outside diameter must be 5.563"; its wall thickness must be not less than 0.187", and its length must be as required to furnish the overall height specified in the order. The round tube must be inserted not less than two and one-half inches (2.5") into the base and welded with four (4) butt welds each not less than one (1) inch long on the inside and a continuous seam weld around the outside. Aluminum alloy pipe in lieu of aluminum alloy tube is acceptable.
- (d) The pedestal cap must be of the same cast aluminum as the base. The pedestal cap shall be essentially conical with a globe-shaped upper-end and having a minimum wall thickness throughout of not less than 1/4 inch. The cone portion must meet the skirted portion of the top in a smooth fillet. The skirt must enclose the top 7/8" inches of the pedestal. Three stainless steel, or other similar approved material, set screws not less than 3/4 inches long must be equally spaced in tapped holes around the skirt and must hold the cap securely in place atop the pedestal. The set screw size must be 5/16 – 18 hex head.

- (e) Welding. The welds shall be made by the inert gas metal welding process. Filler wire shall conform to chemical composition requirements of AWS Alloy Number A5.10-69.

PAINING

- 4. (a) Oil and Grease Removal. All metal surfaces shall be washed with an alkaline detergent to remove any oils or grease.
- (b) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized phosphate wash and must be dried by convection heat.
- (c) Coat. A thermosetting, weathering, polyester powder coat shall be applied electrostatically to all cleaned and treated exterior surfaces to a uniform four mil (4) thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400° Fahrenheit to form a high molecular weight fusion bonded finish.
- (d) Alternate Methods. Alternate powder coat methods may be reviewed and tested on a case-by-case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.
- (e) Durability. The coating shall be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl (by weight) solution at 95° Fahrenheit and 95% relative humidity without blistering. Before testing, the test panel must be scribed with an “X” down to bare metal.
- (f) Coating Measurement. Measurement of coating thickness shall be done in accordance with SSPC-PA 2-73T, “Measurement of Dry Paint Thickness with Magnetic Gauges”, except that the lowest single spot measurement in an area of two (2) square inches must not be less than 3 mils.
- (g) Color. Color shall be gloss black unless identified otherwise in the order. A color sample must be submitted for approval prior to fabrication. This color sample must include the manufacturer’s name and the manufacturer’s color name.

PACKING

- 5. Each pedestal shall be individually wrapped to prevent damage to the surface. Each pedestal shall be suitably packed or blocked to prevent damage during shipment and handling.

**ELECTRICAL SPECIFICATION 1407
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 2, 2009**

**POLE MOUNTED CAST ALUMINUM JUNCTION BOX FOR TRAFFIC
SIGNALS**

SCOPE

1. This specification states the requirements for pole mounted, cast aluminum junction boxes, with terminal strips, to be used for traffic signal multiple cable terminations.

GENERAL

2. (a) Specifications. The junction boxes shall conform in detail to the requirements herein stated, and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revisions will govern. The terminal strip shall meet the applicable sections of NEMA ICS 4-2005, as well as the requirements herein stated.
- (b) Drawing. The drawing mentioned herein is a drawing of the Department of Transportation and will be interpreted as part of these specifications.
- (c) Acceptance. Junction boxes not conforming to this specification will not be accepted.
- (d) Sample. One complete junction box with terminal strip of the manufacture intended to be furnished shall be submitted within fifteen (15) business days after receipt of a request from the Chief Procurement Officer. The box must be delivered to the Division of Electrical Operations at 2451 South Ashland.
- (e) Workmanship. All junction boxes shall be free of casting flaws and must have neat, smooth exterior surfaces. All holes must be accurately located and drilled to ensure interchangeability of all components.

DESIGN

3. (a) Drawing. The junction box must conform in detail to the dimensions and requirements shown on Drawing Number 954.
- (b) Material. The body door and plate must be castings of non-heat treated

aluminum silicon alloy conforming to ANSI alloy 443.0 of ASTM B26.

DETAIL REQUIREMENTS

4. (a) Assembly. Each junction box shall consist of the body, door with its gasket, two cast elbows with gaskets at either end of the box, terminal block mounting bracket, and terminal strip on channel mounted to bracket. All must be completely assembled, painted and ready for installation. A flat plate with gasket shall also be provided so that the City can use the junction box with only one elbow if desired.
- (b) Body. The body shall be cast as shown in Drawing Number 954. The top and bottom sides of the box where flat plates, or other fittings, will be attached, must be identically cast, machined flat, and drilled and tapped in accordance with dimensions shown. All fittings which fit on the top side must fit on the bottom side.
- (c) Door. The door shall be cast as shown in Drawing Number 954. The door must be hinged at the left with stainless steel hinge pins and must open not less than 180° to permit complete access to the interior of the junction box. Two stainless steel Allen head machine screws, undercut and held captive, shall hold the door closed and maintain positive pressure against a sponge neoprene gasket cemented in place completely around the door jamb. The door shall be finished and painted prior to cementing the gasket into its groove in the door.
- (d) Elbow sweep. Two elbows must be provided for cable entry and exit into the box. The elbows shall be cast of the same alloy as the box. The dimensions will be as indicated on Standard Drawing 954.
- (e) End Plate. A flat end plate shall be furnished with each body casting. The plate must be drilled to align with tapped holes in the body casting and have a flush match with the periphery of the top and bottom body casting pads. The plate must have a properly fitted gasket.
- (f) Gaskets. The gasketing between the body and the door shall be of sponge neoprene and must be cemented in place after painting of the door. A cork gasket, 1/8 inch thick, shall be used between the elbow or end plate and the body of the junction box on the top end and bottom end and held in place by four (4) stainless steel screws.
- (g) Mounting Bracket. A terminal block mounting bracket, as shown on Drawing Number 954, shall be furnished and installed in each junction box. The bracket must be cast from ANSI alloy 443.0 per ASTM B26.
- (h) Terminal Strip. The terminal strip will consist of modular blocks. Each block

will consist of two terminals to handle one circuit. The strip will consist of twenty blocks to handle twenty circuits. The terminal strip will be mounted to an aluminum channel. The channel will have pre-punched holes for mounting to the junction box. The channel will be mounted to the box with two #10 screws.

Each block housing shall be constructed of nylon, polypropylene, or another approved material of equal properties. The bottom of the block housing will be dovetailed to fit into the aluminum channel. Overall dimensions of each block will be approximately 1.2 inches wide by 1.5 inches high. Center-to-center spacing between contacts (blocks) must be at least .375 inches.

The terminals shall accommodate AWG wire sizes 8 to 22. The contact type will be tubular clamp, with electroplated tubular copper contact. The screw type will be a steel electroplated number 10-32, slotted pan head. The terminals will be rated at 30 amps and 600 volts.

Maximum service temperature for the terminal strip will be 150° Celsius. The flammability rating must meet UL 94V-0.

- (i) Hardware. The hinge pins and all screws required for assembly of this junction box must be of stainless steel.
- (j) Painting. The exterior surfaces of the junction box shall be properly cleaned and given one (1) coat of zinc chromate primer containing ten percent (10%) iron oxide and one (1) coat of enamel. The color of the enamel must be gloss black or as ordered. A color sample must be submitted and approved before manufacturing commences. The primer and enamel shall be of an approved grade and quality.
- (k) Packing. After the paint is completely dry, and the junction boxes have been assembled, they shall be suitably packed to prevent damage to painted surfaces during shipping and handling. All shipments must be fastened to, and shipped on, 48" x 48" hardwood, 4 way, non-returnable pallets. Total height must not exceed 64" and total weight must not exceed 2,000 pounds.

**ELECTRICAL SPECIFICATION 1428
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
SEPTEMBER 11, 1989**

THERMAL MAGNETIC CIRCUIT BREAKER

SUBJECT

1. This specification covers the requirements for thermal-magnetic circuit breakers capable of providing complete over-current protection for street lighting branch-load and service circuits.

GENERAL REQUIREMENTS

2. (a) Sample. One complete circuit breaker of each type and size, and of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such request. The sample(s) shall be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (b) U.L. Approval. Circuit breakers furnished under this specification shall be listed and approved by Underwriter's Laboratories, Inc.
- (c) Applicable Specifications. Where reference is made to applicable requirements of Underwriter's Laboratories, Inc., Bulletin #489, entitled "Standard for Branch Circuit and Service Circuit Breakers," hereinafter cited as the U.L. Standards, the most recently published revision will govern.
- (d) Assembly. Each circuit breaker must have the thermal-magnetic trip installed, calibrated and sealed within its insulated housing.
- (e) Instructions. Complete installation instructions, details on wiring, and information on operation shall be furnished with each circuit breaker, except as otherwise indicated.
- (f) Packing. Each circuit breaker shall be packed in a suitable manner so that it will not be damaged in shipping or handling.

TYPES AND SIZES

3. (a) **EHD Frame Circuit Breakers.** For use on A-C Systems with a 100-ampere frame; minimum interrupting rating of 18,000 R.M.S. symmetrical amperes at 240 volts A.C.
 1. Single pole, 240 or 480 volts A.C., ampere rating from 15 to 100.
 2. Double pole, 240 or 480 volts A.C., ampere rating from 15 to 100.
- (b) **FDB Frame Circuit Breakers.** For use on A-C Systems with a 150 ampere frame; minimum interrupting capacity of 18,000 R.M.S. symmetrical amperes at 240 volts A-C.
 1. Double pole, 240, 480 or 600 volts A-C, ampere rating from 15 to 150.
 2. Triple pole, 240, 480 or 600 volts A-C, ampere rating from 15 to 150.
- (c) **JDB Frame Circuit Breakers.** For use on A-C Systems with a 250 ampere frame; minimum interrupting current of 65,000 R.M.S. symmetrical amperes at 240 volts A-C.
 1. Double pole, 240, 480 or 600 volts A-C, ampere ratings from 70 to 250.
 2. Triple pole, 240, 480 or 600 volts A-C, ampere ratings from 70 to 250.

DESIGN AND CONSTRUCTION

4. Circuit breakers furnished under this specification must include the following design and construction features: (1) molded insulated housing, (2) thermal-magnetic trip mechanism, (3) silver alloy contacts, (4) corrosion-resistant internal parts, (5) trip-free, indicating handle, and (6) pressure-type terminals.

DETAIL REQUIREMENTS

5. (a) Thermal-Magnetic Trip Mechanism. The breaker must be activated on current overload by means of a thermal-magnetic trip mechanism. This mechanism must be non-adjustable, non-interchangeable, and factory calibrated and sealed. Instantaneous tripping as controlled by the magnetic trip setting, and time delay tripping accomplished by thermal action must be in accordance with the manufacturer's published characteristic curves for these breakers or with calibration requirements of the U. L. Standards, as applicable.
- (b) Contact Mechanism. The contacts must be spring loaded and provide a quick-make, quick-break non-teasing action. The contact mechanism must be such that the breaker will trip open even if the handle is held or locked in the ON position.
- (c) Calibration. Rating and performance of these breakers must be based on calibration at an ambient temperature of 40° C. (104°F.).
- (d) Rated Current. Each breaker must be capable of carrying 100% rated current continuously in its calibrated ambient temperature without tripping and without exceeding the temperature limits specified in the U. L. Standards.
- (e) Contacts. The contacts must be made of a non-welding silver alloy or equivalent, subject to approval.
- (f) Internal Parts. All internal parts of these circuit breakers shall be corrosion resistant material.
- (g) Terminals. Solderless, pressure type terminals of copper construction must be provided for both line and load connections.
- (h) Handle Indication. The handle must indicate clearly whether the circuit breaker is on the ON, OFF, or TRIPPED position.
- (i) Mounting. Breakers furnished under this specification must have drilled and counterbored holes for front mounting which must conform to spacings shown on Department of Transportation Drawings numbered 883, 884, 886, and 887.

- (j) Test Requirements. These breakers must be capable of meeting the following sequence of test requirements as specified in the U. L. Standards.
1. Endurance test.
 2. Calibration test at 200% and 125% of rated current.
 3. Short circuit tests
 4. Calibration test at 500% rated current.
 5. Dielectric strength test.

WARRANTY

6. Circuit breakers furnished under this specification shall be warranted by the manufacturer against defects in materials or workmanship for a period of one year after installation. During this period, should a failure occur, repair or replacement must be made without cost to the City.

**ELECTRICAL SPECIFICATION 1432
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JULY 31, 2006**

SELF-SUPPORTING SECONDARY CABLE

SCOPE

1. This specification describes preassembled, reverse twist, secondary cable consisting of one (1) bare conductor used as a messenger and neutral in combination with two (2) or three (3) cross-linked polyethylene covered, stranded, copper conductors. Cable will be used on distribution circuits operated at a maximum voltage to ground of 600 volts.

GENERAL

2. (a) **Specifications.** The cable shall conform in detail to the requirements herein stated and to the referenced specifications of the American Society for Testing and Materials (ASTM), the National Electric Code (NEC), Underwriters Laboratories (UL), the Insulated Cable Engineers Association (ICEA), and the National Electrical Manufacturers Association (NEMA), in which the most recently published revisions will govern.
- (b) **Acceptance.** Cable not conforming to this specification will not be accepted.
- (c) **Sample.** If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be provided under this specification, shall be submitted within fifteen (15) business days after receipt of the request.
- (d) **Warranty.** The manufacturer shall warrant the cable to be first class material throughout. The manufacturer will be responsible for any cable failing during normal use within one (1) year after the date of installation. The manufacturer will be responsible for providing the footage of cable necessary to replace the failed cable length (without splices).

CABLE

3. (a) The cable must meet the requirements of ICEA Specification S-76-474 for neutral supported power cable assemblies rated for 600 Volts. Each insulated conductor must be listed with UL as Type RHW-2 or Type USE-2, and must meet the NEC's requirements for these types of cable up to 90° Centigrade in wet or dry conditions.

- (b) Messenger. The messenger must be bare hard drawn, copper wire meeting the requirements of ASTM B1.
- (c) Covered Conductors. The covered conductors must be stranded, soft drawn, copper meeting the requirements of ASTM B3.
- (d) Lay. The lay of the stranded conductors must meet the requirements of ASTM B8, Class B.
- (e) Joints. No welds are permitted in the messenger. The stranded conductors may be welded, but a welding in one strand shall be at least fifty feet (50') from any other weld in the same wire or any other wire in the conductor.
- (f) Separator. A separator of mylar tape under the insulation, or other equivalent material, shall be provided. The conductor covering shall be of such consistency that linemen will be able to cut and strip the covering with normally used line tools. Any conductor received which does not meet the cutting and stripping requirements will be returned at the supplier's expense.
- (f) Insulation. The insulation must be black cross-linked polyethylene in accordance with the physical and electrical requirements detailed herein, and determined by the test procedures of ASTM D-470, except as otherwise specified. The outside diameter of the insulating covering must be circular and extruded concentrically over the conductor. It must have an average thickness as shown in these specifications, and a minimum thickness of not less than 95% of the average.

PHYSICAL AND ELECTRICAL PROPERTIES

4. (a) Physical Properties - Initial Value.

- | | | |
|----|-----------------------|---------------|
| 1. | Tensile Strength | 1800 psi min, |
| 2. | Elongation at Rupture | 350% min. |

(b) Physical Properties - After Aging.

After oven exposure at $121^{\circ} \pm 1^{\circ}\text{C}$ for 168 hours:

- | | | |
|----|---|----|
| 1. | Tensile strength, min%
of unaged value | 80 |
| 2. | Elongation, min % of
unaged value at rupture | 80 |

- (c) Moisture Resistance. When tested in accordance with the procedure given in ASTM D-470, except that the water must be maintained at $75^{\circ}\text{C} \pm 1^{\circ}\text{C}$, the insulation must meet the following moisture resistance requirements:

1.	Gravimetric Method:	
	Water absorption, maximum (Mg. per sq. in)	5.0
2.	Electrical Method:	
	Specific inductive capacitance- one day (Max.)	4.0
	Percent (%) change in SIC:	
	1 - 14 days (Max.)	3.0
	7 - 14 days (Max.)	2.0
	Percent (%) change in Power Factor - 1 day (Max.)	1.5
	Stability Factor (Max.)	1.0

- (d) Electrical Characteristics:

1. Dielectric Strength. Each length of insulated conductor must withstand an alternating current potential as shown in Table I for an exposure period of five (5) minutes when tested in accordance with ASTM D-470.
2. Insulation Resistance. The insulation resistance of the insulated conductor must not be less than that corresponding to a constant of 25,000 at 15.6°C (60°F).

- (e) Cold Bend Test Requirement. The insulated conductor must pass the "Cold-Bend, Long-Time Voltage Test on Short Specimens" of ASTM D-470 except that the test must be at minus 55°C .

CABLE ASSEMBLY

5. (a) Cabling. The insulated conductors must be reverse twisted about the messenger one (1) to one and one quarter (1-1/4) revolutions in each direction so that each conductor occupies all of the positions on the periphery of the circle periodically with an approximate distance between reversals of four feet (4').

- (b) Binding of Cable. The insulated conductors shall be bound to the messenger without fillers. The binder wire or tape shall have sufficient strength to support the assembly, but in no case will it be smaller than a #10 AWG equivalent. The binder shall be flat without sharp edges. Its strength shall be suitable for installation by the use of stringing blocks and must not itself tear, nor cut, or otherwise damage the conductor insulation. The binder wire must be applied with a left hand lay of five and one-half inches (5-1/2") \pm one half inch (1/2").

SIZE OF SECONDARY CABLE

6. The size and number of the individual conductors (including the bare messenger) in the secondary cable must be as follows:

<u>No. of Conductors</u>	<u>AWG Size</u>	<u>Insulation Thickness (in.)</u>	<u>Reel Length (ft.)</u>
3	#6	0.060	2,800
3	#4	0.060	2,700
3	#2	0.060	1,700
4	#6	0.060	2,000
4	#4	0.060	1,700
4	#2	0.060	1,400

All the above conductors must be seven (7) strand. All stranding to be standard round or compressed only. Compacted stranding will not be acceptable.

TESTING

7. (a) General. Tests shall be performed on insulation and completed cables in accordance with applicable standards as listed in these specifications. Where standards are at variance with each other or with other portions of this specification, the most stringent requirements, as determined by an engineer from the Division of Engineering, shall apply. Included in these tests will be a 70,000 BTU per hour flame test in accordance with IEEE 383. All tests shall be conducted on cable produced for this order.
- (b) Number of Tests. Insulation tests shall be conducted on samples taken every 25,000 feet or fraction thereof of each conductor size. In no case will samples be taken closer than 15,000 feet apart.
- (c) Test Reports. No cable may be shipped until certified copies of all factory tests have been reviewed and approved by the engineer.

- (d) Acceptance. Where the cable fails to conform to any of the tests specified herein, the following will apply:
1. Insulation or Jacket Tests. Samples must be taken from each reel and must successfully conform to all tests specified herein. Reels from which samples fail to conform, will be rejected.
 2. Completed Cable (Reel) Tests. Any reel which fails to conform to testing will be rejected.
 3. Where five percent (5%) or more of the reels are rejected for any reason, the entire cable order will be rejected.

PACKING AND SHIPPING

8. (a) Reels. The cables must be shipped on non-returnable reels which shall be capable of withstanding, without damage, shipping, outside storage and handling during installation. "City of Chicago" shall be clearly printed on one (1) outside reel flange, and the insulated conductors on the beginning end shall not protrude beyond the reel flange. The bare neutral shall be securely stapled on the outside of the flange. The dimension of the reel flange must not be larger than thirty-eight inches (38") in diameter, the drum sixteen inches (16"0) in diameter, and eighteen inches (18") inside traverse. If reels are to be shipped on flange side, they must have two inch (2") spacers separating them for accessibility to fork lift trucks.
- (b) Length. The cable must be shipped in lengths shown above with a zero plus (+) tolerance and a ten percent (10%) minus (-) tolerance. Lengths shorter than minus ten percent (-10%) must not be shipped as they will not be accepted.

IDENTIFICATION

9. (a) Cable Identification. The cable must be identified by a permanently inscribed legend on each insulated conductor in white lettering. The legend must have the following information at a minimum: conductor size (AWG), 600V, XLPE, 90°, RHW-2 or USE-2, manufacturer's name, date of manufacturer, and phase number. All markings must be a minimum of one-eighth inch (1/8") in height. Marking shall be at approximately two (2) foot intervals.
- (b) Phase Conductor Identification. On the three conductor cable, indelible markings reading "1" and "2" must be imprinted on each phase conductor respectively. On the four conductor cable, "3" must be imprinted on the additional conductor with the phase identification on the other phase

conductors to remain the same.

- (c) Reel Marking. Each reel must be tagged on both the inside and outside of one reel flange with the following information which must be indelibly imprinted on a 2" x 4" brass tag: Purchaser's name and address, wire description, Purchase, or Contract, order number, size designation, net length, manufacturer's name, date of manufacture and gross weight.

**ELECTRICAL SPECIFICATION 1438
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 16, 1990**

BRACKET-ARM: LIGHTING, 21 INCHES LONG

SUBJECT

1. This specification covers the requirements for a lighting bracket-arm, 21" in length measured from the face of the pole, which is to be attached to a utility company wood pole for the purpose of supporting an alley lighting luminaire.

GENERAL

2. (a) Specifications. The lighting bracket-arm shall conform in detail to the requirements herein stated and to the specifications of the American Society for Testing and Materials, where applicable, cited by ASTM number, of which the most recently published revision will govern. Assemblies not conforming to this specification will not be accepted.
- (b) Drawing. The drawings mentioned herein are issued by the Department of Transportation, and are an integral part of this specification.
- (c) Sample. A sample bracket-arm of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer. The sample must be delivered to the City of Chicago, Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (d) Warranty. The contractor warranties for a period of one (1) year from the date of acceptance by the City, that it will, at its own expense, replace any defective arm that has failed due to a design flaw, defective material, or poor workmanship.

LIGHTING BRACKET-ARM ASSEMBLY

3. (a) Design. The lighting bracket-arm assembly shall conform in design and dimensions with drawings numbered 641A and 641B.
- (b) Assembly. Each lighting bracket-arm assembly must be delivered with the pipe-arm in place, properly positioned, and secured in its socket. Each

assembly must be furnished complete with grounding bolt in place with the necessary washer and nut.

- (c) The Casting. The bracket casting shall be homogeneous, free of spalling and blow holes. "Filler" metal shall not be used to provide a smooth surface.
- (d) Pipe-arm. The pipe-arm must be fabricated of aluminum alloy, one and a quarter (1-1/4) inch diameter standard (American Standards Association Schedule 40) pipe conforming to the requirements of ASTM B241 for alloy 6063-T6. The pipe-arm shall be formed as shown on the drawing, and shall have a smooth exterior surface free of protuberances, dents, cracks, or other imperfections marring its appearance. All sharp edges shall be deburred or reamed.
- (e) Pole bracket. The pole bracket must be a casting of high strength, aluminum alloy equal in chemical composition, tensile strength, yield strength and elongation to ASTM B179, alloy ZG42A. A cable entrance shall be provided through the base of the socket, and a suitable bushing or grommet with an opening for two (2) wires of 1/4 inch diameter shall be provided in place in the entrance-way.

BOLTS, WASHERS AND NUTS

- 4. (a) Clamping Bolt and Nut. One (1) aluminum alloy machine bolt and nut of the size shown on the drawing shall be furnished with each lighting bracket arm assembly for clamping the pipe arm in its socket.
- (b) Grounding Bolt, Washer and Nut. A 5/16" diameter aluminum alloy bolt with aluminum alloy flat washer, and aluminum alloy nut must be provided in place as a means for grounding the bracket-arm.

PERFORMANCE TEST REQUIREMENTS

- 5. (a) Static Deflection. The lighting bracket-arm, when rigidly attached to a supporting structure, must withstand a vertical load of 100 pounds and a lateral load of 50 pounds, applied separately, with terminal deflection not exceeding 5% of the length of the bracket-arm. In addition, terminal deflection must not exceed 2° with a vertical load of 40 pounds.
- (b) Rupture Strength. The bracket-arm must be capable of withstanding a non-sustained vertical load of 250 pounds at its free end without collapse or rupture.
- (c) Testing. One (1) unit from each lot of 250 bracket-arms, with a minimum of 2 bracket-arms per contract, will be subject to test for static deflection and rupture strength. In the event any bracket-arm fails to meet test requirements,

the entire lot shall be subject to rejection, except that the manufacturer may subject a minimum of 5 additional bracket-arms in the lot to test, and if all of these fulfill the requirements, the lot will be accepted. Should any of the additional five (5) bracket-arms fail, then the entire lot will be rejected. Certified test reports must be submitted to the Commissioner of Transportation or his duly authorized representative for his approval prior to shipment of material. All units subjected to test will remain the property of the Contractor and may not be included as part of this contract.

WELDS

6. No welds will be allowed. Any alley arms with welds will not be accepted.

PACKAGING

7. (a) General. The arms shall be shipped in bundles. Each arm must be individually wrapped so that the arm can be bundled for shipping and unbundled for delivery without damage to the arm or its finish. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled , shipped and stored without shifting or breaking of the contents. Any bundles, in which either the mast arms or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle at no cost to the City. Each bundle must be capable of being lifted by a fork lift and the bundles must be shipped in a flat bed truck to facilitate unloading. Each arm wrapping must be clearly labeled indicating the arm size, i.e. "21 INCH STEEL ALLEY MAST ARM".

**ELECTRICAL SPECIFICATION 1441
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JULY 31, 2013**

**CABLE: SINGLE CONDUCTOR AERIAL, #6 AWG
WEATHERPROOFED WITH POLYETHYLENE JACKET**

SUBJECT

1. This specification states the requirements for cable intended to be used in overhead distribution on insulators for 240 VAC, 60 cycle, single phase, street lighting circuits. The cable is weatherproofed.

GENERAL

2. (a) Specifications. The cable shall conform in detail to the requirements herein stated, and to the specifications and methods of test of the Insulated Cable Engineer's Association (ICEA) and the American Society for Testing and Materials (ASTM), cited by number, in which the most recently published revisions will govern.
- (b) Acceptance. Cable not conforming to this specification will not be accepted.
- (c) Sample. A three foot sample of the cable intended to be furnished shall be submitted within fifteen (15) business days after receipt of such a request from the Chief Procurement Officer. The sample must be sent to the Engineer of Electricity unless otherwise directed.
- (d) Warranty. The manufacturer shall warrant the cable to be first class material throughout. In lieu of other claims against them, if the cable is installed within twelve (12) months of date of shipment, the manufacturer must replace any cable failing during normal and proper use within two years of date of installation. The Commissioner will be the sole judge in determining if a cable section needs to be replaced. The length of replacement will be the entire length of unspliced cable from existing termination/splice point to termination/splice point All replacements under this warranty shall be made free of charge F.O.B. delivery point of the original contract.

CONSTRUCTION

3. (a) The cable must have a copper conductor with a tight fitting concentric layer of polyethylene.
- (b) Conductor. The conductor must be made up of medium hard drawn, solid, round copper wire meeting the requirements of ASTM B-2. The conductor must be size 6, American Wire Gauge.
- (c) Cover. The cover must be polyethylene. It must be circular in cross-section, concentric to the conductor, and must have an average thickness of 30 mils. The minimum thickness at any cross section must not be less than ninety percent (90%) of the average thickness.

PHYSICAL AND ELECTRICAL REQUIREMENTS

4. The cable must meet the physical and electrical requirements of ICEA S-70-547.

PACKAGING

5. (a) Cable Marking. The cable must be identified by a permanently inscribed legend in white lettering as follows:

1/C No. 6 AWG – WEATHERPROOFED AERIAL PE

The legend shall be repeated at approximately eighteen (18) inch intervals on the outside surface of the cable parallel to the longitudinal axis of the conductor. A sequential footage marking must be located on the opposite side from the legend.

- (b) Reels . The completed cable shall be delivered in lengths of 1000 feet in coils with a nominal 21 inch eye opening. Both ends of each length of cable shall be properly sealed against the entrance of moisture and other foreign matter by the use of clamp-on cable caps. The ends shall be securely fastened so as not to become loose in transit.

Before shipment, heavy cardboard or plastic wrapping shall be applied to all coils. Coils must then be fastened to 48 inch by 48 inch hardwood 4-way non-returnable pallets for shipment. Total height of each pallet must not exceed 64 inches. Total weight of each pallet must not exceed 2200 pounds.

- (c) Marking . A metal tag must be securely attached to each pallet indicating

the coil number, contract number, date of shipment, gross and tare weights, City Commodity Code number if applicable, footage, and a description of the cable. Directions for unrolling the cable and any other pertinent information must be placed on each coil package with an approved permanent marking material such as oil-based paint or a securely attached metal tag.

**ELECTRICAL SPECIFICATION 1443
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JULY 11, 2006**

SECONDARY RACK, 2 OR 3 WIRE, WITH INSULATORS

SUBJECT

1. This specification covers the requirements for 2 and 3 wire secondary racks complete with insulators for attachment to street lighting poles for the purpose of supporting aerial circuit wires.

GENERAL

2. (a) Specifications. Each 2 or 3 wire secondary rack shall conform in detail to the requirements herein stated, and to the specifications of the American Society for Testing and Materials, cited by ASTM Designation number, of which the most recently published revision will govern. Secondary racks not conforming to this specification will not be accepted.
- (b) Sample. If requested, each bidder shall submit with his proposal one complete sample secondary rack with insulators for approval by the Commissioner. The sample must be submitted within fifteen (15) business days of such request from the Chief Procurement Officer.
- (c) Warranty. Secondary rack and pole clamps furnished under this specification shall be warranted against failure from defects due to materials or workmanship for a period of one year after delivery. In the event of failure of any of the components, the manufacturer will replace the rack, at no cost to the City.

SECONDARY RACK

3. (a) General Design. The secondary rack shall be the medium duty type with extended back. It shall be suitable for either 2 or 3 wire, as indicated in the bid proposal, with 8-inch spacing between centers of the clevises.
- (b) Back Section. The back section of the secondary rack must be made from hot-wrought merchant quality carbon steel 1/8 inch thick. The steel must conform with ASTM Specification A 575, Grade M1010. The back must be formed to the shape of an inverted trough, the flat portion of which must be approximately 1-1/4 inches in width. Mounting slots, 11/16 inch by 1-1/4

inch, must be longitudinally centered on the flat of the back section and located so as to coincide with the centers of the clevises, with additional slots provided at the top and bottom. The 2-wire back must be at least 18 inches in length. The 3-wire back must be at least 24 inches in length.

- (c) Clevises. Clevises must be made from 1/8 inch thick steel strip of the same material as the back section, and so formed to fit the back snugly. The prongs of the clevis must be approximately 4 inches apart and formed to the shape of an inverted trough, the flat portion of which must be approximately 3/4 inch in width with the edges pitched at an angle of 30° with the flat portion. Each clevis shall be fabricated in such a manner that the pitched edges of both prongs must slope in the same direction. The clevises must be riveted to the back section with two (2) 5/16 inch steel rivets.
- (d) Rack Bolt. The rack bolt must be a 9/16 inch diameter button head bolt made of hot-wrought carbon steel conforming with the requirements of ASTM Specification A 576, Grade 1040, complete with a 1/4 inch by 2 inch brass cotter pin at the bottom end. Centerline of the rack bolt must be located 4 inches out from the face of the back section.
- (e) Spool Insulators. Spool insulators must be electrical grade white or gray glazed porcelain.
- (f) After fabrication, the secondary rack, clevises, and all steel hardware must be hot dip galvanized according to ASTM 123. Bolts, washers, and nuts must be hot dipped galvanized according to ASTM 153.

TESTS

- 4. At the discretion of the Commissioner, secondary racks furnished under this specification will be subject to testing to determine compliance with the strength requirements of ANSI medium type secondary racks.

**ELECTRICAL SPECIFICATION 1447
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JANUARY 22, 2020**

**POLE: ANCHOR BASE, 3 AND 7 GAUGE, TAPERED TUBULAR STEEL,
WITH HANDHOLE ENTRY**

SUBJECT

1. This specification states the requirements for tapered, tubular, 3 gauge and 7 gauge steel anchor base poles with mast arm supports. They will support street light luminaires and/or traffic signal mast arms and will be served by underground cables.

GENERAL

2. (a) Specifications. The poles shall conform in detail to the requirements herein stated, and to the requirements of the following organizations cited herein, of which the most recent revisions shall govern:

American Association of State Highway and Transportation Officials (AASTHO)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Poles not conforming to this specification will not be accepted.
- (c) Bidders Drawings. Bidders shall submit with their bids detailed scale drawings of the mast showing actual dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must show every dimension necessary to show how all parts will fit each other and be properly held in assembly. These drawings must also be submitted in electronic format, preferably MicroStation, if requested by the City.
- (d) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state necessary requirements.
- (e) Sample. If requested by the Chief Procurement Officer, one completely

assembled anchor-base pole of the manufacture intended to be furnished, must be submitted for review within fifteen (15) business days of receiving the request.

- (f) Warranty. The manufacturer shall warrant the performance and construction of the light poles to meet the requirements of this Specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the light poles have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

STANDARDS

3. (a) Assembly. Each anchor base pole shall consist of a steel mast with handhole entry, entry door with machine screws, grounding nut, mast base plate, top cap for mast, two (2) mast arm supports, bolt covers, and all necessary hardware required for complete assembly of these parts, ready for assembly, without special tools.
- (b) Interchangeability. Members of each pole type shall be mutually interchangeable for assembly, so that no reworking will be required to make any member fit properly in the place of any other similar member of any other similar pole.
- (c) Design. Each pole type shall conform in design and dimensions to the pertinent drawing(s) listed in Table "A".

MASTS

4. (a) Mast Size. The outside diameters of the mast of each pole type shall be as listed in Table A. The mast must be tapered at 0.14 inches per foot.
- (b) Material. The mast must be fabricated from one length of No. 3, No. 7, or No. 11 Standard gauge steel meeting the material requirements of ASTM A606 for low alloy high strength coil steel, which, after fabrication, must possess an ultimate tensile strength of not less than 70,000 psi and a yield strength of not less than 60,000 psi, in accordance with ASTM A595, Grade C. Chemistry of the steel must be such as to insure resistance to atmospheric corrosion superior to that of ordinary copper bearing steel. Material certification is required. Manufacturer's steel meeting the specified physical and chemical requirements, and approved by the Commissioner, will be

accepted.

- (c) Fabrication. The mast must be fabricated with not more than one (1) longitudinal weld. The weld shall be ground smooth so that it is virtually invisible. There shall be no lateral welds in the masts other than where the masts are welded to the steel bases. Each mast must be straight and centered on its longitudinal axis. Each mast must be formed on a mandrel and worked to form a round cross-section. The completed, unpainted masts shall have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance.
- (d) Base. The mast base shall be a steel plate, of low alloy, high strength steel as noted in Par. 4 (b).

Plate Base. The base plate for each pole type shall be as listed in Table "A". It must be fabricated from the same ASTM A606 low alloy, high strength steel as is used for the mast. After fabrication the steel must meet the requirements of ASTM A588. The mast must be inserted into the base to a maximum depth which will still allow for an adequate weld to be made between the bottom of the mast and the plate. A circumferential weld must be made between the mast and the base at both the top and underside of the plate. Non-metallic removable bolt covers which completely cover the anchor bolts and nuts shall be provided. The covers must be attached with stainless steel screws coated with a non-seizing compound, or another type of non-seizing fastener, as approved by the Commissioner. The covers shall enclose the anchor bolts and be secured in an approved manner. The base shall be attached to the mast so that the bearing surface of the base is at right angles to the longitudinal axis of the mast. The vertical center line of the seam must be positioned so that no welds for the simplex attachments or the handhole opening will go through the seam.

Anchor Rod Openings. All anchor rod openings for each pole type shall have a width as listed in Table "A". Each opening must be sized to have a circumferential slot length equal to 15° of the circumference.

- (e) Mast Arm Support Plates. The mast arm support plates will be made of cast steel conforming to the requirements for Grade 65-35 cast steel of ASTM A27, or equivalent, subject to approval. They shall neatly fit the external surface of the mast. The upper mast arm support plate must have a hollow protuberance, the hole of which must be approximately equivalent to two (2) inches in diameter, extending into the interior of the pole providing a smooth surface for the lamp cables to rest upon. The mast arm support plates shall be designed so that they will carry the mast arm and hold it in the proper position for fastening the mast arm to the mast. The design of the mast arm support plates must be a two (2) bolt type as shown on Drawing No. 659.

- (f) Provision for Ground. A 1/2-13 UNC (unified thread – course ANSI B1.1) square nut must be welded to the inside of the mast on the handhole entry frame for a ground connection.
- (g) Entry. A vertical doorframe carrying a removable door providing access to the interior of the mast must be welded into a close fitting opening centered approximately 15 inches above the bottom of the base. The doorframe must be formed and welded of steel with a cross section of two and one-quarter (2-1/4) inches wide by one-quarter (1/4) inch thick to adequately reinforce the opening of the mast. The internal horizontal clearance of the doorframe must be four and three-quarter (4-3/4) inches; its internal vertical clearance must be seven (7) inches. Its upper and lower ends must be semi-circular meeting its straight sides tangentially. The radius of this opening must be two and three-eighths (2-3/8) inches. The vertical center line of the entry must be at a right angle clockwise from the vertical center line of the mast arm supports. The frame must have two welded tabs; one at the top and one at the bottom of the door frame. These tabs must be drilled and tapped to accept a 1/4-20 UNC screw. The top hole must be located 13/16 of an inch from the top of the opening. The bottom hole must be located 13/16 of an inch from the bottom of the opening. The 1/4-20 UNC machine screws must be stainless steel with hex heads, meeting the requirements of ASTM A193. The screws shall be treated with a compound to prevent seizing. Other non-seizing types of screws and fasteners may be considered. An alternate method of attachment consisting of a removable hinge on the bottom with a screw connection at the top may be considered. (The above requirements apply to all pole masts except those with a 10 inch bolt circle. Poles with 10 inch bolt circles must have handhole openings of 3" by 5". All other requirements apply.)
- (h) Door. The removable door must be formed of sheet steel approximately one-eighth (1/8) inch thick. It shall be flat or dished depending upon the pole type, and fit the doorframe closely so that it will stay in proper position even if its locking screws are slightly loosened. The door must be drilled top and bottom to accept the 1/4-20 UNC hex head machine screws which will fasten the door to the doorframe. A half-circle piece of steel must be welded by the screw opening, to allow only a socket wrench to be used. All doors shall be interchangeable. An alternate method of attachment using an internal hinge at the bottom of the door with a screw at the top of the door will be considered. Any alternate method will be subject to approval by the Commissioner or his duly authorized representative.
- (i) Locking Device. Any other door locking device, other than the one outlined above in (g) and (h), must be approved by the Commissioner or his duly authorized representative.
- (j) Tag. To each pole must be attached immediately below the handhole, by

mechanical means and not by adhesive, a stainless steel tag with a stamped or embossed legend which must include the pole outside diameter at the base, the overall length, and the gauge; i.e., 12.5" X 34'-6" X 3 gauge.

- (k) Structural Requirements. The mast shall be manufactured in accordance with AASTHO's 1994 version of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". The shaft and base assembly must be designed to meet AASTHO's 1994 criteria for 80 MPH wind loading with a 30% gust factor. The poles shall be designed appropriately for Chicago applications for both street lighting and traffic signal applications, including signal mast arms.

TOP

5. (a) Design. The mast top shall be essentially conical with a globe-shaped upper-end and having a minimum wall thickness throughout of not less than 1/4 inch. The cone portion must meet the skirted portion of the top in a smooth filet, the skirt must enclose the top 7/8" inches of the mast. Three stainless steel, or other similar approved material, set screws not less than 3/4 inches long must be equally spaced in tapped holes around the skirt and must hold the top securely in place atop the mast. The design of the top shall be similar to the one shown on Drawing #11420A.
- (b) Material. The top must be aluminum alloy 356-F per ASTM B108. It shall have smooth surfaces, neat edges and corners and be free from fins, holes or other casting flaws. Non-metallic tops may be substituted if approved by the Commissioner.
- (c) Finish. Tops shall be painted as herein specified.

HARDWARE

6. All the hardware necessary to complete the assembly of the pole shall be furnished. All hardware will be as specified elsewhere in these specifications. Hardware not specified elsewhere must be stainless steel meeting the requirements of ASTM A193, or equal corrosion-resistant non-seizing metal, or a non-metallic material subject to approval by the Commissioner.

WELDING

7. (a) General. Every welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings; however, each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods, he proposes to use in fabricating the pole.

- (b) Testing. Welds shall be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection will be governed by the same conditions as in Section 9. If the magnetic inspection process is to be used, the dry method with the direct current must be employed. All transverse welds must be magnetized by the "prod" (Circular magnetization) method. Longitudinal welds may be magnetized by either circular or longitudinal magnetization.

PAINING

8. (a) Oil and Grease Removal. All metal surfaces shall be washed with an alkaline detergent to remove any oils or grease.
- (b) Metal Cleaning. All exterior metal surfaces shall be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10. Included in this process will be the interior base section of the mast to a minimum height of twelve (12) inches.
- (c) Chemical Pretreatment. The cleaned metal surfaces shall then be treated with a hot, pressurized iron phosphate wash and shall be dried by convection heat.
- (d) Primer Coat. All exterior surfaces are to be coated with corrosion-inhibiting zinc-rich aromatic urethane conforming to SSPC Paint 20, Type II. Dry film thickness shall be a minimum of 2.5 mils (.0025"). The aromatic urethane shall consist of a zinc dust content not less than 83% by weight in dried film. The coating shall be airless-spray applied and moisture cured.
- (e) Finish Coat. All exterior surfaces are to be subsequently coated with aliphatic acrylic polyurethane paint, conforming to SSPC-36, to a minimum dry film thickness of 3.0 mils (.003"). The coating shall be airless-spray applied and cured in a gas-fired convection oven by heating the steel substrate to between 150° Fahrenheit and 220° Fahrenheit.
- (f) Interior Coat. Interior surfaces are to be coated with red oxide rust inhibitive alkyd primer to a dry film thickness of 1.5 mils.
- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl (by weight) solution at 95°F and 95% relative humidity without blistering. Before testing, the panel must be scribed with an "X" down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "single spot measurement" in an

area of two square inches must be not less than 5.5 mils.

- (i) Color. Color must be gloss black unless otherwise noted in the order. A color sample must be submitted for approval prior to fabrication.
- (j) Alternate Methods. Alternate painting methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.

MAST TEST

- 9. (a) General. All completed masts shall be available for testing for maximum deflection and set. The masts shall meet the structural requirements of Section 4(k). Unless specifically authorized in writing, all tests shall be made at the works of the manufacturer. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the masts are shipped.
- (b) Lot. Tests for welds, deflection and set of the mast and of the mast arm supports shall be made upon three (3) masts of the first fifty (50) in every order. An additional one (1) mast shall be tested for each additional fifty (50) masts in the order. The selection of masts for testing shall be random from the entire completed lot. If any of the masts in any lot fail to meet the test, an additional three (3) masts of the same lot must be tested. If any of these masts fail to meet the test requirements, the entire lot will be subject to rejection, except that the manufacturer may subject each mast in the lot to the test, and those which fulfill the requirement will be accepted. After testing, each base weld must be inspected by the magnetic particle method to determine that the welds have not been affected.
- (c) Mast Requirements. With base rigidly anchored, a test load as indicated in Table A must be applied at a point approximately two feet (2'0") from the free end. The load must be applied at right angles to the center line of the mast and in the same vertical plane. The deflection must not be greater than that indicated in Table A. Within one (1) minute after the test load is released, measurement must be made of the set taken by the mast. This set must not be greater than that indicated in Table A. The deflection measurement device must be reset to zero and the test load must be reapplied. The deflection must not change from the deflection noted in the first test by more than $\pm 5\%$. No measurable set must be noted within one (1) minute after test load is released.
- (d) Mast Arm Support (simplex) Requirements. With an appropriate mast arm firmly attached to the mast, a test load of 300 pounds must be applied to the mast arm as a side pull at a point seven (7) feet from the mast. After the test,

the mast arm support welds on the mast must be tested by the magnetic particle method to determine that they have not been affected.

PACKAGING

10. (a) General. The poles must be shipped in twelve (12) pole bundles. Each pole must be individually wrapped so that the pole can be bundled for shipping and unbundled for delivery to the City without damaging the pole or its finish.
- (b) Bundles. The bundles shall consist of twelve (12) poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting of contents or breaking, subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two (2) high without breaking or shifting of the contents. Each bundle must be capable of being lifted by a forklift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading. Each pole wrapping must be clearly labeled indicating the pole size, i.e. 34'6", 7 GAUGE, STEEL POLE, 15" B.C.
- (c) Hardware. The bolt covers and their attachment devices must be shipped with each bundle and packaged in twelve (12) sets of four (4) each. The package must be labeled and placed in a prominent position to facilitate accessibility, and must be attached to, or within, the bundle in such a manner as to assure safe delivery. Payment will be withheld for any bundle delivered without the accompanying hardware. Pole caps must be attached at the manufacturer's facilities or be packed separately in a manner similar to the bolt covers, and the same payment conditions will prevail. Cracked, broken or chipped parts will be considered as an incomplete delivery as regards payment.

TABLE A

POLE	GAUGE	BOLT CIRCLE	ANCHOR ROD	BASE P L A T E	TEST L O A D	M A X. D E F	M A X. S E T	D R A W I N G
7.67"x12.5" x34'6"	3	16.5"	1.5"	1.75"	3200#	22"	2.5"	827
6.17"x11"x 34'6"	3	17.25"	1.25"	1.5"	2500#	26"	2.5"	824
5.17"x10.0" x34'6"	3	15.0"	1.25"	1.5"	2000#	30"	2.5"	808
5.17"x10.0" x34'6"	7	15.0"	1.25"	1.5"	1500#	30"	2.5"	808
3.95"x8.5"x 32'6"	3	11.5"	1.25"	1.5"	1500#	33"	2.5"	763
3.95"x8.5"x 32'6"	7	11.5"	1.0"	1.25"	1200#	33"	2.5"	762
3.87"x8.0"x 29'6"	3	10.0"	1.0"	1.5"	1500#	28"	1.0"	657
3.87"x8.0"x 29'6"	7	10.0"	1.0"	1.25"	1200#	28"	1.0"	656
4.15"x8.0"x 27'6"	3	10.0"	1.0"	1.5"	1500#	23"	1.0"	655
4.15"x8.0"x 27'6"	7	10.0"	1.0"	1.25	1200#	23"	1.0"	654
4.20"x7.0"x 20'0"	3	10.0"	1.0"	1.0"	1500#	13"	1.0"	653
3.70"x6.5"x 20'0"	11	10.0"	1.0"	1.0"	800#	14"	1.0"	652

**ELECTRICAL SPECIFICATION 1450
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 20, 2007**

MAST ARMS: 4-, 8-, 12-, AND 15-FOOT: STEEL

SUBJECT

1. This specification covers the requirements for 4-, 8-, 12-, and 15-foot steel mast arms for supporting street light luminaires.

GENERAL

2. (a) Specifications. The mast arms shall conform in detail to the requirements herein stated, and to the requirements of the following organizations cited herein, of which the most recently published revision will govern:

American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)

- (b) Acceptance. Mast arms not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation. They are integral parts of this specification cooperating to state necessary requirements.
- (d) Bidders Drawings. Bidders shall submit with their bids detailed scale drawings of the mast arms and attachments showing actual dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must give every dimension necessary to show how the parts will fit each other and be properly held in assembly. These drawings shall be submitted in electronic format, preferably Microstation 95, if so requested by the City.
- (e) Sample. One complete mast arm of each size and of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.

- (f) Warranty. The manufacturer shall warrant the performance and construction of the mast arms to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the mast arms have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

DESIGN

3. (a) 4-Foot Mast Arm. Each 4-foot mast arm must be fabricated from a continuous, single piece, two (2) inch "extra strong" steel pipe conforming to the requirements of ASTM A53, Table X2. It must conform in detail with the mast arm shown on Drawing Number 661.
- (b) 8-Foot Mast Arm. Each 8-foot mast arm must be fabricated from a continuous, single piece, two (2) inch "extra strong" steel pipe conforming to the requirements of ASTM A53, Table X2. It must conform in detail with the mast arm shown on Drawing Number 620.
- (c) 12-Foot Mast Arm. Each 12-foot mast arm must be fabricated from two (2) continuous, single piece, two (2) inch "standard" steel pipes conforming to the requirements of ASTM A53, Table X2. It must conform in detail with the mast arm shown on Drawing Number 839.
- (d) 15-Foot Mast Arm. Each 15-foot mast arm must be fabricated from two (2) continuous, single piece, two (2) inch "standard" steel pipes conforming to the requirements of ASTM A53, Table X2. It must conform in detail with the mast arm shown on Drawing Number 840.
- (e) Mast Arm Attachment. The mast arm attachment to be welded to all mast arms will be a steel forging per ASTM A668, Class D, or cast steel conforming to the requirements for Grade 65-35 cast steel of ASTM A27, or can be fabricated from corrosion resistant steel plate such as "Cor-Ten" or approved equal. It shall be so designed that it may be fitted over the mast arm supports on the pole and be held by the mast arm supports in proper position without other support. The attachment must conform to the details shown on Standard Drawing 724. Provision must be made for fastening the attachment to each mast arm support by two special screws and washers as noted in Section 6.
- (f) Entryway for Wires. A drilled opening lined with a neoprene grommet

having inserted therein a neoprene plug must be provided on the underside of the upper member of all arms approximately three (3) inches from the point of attachment. The clear opening must not be less than five-eighths (5/8) inch in diameter. Its design must be submitted for approval by the Commissioner or his authorized representative.

- (g) Mast Arm Members. All mast arm members shall conform with the type of steel required for the arm specified. The members must be continuous lengths of pipe cut to the proper size to fabricate the mast arm lengths requested. No butt welded, swaged and welded or other pieced together configurations of pipe lengths will be accepted. The outer and inner surfaces of the pipes shall be smooth and even without protrusions, nicks, holes or other imperfections.

PAINTING

- 4. (a) Oil and Grease Removal. All metal surfaces shall be washed with an alkaline detergent to remove any oils or grease.
- (b) Metal Cleaning. All exterior metal surfaces shall be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10. Included in this process shall be one to two inches of the interior section of the mast arm.
- (c) Chemical Pretreatment. The cleaned metal surfaces shall be treated with a hot, pressurized iron phosphate wash and shall be dried by convection heat.
- (d) Exterior Coat. A Thermosetting, polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform eight (8) mil thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400°F to form a high molecular weight fusion bonded finish.
- (e) Alternate Methods. Alternate powder coat methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.
- (f) Interior Coat. The interior metal surfaces must be powder coated with a thermoplastic hydrocarbon resin containing corrosion inhibitors. The resin shall be formulated for application over untreated metal surfaces. The resin must be applied at a temperature of approximately 200°F to a minimum thickness of three (3) mils. The interior thermoplastic coat must overlap the interior, thermosetting base coat by approximately one (1) inch. Alternate interior coatings may be used subject to prior approval of the Commissioner.

- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl solution at 95°F and 95% relative humidity without blistering.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-PA 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "Single spot measurement" in an area of two square inches must be not less than 7.0 mils.
- (i) Color. Color must be gloss black, unless otherwise specified in the order. A color chip sample must be submitted for approval prior to fabrication.

WELDING

- 5. (a) Standards. Every weld shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings; however, each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods he proposes to employ in fabricating the mast arm.
- (b) Testing. The welds shall be inspected for penetration and soundness by the magnetic particle inspection method or by radiography. If the magnetic inspection process is used, the dry method with direct current must be employed.

SCREWS

- 6. Two (2) special 1/2" - 13 NC x 1-1/2" long stainless steel cap screws, and two (2) stainless steel flat washers, must be provided for each mast arm attachment.

MAST ARM TESTS

- 7. (a) General. Tests must be made upon three (3) of the first fifty (50) arms in any order. An additional one (1) arm must be tested for each additional fifty (50) arms in the order.
- (b) 4-Foot Mast Arm. The 4-foot mast arm, when securely attached to a suitable and proper supporting structure, must withstand a side pull of not less than three hundred (300) pounds applied at a point three feet six inches (3'-6") from the connection to the supporting structure without failure of welds.
- (c) 8-Foot Mast Arms. The 8-foot mast arm, when securely attached to a suitable and proper supporting structure, must withstand a side pull of not

less than three hundred (300) pounds applied at a point seven (7) feet from the connection to the supporting structure without failure of the welds.

- (d) 12-Foot and 15-Foot Mast Arms. The 12-foot mast arm and the 15-foot mast arm, when securely attached to a suitable and proper supporting structure, must withstand a side pull of 300 pounds applied at a point seven (7) feet from the connection to the supporting structure without failure of the welds.
- (e) Rejection. If any of the mast arms in any lot fail to meet the test, an additional three (3) arms in the same lot must be tested. If any of these mast arms fail to meet the test requirements the entire lot will be subject to rejection, except that the manufacturer may subject each mast arm in the lot to the test, and those which meet the requirements will be accepted.
- (f) All test results must be certified by the manufacturer. Documentation must be available for the City to approve.

PACKAGING

- 8. (a) General. The arms shall be shipped in bundles. Each arm must be individually wrapped so that the arm can be bundled for shipping and unbundled for delivery without damage to the arm or its finish. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled , shipped and stored without shifting or breaking of the contents. Any bundles, in which either the mast arms or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle at no cost to the City. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped in a flat bed truck to facilitate unloading. Each arm wrapping must be clearly labeled indicating the arm size, i.e. "8' STEEL LUMINAIRE MAST ARM".
- (b) The hardware must be shipped with each bundle. The package must be labeled and placed in a prominent position to facilitate accessibility, and must be attached to, or within, the bundle in such a manner as to assure safe delivery.

**ELECTRICAL SPECIFICATION 1451
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 3, 2006**

**CABLE: SINGLE CONDUCTOR, COPPER, MV-105,
15,000 VOLT, 220 MIL E.P.R. INSULATION,
5 MIL COPPER TAPE SHIELD AND PVC JACKET**

SUBJECT

1. This specification states the requirements for a single conductor copper, 15,000 volt cable for use on single or three phase, 60 cycle, alternating current underground circuits between medium voltage transformers. The cable shall be classified as MV-105 per Underwriter's Laboratories.

GENERAL

2. (a) The following organization's specifications are referenced herein:

American Society for Testing and Materials - ASTM
Association of Edison Illuminating Companies - AEIC
Insulated Cable Engineers Association - ICEA
National Electrical Manufacturer's Association - NEMA
Underwriters Laboratories - UL
- (b) The cable must conform in detail to the requirements stated herein and to the latest edition of ICEA S-93-639 (NEMA WC-74), ICEA S-97-682, UL1072 and AEIC CS8-00.
- (c) Cable not conforming to this specification will not be accepted.
- (d) Sample. A three (3) foot section of cable of the manufacture intended to be provided must be submitted to the Engineer of Electricity within fifteen (15) business days from the receipt of such a request from the Chief Procurement Officer.
- (e) Warranty. The manufacturer shall warrant the cable to be first class, virgin material throughout. He shall further warrant that all cable will be free from defects in design, materials and workmanship for a period of two (2) years from date of delivery to the City. Any cable failing during the warranty period due to said defect(s) must be replaced by the manufacturer at no cost

to the City. The length of cable to be replaced must be measured from one installed point of termination to the next point of installed termination. The Commissioner will be the sole judge in determining which cable needs to be replaced.

CONSTRUCTION

3. (a) The completed cable must consist of a stranded copper conductor, strand screen, EPR insulation and insulation shield all applied in a triple tandem extrusion process. A copper tape shield and a PVC jacket must be applied overall.
- (b) Cables shall be suitable for operation in wet or dry locations and must be rated 105° Centigrade for continuous operation, 130° Centigrade for overload operation and 250° Centigrade for short circuit conditions.
- (c) Cables must be UL listed at 15 KV, 133% insulation level and be classified as MV-105 (medium voltage - 105°).
- (d) Cables shall be free of insulation and/or jacket repairs.

CONDUCTOR

4. (a) The conductor must be soft drawn annealed round copper wire.
- (b) The conductors must be concentric lay with a Class B stranding in accordance with ASTM B3 and B8.
- (c) The conductor size will be No. 2 AWG, No. 1/0 AWG or other sizes as noted in proposal.

STRAND SCREEN

5. (a) The conductor strand screen must be a black extruded, semi-conducting, thermosetting compound. It must be free stripping from the conductor and inseparably bonded to the overlying insulation.
- (b) The minimum thickness of the strand screen must be 2.5 mils. The thickness of the strand screen shall not be considered a part of the insulation thickness.
- (c) The conductor strand screen must comply with the requirements of ICEA S-93-639, ICEA S-97-682, and UL 1072.

INSULATION

6. (a) The insulation must be a black thermosetting ethylene-propylene rubber (EPR) per ICEA S-93-639 (NEMA WC-74), AEIC specification CS8-00 and UL 1072, or latest revisions thereof.
- (b) The insulation must be circular in cross section, concentric to the conductor and must have an average thickness of 220 MILS (per 133% insulation level) with a minimum thickness not less than 90% of the average.
- (c) Initial physical requirements.
- | | |
|----------------------------------|------|
| 1. Tensile strength, Min., PSI | 1200 |
| 2. Elongation at rupture, Min. % | 250 |
- (d) After conditioning in an air oven at $121 \pm 1^\circ\text{C}$ for 168 hours using methods of test described in ASTM-D 573:
- | | |
|--|----|
| Tensile strength, minimum percent of unaged value | 90 |
| Elongation at rupture, minimum percent of unaged value | 90 |
- (e) After 168 hours in water at $70 \pm 1^\circ\text{C}$, maximum water absorption must be:
- | | |
|----------------------------|-----|
| Milligrams per square inch | 5.0 |
|----------------------------|-----|
- (f) At 15.6°C :
- | | |
|---------------------------|-----|
| Maximum % P.F. @ 80 V/Mil | 1.0 |
|---------------------------|-----|

INSULATION SCREEN

7. (a) A tight constricting envelope of black semi-conducting thermosetting material must be applied over the insulation. This covering shall conform to the contour of the insulation surface following non-uniformities and shall exclude air pockets adjacent to the insulation. It shall have resiliency to follow the expansion and contraction cycles of the cable remaining in constant contact with the insulation. The compounds chemical and mechanical compatibility with the insulation must be evidenced by compliance with the requirements of the cyclic aging and resistance stability tests per AEIC CS8-00.
- (b) The insulation screen must meet the requirements of ICEA S-93-639, NEMA WC-74, AEIC CS8-00 and UL 1072 or the latest revisions thereof.
- (c) The screen must strip freely from the insulation and, when removed, must not

leave any conducting particles, deposits or other residue on the surface of the bared insulation.

- (d) The guaranteed peel strength of the screen from the insulation must be between 6 and 24 pounds per half inch width when tested per AEIC CS8-00 or latest revision thereof.

COPPER TAPE SHIELD

8. (a) The insulation screen must be covered with a metallic tape shield applied helically with a 25 percent overlap.
- (b) The metallic tape must be uncoated, non-magnetic, copper, per ICEA S-93-639. The tape must be 5 mils in thickness.

JACKET

9. (a) The jacket must be a black polyvinyl chloride (PVC).
- (b) The jacket thickness must be a minimum of 80 mils average, with no spot less than 90% of the average.
- (c) The jacket must have the following physical properties:

1. Unaged Physical:

Tensile (PSI)	1500
Elongation (%)	100

2. After air oven for 120 hours @ 100°C:

Tensile (% of unaged)	85
Elongation (% of unaged)	60

3. After immersion in #2 oil for 4 hours @ 70°C:

Tensile (% of unaged)	80
Elongation (% of unaged)	60

4. After air oven for 1 hour @ 121°C:

Heat Distortion (% max)	50
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5. After 168 hours @ 70°C:

Gravimetric water absorption (max. MG/IN²) 20

TESTING

10. (a) All cable produced under this specification will be subject to testing. Tests must be performed as required by ICEA S-93-639, CS8-00, and UL 1072.
- (b) Tests must include conductor DC resistance, high voltage, insulation resistance, cold bend test, corona test per CS8-00, water absorption test, and any other tests that may be specified to insure the produced cable meets these specifications.
- (c) Tests must be performed on samples taken from completed cable. One (1) sample must be taken for each 5,000 feet or fraction thereof.
- (d) Any reel which fails to conform to these test requirements will be rejected. Certified reports attesting to each test must be furnished prior to the delivery of the cable.

IDENTIFICATION

11. (a) On the black PVC jacket, at approximately two (2) foot intervals, the following information must be printed with permanent, white, contrasting ink:
1. Name of Manufacturer
 2. Date of Manufacture
 3. Wire size
 4. 15KV, CU, 220 Mil EPR, 80 Mil PVC.
 5. (UL) MV-105
- (b) On the PVC Jacket, on the side opposite the legend, at one (1) foot intervals, the manufacturer must print sequential footage.

PACKAGING

12. (a) All cable must be shipped on sound, substantial, non-returnable reels with a three inch (3") steel reinforced arbor. Two 1/C cables must be parallel wound on each reel. Both cable ends must be readily accessible so that both conductors can be readily installed with a one reel set-up. Both ends of each length of cable shall be properly sealed against the entrance of moisture and other foreign matter. The ends must be securely fastened so as not to become loose in transit.
- (b) All reels must be 100% lagged with 2"x4" wood lagging.
- (c) Reel size must be a maximum of 76" high x 40" wide. The reel core diameter

must be based on the minimum bending radius of the cable but must not be smaller than 36".

- (d) It is desirable that reels contain 2,500 linear feet per conductor but in no case may the maximum gross reel weight exceed 4,500 pounds.
- (e) A metal tag(s) must be securely fastened to each reel indicating the reel number; gross and tare weights; a description of the cable; directions for unrolling the cable; the total footage of cable on the reel; and the beginning and ending sequential footage numbers on the reel for each cable.

**ELECTRICAL SPECIFICATION 1452
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 19, 2014**

POLE: ANCHOR BASE, ALUMINUM, TAPERED TUBULAR SHAFT

SUBJECT

1. This specification states the requirements for tapered, tubular, aluminum anchor base poles. They will support street light luminaires mounted on either truss type arms or davit style arms. The poles will be served by underground cables.

GENERAL

2. (a) Specifications. The poles shall conform in detail to the requirements herein stated, and to the requirements of the following organizations as cited herein:

Aluminum Association (AA)
American Association of State Highway and Transportation Officials (AASTHO)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Poles not conforming to this specification will not be accepted. The Commissioner will be the sole judge in determining if the poles meet this specification.
- (c) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the mast showing actual dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must show every dimension necessary to show how all parts will fit each other and be properly held in assembly. These drawings must also be submitted in electronic format, in the latest version of either MicroStation or AutoCAD, if so requested by the City.
- (d) Standard Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state necessary requirements.

- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled anchor-base pole of the manufacture intended to be furnished, must be submitted for review by the Commissioner within fifteen (15) business days after receipt of notice.
- (f) Warranty. The manufacturer shall warrant the performance and construction of the light poles to meet the requirements of this specification and shall warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the light poles have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or any faults in the anodized surfaces. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made. The Commissioner's decision will be final.

STANDARDS

- 3. (a) Assembly. Each anchor base pole shall consist of an aluminum mast with handhole entry, aluminum hinged entry door, grounding nut, mast base plate, top cap for non-davit masts, bolt covers, and all necessary hardware required for complete assembly of these parts, ready for assembly, without special tools.
- (b) Interchangeability. Members of each pole type must be mutually interchangeable for assembly, so that no reworking will be required to make any member fit properly in the place of any other similar member of any other similar pole.
- (c) Design. Each pole type must conform in design and dimensions to the pertinent drawing(s) listed in Table A.

MASTS

- 4. (a) Mast Size. The outside diameters of the mast of each pole type shall be as listed in Table A. The mast taper will be approximately 0.14 inches per foot.
- (b) Material. The shaft must be fabricated from one length of 6063-T4 wrought aluminum alloy meeting the requirements of ASTM B221. After all welding operations are completed, the mast must be brought to a T6 temper having minimum physical characteristics of ASTM B221. The wall thickness of the shaft and the diameter of the shaft shall be as listed in Table A and as shown on the appropriate standard drawing. Material certification shall be provided from the tube manufacturer.

- (c) Fabrication. The mast must be fabricated with no longitudinal or lateral welds in the tube. The completed masts must have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance. Each mast must be straight and centered on its longitudinal axis.
- (d) Base. The mast base must be a permanent mold aluminum casting conforming to the requirements for aluminum alloy 356-T6 of ASTM B-108 or ASTM B-26. The base shall be similar in shape and dimensions to that shown on the appropriate standard drawing for the specific mast. The base shall consist of a collar, flange, and any other members necessary to provide strength and reduce the concentration of anticipated stresses. The shaft must extend into the base as shown on the appropriate standard drawing and be circumferentially welded to the base casting at the top outer surface and the lower inner surface of the base. Bases must be attached to the mast so that the bearing surface of the base is at right angles to the longitudinal axis of the mast.

Non-metallic removable bolt covers which completely cover the anchor bolts and nuts must be provided. The covers must be attached with stainless steel screws or another type of non-seizing fastener, as approved by the Commissioner. The covers must enclose the anchor bolts and be secured in an approved manner.

All anchor rod openings for each pole type must have a width as listed in Table A. Each opening must be sized to have a circumferential slot length equal to 15° of the circumference.

- (e) Cable Entry for Conventional Poles. An opening of approximately one and one quarter inches (1-1/4") in diameter, rimmed with a rubber or nylon grommet, must be furnished and installed at the point on the shaft where the clamp on the upper member of the mast arm bracket meets the pole. Certain masts may require two cable entries, depending on the order. There will be no extra compensation for the extra cable entry. This cable entry requirement does not apply to pole masts designed for davit style arms. This requirement does apply to conventional poles (Drawings 890 and 938).
- (f) Option: Side Mount for Luminaire. If requested, the pole mast will be prepared for the mounting of a sidewalk-side luminaire. An opening of approximately one and one-quarter inches (1-1/4") in diameter, rimmed with a rubber or nylon grommet, must be furnished and installed at the proper height, as indicated on the appropriate standard drawing, or as directed in the order. In addition, two (2) holes must be drilled to accept two (2) rivnuts for mounting a City back plate for a mid-mount luminaire. All three (3) holes must be properly spaced and aligned to accept the City standard back plate for the appropriate mid-mount luminaire. The rivnuts (3/8-16) must be inserted in the pole. The holes must be properly aligned with the handhole as

indicated on the standard drawings.

- (g) Top of Shaft for Davit Arm. The top one foot of the mast shall be formed as shown on the appropriate standard drawing. An adapter ring may be provided if required. Two sets of holes 9/16 inches in diameter must be drilled through the mast to accommodate two bolts to attach a davit arm. The lower set (two holes) must be in line with the mast arm. The other set must be 90° apart from the other. These requirements apply to pole masts designed for davit style arms.
- (h) Provision for Ground. A tapped hole must be provided on an extension or offset, centered on the handhole door frame's interior vertical surface, to accept a 1/2"-13 bolt for a ground connection.
- (i) Entry. A vertical doorframe for reinforcing a door opening which provides access to the interior of the mast must be welded on the inside of the pole and be centered approximately 18 inches above the bottom of the base. The doorframe must be formed and welded of aluminum alloy 6063-T6 with a cross-section to adequately reinforce the opening of the mast. The doorframe must be as indicated on the appropriate standard drawing. The actual door opening must be sized to perfectly match the door size. For all arterial poles and for all conventional poles, the vertical centerline of the entry must be at a right angle clockwise to the vertical centerline of the mast arm. For the residential davit poles, the vertical centerline of the entry must be in-line with the vertical centerline of the mast arm. An internal flange must be welded to the inside of the pole at the bottom of the door opening. This flange will be drilled to accept a bolt. The bolt will be used to attach a hinged door to the pole. An aluminum tab must be welded to the inside upper portion of the door opening. A hole must be drilled into the tab that will accept a 1/4 inch screw. The hole must be centered horizontally in the door opening and must be centered 3/8 of an inch down from the uppermost portion of the door opening. A steel spring clip must be mounted to the tab. The clip must be made to accept a 1/4"-20 machine screw.
- (j) Door. The removable door must be formed of the same aluminum as the pole. The door must fit the pole opening within a tolerance of 1/8 of an inch. The door must be flush with the pole surface in the closed position and appear as part of the original mast. The door must be attached to an internal hinge which will allow the door to open out and down. The hinge must be bolted to a flange on the inside of the pole at the bottom of the door opening, so that the door and hinge may be un-bolted and replaced if need be. The door opening must be sized according to the appropriate standard drawing. A hole must be drilled in the top of the door in alignment with the hole on the mast. A 1/4"-20 Allen head button machine screw must be provided to fasten the door to the doorframe. The screw must have a stainless steel core with a nylon threaded body. Other types of non-seizing fasteners may be considered.

All doors of the same size must be interchangeable. The door and attachment method will be subject to approval by the Commissioner or his duly authorized representative.

- (k) Tag. To each pole must be attached immediately below the handhole, by mechanical means and not by adhesive, a stainless steel tag with a stamped or embossed legend which must include the pole outside diameter at the base, the overall length, and the wall thickness.
- (l) Structural Requirements. The mast shall be manufactured in accordance with AASTHO's 1994 version of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". The shaft and base assembly must be designed to meet AASTHO's 1994 criteria for 80 MPH wind loading with a 30% gust factor. The poles shall be designed appropriately for Chicago street lighting applications, including mast arm and luminaires. Thirty - foot davit poles and thirty- foot conventional poles for arterial streets must also allow for banner and flower basket attachments. The pole manufacturer must provide load calculations that verify that the poles are designed properly.

TOP CAP FOR NON-DAVIT POLES

- 5. The top cap shall be aluminum alloy. It must have smooth surfaces, neat edges and corners and be free from fins, holes, or other casting flaws. Three stainless steel set screws not less than 3/8 inches long must be equally spaced in tapped holes around the skirt to securely hold the top in place.

VIBRATION DAMPER

- 6. Each pole shaft will have an internal vibration damper, if requested, located at a position as shown on the appropriate standard drawing. The vibration damper must be welded or bolted to the inside of the pole shaft. If the standard drawing does not show a vibration damper none should be provided. The design of the vibration damper is subject to approval by the Commissioner or his representative.

HARDWARE

- 7. All the hardware necessary to complete the assembly of the pole must be furnished. All hardware will be as specified elsewhere in these specifications. Hardware not specified elsewhere must be stainless steel, or equal corrosion-resistant non-seizing metal, or a non-metallic material subject to approval by the Commissioner.

WELDING

8. (a) General. Every welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods, he proposes to use in fabricating the pole.
- (b) Testing. All welds of five percent (5%) of the poles in every lot must be inspected for penetration and soundness of the welds by radiography, or by a penetrant method. Acceptance or rejection will be governed by the same conditions as in the TESTING Section.
- (c) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed. Certifications must be available upon request.

FINISH

9. (a) General. All completed masts shall have a brushed satin natural finish or an anodized finish, as required by the project or in the purchase order.
- (b) A satin aluminum finish requires that each mast be rotary sand finished. The satin finish shall be accomplished by using 40-50 grit belts to remove taper marks and scratches. A minimum of one pass with a 120 grit belt over the entire shaft is required to provide a uniform appearance.
- (c) An anodized finish will be either matte black or semi-gloss black. A color sample must be submitted for approval before any factory production. The anodizing process must include cleaning, etching, anodizing, and sealing the mast. The etching process must meet the requirements of AA-C22. The anodizing process must meet the requirements of AA-A42. The contractor must submit his anodizing process for approval before any factory production.

MAST TEST

10. (a) General. All completed masts shall be available for testing for maximum deflection and set. The masts must meet the structural requirements of Section 4(1). Unless specifically authorized in writing, all tests must be made by the manufacturer. A record of every test must be made and a certified copy of the test record must be submitted to the Electrical Section of the Division of Engineering before the masts are shipped.

- (b) Lot. Tests for deflection of the mast must be made upon five (5%) percent of all the masts in every lot (two (2) min.). The selection of masts for testing must be random from the entire completed lot. If any of the masts in any lot fail to meet the test, an additional three (3%) percent of the masts of the same lot must be tested (two (2) min.). If any of these masts fail to meet the test requirements, the entire lot will be subject to rejection, except that the manufacturer may subject each mast in the lot to the test, and those which fulfill the requirement will be accepted. After testing, each base weld must be inspected by radiography or the penetrant method to determine that the welds have not been affected. After testing, no permanent set should be visible or apparent. The mast should appear straight.
- (c) Mast Requirements. With base rigidly anchored, a test load of 500 pounds must be applied at a point approximately eighteen inches (18") from the free end. The load must be applied at right angles to the center line of the mast and in the same vertical plane. With no failure of any component part, the deflection must not be greater than 7.5% of the pole height. After removal of the load, the deflection measurement device must be reset to zero and the test load must be reapplied. The deflection must not change from the deflection noted in the first test by more than $\pm 5\%$.

PACKAGING

11. (a) General. The poles must be shipped in bundles. Each pole or bundle shall be wrapped so that the poles can be handled and stored without damage to the surfaces.
- (b) Bundles. The poles in each bundle must be laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting of contents or breaking. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two (2) high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (c) Hardware. The bolt covers and their attachment devices must be shipped with each bundle. The package must be labeled and placed in a prominent position to facilitate accessibility, and must be attached to, or within, the bundle in such a manner as to assure safe delivery. Payment will be withheld for any bundle delivered without the accompanying hardware. Pole caps must be attached at the manufacturer's facilities, or be packed separately in a

manner similar to the bolt covers, and the same payment conditions will prevail. Cracked, broken or chipped parts will be considered as an incomplete delivery as regards payment.

TABLE A

POLE	THICK	BOLT CIRCLE	ANCHOR ROD	BASE P L A T	M A X. D	D R A W I
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	N E S S			E	E F L	N G
7"x4.5"x12'- 5"	.156"	10"	1.0"	0.75"	11"	940
7"x4.5"x20'- 0"	.156"	10"	1.0"	0.75"	18"	890
8"x4.5"x27'	.312	11.5"	1.0"	0.75"	26"	975
10"x6"x24'- 5"	.312"	15"	1.25"	1.25"	22"	941
10"x6"x27'- 10.5"	.312"	15"	1.25"	1.25"	25"	938
10"x6"x29'- 4.625"	.312"	15"	1.25"	1.25"	27"	971
10"x6"x34'- 4.625"	.312"	15"	1.25"	1.25"	31"	972

**ELECTRICAL SPECIFICATION 1453
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 14, 2013**

MAST ARMS: ALUMINUM, TRUSS TYPE AND DAVIT TYPE

SUBJECT

1. This specification covers the requirements for aluminum mast arms for supporting street light luminaires. The aluminum arms will be supported by aluminum light poles.

GENERAL

2. (a) Specifications. The mast arms shall conform in detail to the requirements herein stated and to the requirements of the following organizations as cited herein:

Aluminum Association (AA)
American Association of State Transportation and Highway Officials (AASTHO)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Mast arms not conforming to this specification will not be accepted. The Commissioner will be the sole judge in determining if the arms meet this specification.
- (c) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the mast arm and bracket attachment proposed to be welded to the mast arm as the means for attaching these mast arms to poles. For davit arms, drawings must show how the davit is attached to the top of the light pole and is secured. The drawings must give every dimension necessary to show how the parts will fit each other and be properly held in assembly. These drawings must also be submitted in electronic format, in the latest version of either Microstation or Autcad, if so requested by the City.
- (d) Drawings. The drawings mentioned herein are drawings of the Department

of Transportation being an integral part of this specification cooperating to state the necessary requirements.

- (e) Sample. If requested by the Chief Procurement Officer, one complete mast arm of the manufacture intended to be furnished, must be submitted within fifteen (15) business days upon receipt of such request.
- (f) Warranty. The manufacturer shall warrant the performance and construction of the mast arms to meet the requirements of this specification and shall warrant all parts, components, and appurtenances against defects due to design, workmanship, or materials, developing within a period of five years after the mast arms have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or any faults in the anodized surfaces. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made. The Commissioner's decision will be final.
- (g) Structural Requirements. The arms shall be manufactured in accordance with AASTHO's 1994 version of the Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. The arms must be designed to meet AASTHO's 1994 criteria for 80 MPH wind loading with a 30% gust factor. The arms shall be designed for Chicago street lighting applications. The arm manufacturer must provide structural calculations that verify that the arms are designed properly.

TRUSS ARM DESIGN

- 3. (a) Each mast arm must be a truss type fabricated of two (2) inch "standard" aluminum pipe or tube 6063-T4 alloy conforming to the requirements of ASTM B429, or ASTM B221, or other approved design. The arm must be heat treated to a T-6 temper after fabrication and welding.
- (b) Mast Arm Attachment. The mast must be attached to the pole by means of an extruded aluminum clamp with a bolting arrangement to hold the arm firmly in place. The extrusion must be aluminum alloy 6061-T6 conforming to the requirements of ASTM B221, B308, or an approved equal. The clamps shall be designed to securely fasten the mast arm to the pole so that the arm cannot be dislodged vertically or horizontally from its intended position on the pole by wind gusts, vibrations or other normally anticipated natural phenomena.
- (c) Dimensions. The truss type arm must have the dimensions indicated on Standard Drawing 943 or Standard Drawing 944 for the appropriate arm specified. Truss arms will be available in nominal horizontal lengths of 4 foot, 6 foot, 8 foot, 12 foot, and 15 foot, with either 4.5 inch or 6 inch clamps.

The distance between the lower and upper members, measured between the vertical centers of the upper and lower attachment plates, must be 1'-9". With the arm attached to the pole intended to be supplied, the vertical rise from the center of the top attachment plate to the horizontal centerline of the end of the arm must be no greater than 2'-8". The horizontal axis of the free end of the upper member, when attached to the pole, must not exceed 3° above the true horizontal without the luminaire weight, nor be less than 1/2° above the true horizontal with a 35 lb. weight supported at the free end of the arm.

- (d) Mating of Members. The upper and lower members shall be mated in such a manner as to assure that they will not separate due to vibration, weather conditions such as high wind gusts, icing, etc., or any other normally anticipated stress condition.
- (e) Interchangeability. Members of each truss arm size must be mutually interchangeable for assembly, so that no reworking will be required to make any member fit properly in the place of any other similar member of any other similar arm.

DAVIT ARM DESIGN

- 4. (a) Each arm must be fabricated from either 4.5 inch diameter or 6.0 inch diameter aluminum tubing of 6063-T4 alloy. After all fabrication and welding, the arm must be heat treated to a T6 temper.
- (b) The arm must be attached to the mast by slipping the bottom of the arm tube over the top of the mast. The arm must have four (4) holes pre-drilled at its base to accommodate two (2) through bolts set 90° apart, as shown on the Standard Drawings. The bottom bolt will be in direct line with the length of the arm. The holes must match the holes in the mast so that after assembly the arm and mast appear as a single continuous unit. When bolted to the pole, the arm must not shift or become dislodged by wind gusts, vibrations, or other phenomena.
- (c) The davit arm must be dimensioned as indicated on Standard Drawing 945, 946, 948, 949, or 950, for the appropriate arm specified. Davit arms must be available in nominal horizontal lengths of 8 foot and 12 foot for the 4.5 inch pole tops. Davit arms must be available in nominal lengths of 8 foot, 12 foot, and 15 foot for 6 inch pole tops. Davit arms will be single or twin as specified. A 2 3/8 inch diameter tenon will be attached to the end of each arm. The horizontal axis of the tenon, when the arm is attached to the pole, must not exceed 3° above the true horizontal without the luminaire weight, nor be less than 1/2° above the true horizontal with a 35 lb. weight supported by the tenon.
- (d) Interchangeability. All davit arms for a 4.5 inch pole top must be

interchangeable with each other. The same is required of davit arms for a 6 inch pole top.

WELDING

5. (a) General. Every welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods, he proposes to use in fabricating the arms.
- (b) Testing. All welds of five percent (5%) of the arms in every lot must be inspected for penetration and soundness of the welds by radiography or by penetrant inspection. Acceptance or rejection will be governed by the same conditions as in the TESTING Section.
- (c) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed. Certifications must be made available upon request.

FINISH

6. (a) General. All completed arms shall have a brushed satin natural finish or an anodized finish, as required by the project or in the purchase order.
- (b) A satin aluminum finish requires that each arm be rotary sand finished. The satin finish shall be accomplished by using 40-50 grit belts to remove taper marks and scratches. A minimum of one pass with a 120 grit belt over the entire arm is required to provide a uniform appearance.
- (c) An anodized finish will be either matte black or semi-gloss black. A color sample must be submitted for approval before any factory production. The anodizing process must include cleaning, etching, anodizing, and sealing the aluminum arm. The etching process must meet the requirements of AA-C22. The anodizing process must meet the requirements of AA-A42. The contractor must submit his anodizing process for approval before any factory production.

HARDWARE

7. All hardware furnished for attachment of mast arm to pole must be series 300 stainless steel. All hardware necessary to complete the assembly of the arm to the pole must be provided.

MAST ARM TESTS

8. (a) General. Five percent (5%) of the mast arms of each size in every order shall be tested for structural integrity.
- (b) Tests. The mast arms, when securely attached to a suitable and proper supporting structure, must withstand a horizontal (sideward) pulling force as indicated in Table A, and a vertical (downward) load as indicated in Table A. These loads may be applied independently. Each load must be applied at the end of the arm without any apparent permanent set, or damage to the welds joining the arm and mast arm attachment. The appropriate loading for each arm is indicated in Table A. On twin arms each arm extension must be tested.
- (c) Rejection. If the mast arms fail to meet the test, an additional three percent (3%) of the mast arms in the same lot must be tested. If any of these mast arms fail to meet the test requirements, the entire lot will be subject to rejection, except that the manufacturer may subject each mast arm in the lot to the test, and those which fulfill the requirements will be accepted.
- (d) All mast arms must meet the structural requirements of Section 2(g). All tests shall be certified by the manufacturer. Test results should be submitted to the Electrical Section of the Division of Engineering, upon request.

PACKAGING

9. (a) General. The mast arms must be shipped in bundles. Each arm or bundle shall be wrapped so that the arms can be handled and stored without damage to the surfaces.
- (b) Bundles. The bundles shall consist of fifty (50) to seventy five (75) arms laid to form an approximately rectangular bundle. Materials such as lumber (2"x4"), stainless steel banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting of contents or breaking, subject to approval. Any bundles, in which either the arms or packaging, is received broken, damaged, or with contents shifted, will not be accepted, and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two (2) high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (c) Hardware. The clamp backs and mounting hardware must be attached to the clamp fronts on the end of the arm, and must be shipped with each mast arm bundle. Mounting hardware for the davit arms must be packed and shipped

with each davit arm bundle. Payment will be withheld for any bundle delivered without the accompanying hardware. Cracked, broken or chipped parts will be considered as an incomplete delivery as regards payment.

TABLE A

ALUMINUM ARM	HORIZONTAL LOAD	VERTICAL LOAD	DRAWING #
Truss 4.5"x 4'	100#	250#	943
Truss 4.5"x 6'	100#	250#	943
Truss 4.5"x 8'	100#	250#	943
Truss 4.5"x 12'	100#	250#	943
Truss 4.5"x 15'	100#	250#	943
Davit 4.5"x 8'	100#	250#	945
Davit 4.5"x 12'	100#	200#	946
Davit 6.0"x 8'	100#	250#	948
Davit 6.0"x 12'	100#	250#	949
Davit 6.0"x 15'	100#	250#	950

**ELECTRICAL SPECIFICATION 1454
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED SEPTEMBER 25, 2020**

MAST ARM: TRAFFIC SIGNAL MONO-TUBE

SUBJECT

1. This specification states the requirements for a tapered, tubular, 7 gauge steel mono-tube arm with mounting brackets. The arm will support traffic signals and signs.

GENERAL

2. (a) Specifications. The arms shall conform in detail to the requirements herein stated, and to the requirements of the following organizations cited herein:

American Association of State Highway and Transportation Officials (AASHTO)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Arms not conforming to this specification will not be accepted.
- (c) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the mast arm showing actual dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must show every dimension necessary to show how all parts will fit each other and be properly held in assembly. These drawings shall also be submitted in electronic format, preferably MicroStation dgn format, if requested by the City.
- (d) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state necessary requirements.
- (e) Sample. If requested by the Chief Procurement Officer, one complete mast arm of the manufacture intended to be furnished must be submitted for review by the Commissioner within fifteen (15) business days of receiving

such request.

- (f) Warranty. The manufacturer shall warrant the performance and construction of the mast arms to meet the requirements of this specification and shall warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the mast arms have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

STANDARDS

3. (a) Assembly. Each arm shall consist of a tubular tapered steel shaft, mounting brackets, an aluminum cap, and all mounting hardware.
- (b) Interchangeability. Members of each arm type must be mutually interchangeable for assembly, so that no reworking will be required to make any member fit properly in the place of any other similar member of any other similar arm.
- (c) Design. Each arm must meet the requirements as shown on Standard Drawing 870.

ARMS

4. (a) Arm Size. The outside diameters of the arm of each size shall be as listed in Standard Drawing 870.
- (b) Material. The arm must be fabricated from one length of No. 7 Standard gauge steel meeting the requirements of ASTM A606 for low alloy high strength coil steel, which, after fabrication, must possess an ultimate tensile strength of not less than 70,000 psi and a yield strength of not less than 60,000 psi, in accordance with ASTM A595, Grade C. Chemistry of the steel shall be such as to insure resistance to atmospheric corrosion superior to that of ordinary copper bearing steel. Material certification is required. Manufacturer's steel meeting the specified physical and chemical requirements, and approved by the Commissioner, will be accepted.
- (c) Fabrication. The arm must be fabricated with not more than one (1) longitudinal weld. The weld must be ground smooth so that it is virtually invisible. There must be no lateral welds in the arms other than where the arms are welded to the steel clamp. Each arm must be straight and centered on its longitudinal axis. Each arm must be formed on a mandrel and worked

to form a round cross-section. The completed, unpainted arms shall have smooth external surfaces free from protuberances, dents, cracks, or other imperfections marring their appearance.

- (d) Clamp. The arm clamp must be of low alloy, high strength steel as noted in Section 4 (b). The clamp must be constructed as shown on Standard Drawing 870.
- (e) Structural Requirements. The mast arm must be manufactured in accordance with AASTHO's 1994 version of the Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. The arm assembly must be designed to meet AASTHO's 1994 criteria for 80 MPH wind loading with a 30% gust factor. The arms shall be designed appropriately for traffic signal applications within the City of Chicago.

CAP

- 5. (a) Design. The arm cap shall be essentially conical with a globe-shaped upper-end and having a minimum wall thickness throughout of not less than 5/32 inches. The cone portion must meet the skirted portion of the arm in a smooth filet, the skirt must enclose the top 7/8" inches of the arm. Three stainless steel, or other similar approved material, set screws not less than 3/4 inches long must be equally spaced in tapped holes around the skirt and must hold the cap securely in place on the arm.
- (b) Material. The cap must be of aluminum alloy 356-F per ASTM B108. It shall have smooth surfaces, neat edges and corners and be free from fins, holes, or other casting flaws.
- (c) Finish. Tops shall be painted as herein specified.

HARDWARE

- 6. All the hardware necessary to complete the assembly of the arm must be furnished. All hardware shall be stainless steel, or equal corrosion-resistant non-seizing metal, subject to approval.

WELDING

- 7. (a) General. Every welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings; however, each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods, he proposes to use in fabricating the arm.

- (b) Testing. All welds of the first three (3) arms of the first fifty (50) arms in every lot must be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection must be governed by the same conditions as in Section 9. If the magnetic inspection process is used, the dry method with the direct current shall be employed. All transverse welds must be magnetized by the "prod" (circular magnetization) method. Longitudinal welds may be magnetized by either circular or longitudinal magnetization.

PAINING

8. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove any oils or grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides, and foreign matter and provide a "near white" surface in accordance with SSPC-SP 10.
- (c) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Primer Coat. All exterior surfaces are to be coated with corrosion-inhibiting zinc-rich aromatic urethane conforming to SSPC Paint 20, Type II. Dry film thickness shall be a minimum of 2.5 mils (.0025"). The aromatic urethane shall consist of a zinc dust content not less than 83% by weight in dried film. The coating shall be airless-spray applied and moisture cured.
- (e) Finish Coat. All exterior surfaces are to be subsequently coated with aliphatic acrylic polyurethane paint, conforming to SSPC-36, to a minimum dry film thickness of 3.0 mils (.003"). The coating shall be airless-spray applied and cured in a gas-fired convection oven by heating the steel substrate to between 150° Fahrenheit and 220° Fahrenheit.
- (f) Interior Coat. Interior surfaces are to be coated with red oxide rust inhibitive alkyd primer to a dry film thickness of 1.5 mils.
- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% Na Cl (by weight) solution at 95°F and 95% relative humidity without blistering. Before testing, the panel must be scribed with an "X" down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "single spot measurement" in an area of two square inches must not be less than 5.5 mils.

- (i) Color. Color must be gloss black unless noted otherwise in the order. A paint chip must be submitted for approval prior to fabrication.
- (j) Alternate Methods. Alternate coating methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.

ARM TEST

- 9. (a) General. All completed arms shall be available for testing for maximum deflection and set. Unless specifically authorized in writing, all tests must be made at the works of the manufacturer. A record of every test must be made and a certified copy of the test record must be submitted to the Engineer of Electricity before the arms are shipped.
- (b) Lot. Tests for deflection and set must be made upon the first three (3) arms in the first fifty (50) arms in the lot. An additional one (1) arm must be tested for each additional fifty (50) arms. If any of the arms in any lot fail to meet the test, an additional three (3) arms of the same lot must be tested. If any of these arms fail to meet the test requirements, the entire lot will be subject to rejection, except that the manufacturer may subject each arm in the lot to the test, and those which fulfill the requirement will be accepted. After testing, each weld must be inspected by the magnetic particle method to determine that the welds have not been affected.
- (c) Requirements. With arm rigidly anchored, a test load as indicated in the table in Standard Drawing 870 must be applied at a point approximately two feet (2'0") from the free end. The load must be applied at right angles to the center line of the arm and in the same vertical plane. The deflection must not be greater than that indicated. Within one (1) minute after the test load is released, measurement must be made of the set taken by the arm. The deflection measurement device must be reset to zero and the test load must be reapplied. The deflection must not change from the deflection noted in the first test by more than $\pm 5\%$. No measurable set must be noted within one (1) minute after test load is released.

PACKAGING

- 10. (a) General. The arms shall be shipped in twelve (12) arm bundles. Each arm must be individually wrapped so that the arm can be bundled for shipping

and unbundled for delivery to the job site without damaging the arm or its finish.

- (b) Bundles. The bundles shall consist of twelve (12) arms laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped, and stored without shifting of contents or breaking, subject to approval. Any bundles, in which either arms or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two (2) high without breaking or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading. Each arm wrapping must be clearly labeled indicating the mast size, i.e. "30' SIGNAL MAST ARM".
- (c) Hardware. The hardware must be shipped with each bundle and packaged in twelve (12) sets of four (4) each. The package shall be placed in a prominent position to facilitate accessibility, and must be attached to, or within, the bundle in such a manner as to assure safe delivery. Payment will be withheld for any bundle delivered without the accompanying hardware. Arm caps must be attached at the manufacturer's facilities or be packed separately in a manner similar to the other hardware, and the same payment conditions will prevail. Cracked, broken or chipped parts will be considered as an incomplete delivery as regards payment.

**ELECTRICAL SPECIFICATION 1457
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 3, 2006**

**CABLE: SERVICE ENTRANCE,
THREE INSULATED CONDUCTORS IN ONE OVERALL JACKET,
600 VOLT**

SUBJECT

1. This specification states the requirements for a three conductor (two power conductors and one neutral conductor) Ethylene Propylene Rubber (EPR) insulated, chlorosulfonated polyethylene (CSPE) or polyvinyl chloride (PVC) jacketed cable for installation on Commonwealth Edison service poles for the purpose of providing secondary power feeds from Commonwealth Edison to a City disconnect mounted on the pole for street lighting or traffic signal circuits.

GENERAL

2. (a) Specifications. The cable shall conform in detail to the requirements herein stated, and to the applicable portions of the specifications and methods of test of the following agencies:
 - (1) ICEA Specification S-95-658
 - (2) IEEE Standard 383
 - (3) ASTM Standard E-662-79
 - (4) ASTM Standard D-470-81
 - (5) UL 44
 - (6) UL 854
- (b) Acceptance. Cable not conforming to this specification will not be accepted.
- (c) Sample. A three (3) foot sample of the cable intended to be provided under this contract must be submitted to the Engineer of Electricity within fifteen (15) business days after receipt of such a request from the Chief Procurement Officer.
- (d) Warranty. The manufacturer shall warranty the cable to be first class material throughout. If the cable is installed within one year of the date of shipment, the manufacturer must replace any cable failing during normal and proper use within two years of installation. The cable length to be replaced will be the

entire unspliced length where the fault has been located. The Commissioner will be the sole judge in determining if a cable has failed and should be replaced. All replacements under this warranty must be made free of charge F.O.B. delivery point of the original contract

CABLE

3. (a) **Construction.** The cable must consist of three (3) conductors separately insulated and color coded. Suitable fillers must be used to produce essentially a round cross section in the completed cable. The insulated conductors must be cabled with a suitable left hand lay in conformance with the latest revision of ICEA S-95-658. A binder tape must be used over the cabled conductor assembly and a jacket applied overall.
- (b) **Sealing.** The ends of each length of cable shall be sealed against the entrance of moisture.
- (c) **Marking.** The color of the neutral conductor must be white; that of the phase conductors must be black and red, respectively. The jacket must be black.
- (d) Each conductor shall consist of a round copper wire with a tight fitting, free stripping, concentric layer of Ethylene Propylene insulation. The cable must be rated for continuous duty at 90°C operating temperature, wet or dry, 130°C emergency overload temperature and 250°C short circuit temperature.

CONDUCTOR

4. (a) **Material.** The conductor shall either be soft or annealed round copper wire, tin coated.
- (b) **Specifications.** The conductor must meet the requirements of ASTM B3, and B8 for stranded Class B copper.
- (c) **Size.** The conductor size shall be as stated in the proposal or on the plans.

INSULATION

5. (a) **Type.** The insulation must be Ethylene Propylene compound meeting the physical and electrical requirements specified herein.
- (b) **Thickness.** The insulation must be circular in cross-section, concentric to the conductor, and must have an average thickness not less than 30 mils (.030") for #14 AWG, 55 mils (.055") for #4 AWG, 65 mils (.065") for #2 AWG, 80 mils (.080") for #1/0 AWG, 80 mils (.080") for #2/0 AWG, and a spot thickness not less than ninety percent (90%) of the average thickness.

- (c) Initial Physical Requirements:
- | | |
|-----------------------------------|------|
| (1) Tensile Strength, min., psi. | 1200 |
| (2) Elongation at Rupture, min. % | 250 |
- (d) Air Oven Exposure Test. After conditioning in an air oven at $121 \pm 1^\circ\text{C}$ for 168 hours using methods of test described in ASTM-D 573:
- | | |
|--|----|
| (1) Tensile strength, min% of unaged value | 75 |
| (2) Elongation, min % of unaged value at rupture | 75 |
- (e) Mechanical Water Absorption:
- (1) Gravimetric Method: After 168 hours in water at $70 \pm 1^\circ\text{C}$:
- | | |
|---|-----|
| Water absorption, maximum
(Mg. per sq. in) | 5.0 |
|---|-----|
- (f) Cold Bend Test Requirements. The completed cable must pass the "Cold-Bend, Long-Time Voltage Test on Short Specimens" of ASTM D-470 except that the test temperature must be minus (-) 25°C .
- (g) Electrical Requirements.
- (1) Voltage Test. The completed cable must meet an A.C. and D.C. voltage test in accordance with ASTM- D-470 and D-2655.
- (2) Insulation Resistance. The completed cable must have an insulation resistance constant of not less than 20,000 when tested in accordance with methods shown in ASTM D-470.

JACKET

6. (a) Type. The jacket shall be either a chlorosulfonated polyethylene (CSPE) or a polyvinylchloride (PVC) compound meeting the physical and electrical requirements specified herein. CSPE must meet the environmental requirements of CFR Title 40, Part 261 for leachable lead content.
- (b) Thickness. The jacket must be circular in cross-section, concentric with the insulation, must have an average thickness not less than 45 mils (.045") for #14 AWG, 80 mils (.080") for #2 and #4 AWG, and not less than 95 mils (.095") for #1/0 and #2/0 AWG, and a spot thickness not less than ninety percent (90%) of the average thickness.

- (c) Initial Physical Requirements:
 - (1) Tensile strength minimum PSI..... 1800
 - (2) Elongation at rupture, minimum percent 300
- (d) Air Oven Exposure Test. After conditioning in an air oven at $121 \pm 1^{\circ}\text{C}$ for 168 hours:
 - (1) Tensile strength, minimum percent of unaged value 75
 - (2) Elongation at rupture, minimum percent of unaged value 60
- (e) Mechanical Water Absorbtion. After 168 hours at $70 \pm 1^{\circ}\text{C}$:
 - (1) Milligrams per square inch, maximum 20

TESTING

- 7. (a) General. Tests shall be performed on insulation, jacket and completed cables in accordance with the applicable standards as listed in these specifications. Included in these tests will be a 70,000 BTU per hour flame test in accordance with IEEE 383. Where standards are at variance with each other or with other portions of this specification, the most stringent requirements, as determined by an engineer from the Division of Engineering, will apply. All tests shall be conducted on cable produced for this order.
- (b) Number of Tests. Insulation and jacket tests shall be conducted on samples taken every 5,000 feet or fraction thereof of each conductor size. In no case must less than two (2) samples be taken. Approximately five percent (5%) of the cable must be tested. Where the cable fails to conform to any of the tests specified herein, samples must be taken from each reel and must successfully conform to all tests specified herein. Reels from which samples fail to conform, will be rejected.
- (c) Test Reports. No cable may be shipped until certified copies of all factory tests have been reviewed and approved by the engineer.

PACKAGING

- 8. (a) Cable Marking. The cable must be identified by a permanently inscribed legend in white lettering as follows:

3/C - No. (conductor size) AWG-600V-90°C-EPR/CSPE or EPR/PVC-manufacturer's name- month/year of manufacture

The legend must be repeated at approximately eighteen (18) inch intervals on the outside surface of the cable parallel to the longitudinal axis of the conductor.

- (b) Reels. The completed cable shall be delivered on sound substantial, non-returnable reels. Both ends of each length of cable must be properly sealed against the entrance of moisture and other foreign matter by the use of clamp-on cable caps. The ends must be securely fastened so as not to become loose in transit. Before shipment, all reels must be wrapped with cardboard or other approved wrapping.
- (c) Footage. Each reel must contain 1,000 foot of cable for either #4 AWG or #2 AWG and 500 feet of cable for #1/0 AWG or #2/0 AWG. A tolerance limit of plus or minus ten percent ($\pm 10\%$) shall be adhered to.
- (d) Reel Marking. A metal tag must be securely attached to each reel indicating the reel number, contract number, date of shipment, gross and tare weights, description of the cable and the total footage. Directions for unrolling the cable must be placed on the reel with an approved permanent marking material such as oil-based paint or a securely attached metal tag.

TABLE 1 - THREE CONDUCTOR SERVICE ENTRANCE CABLE

Size (AWG)	Overall Diameter (mils)	No. Of Strands	Test Volts (KV)	Footage per Reel	Insulation (mils)	Jacket (mils)
4	950	7	4.5	1000	55	80
2	1100	7	4.5	1000	65	80
1/0	1400	19	5.5	500	80	95
2/0	1800	19	5.5	500	80	95

**ELECTRICAL SPECIFICATION 1458
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 4, 2014**

**ELECTRICAL MANHOLE FRAMES AND COVERS
24 INCH AND 30 INCH DIAMETER**

SCOPE

1. This specification describes the requirements for both 24 inch and 30 inch round frames and covers. These frames and covers will be used for electrical manholes and handholes and will provide access to the interior of the manholes and handholes. The 24 inch frames and covers will be used in parkway and sidewalk areas. The 30 inch frames and covers will be used in streets and in driveways and will provide sufficient strength to withstand normal traffic conditions.

GENERAL REQUIREMENTS

2. (a) Conformance. The manhole frames and covers shall conform with every detail of the requirements herein stated and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number in which the most recently published revision will govern.
- (b) Acceptance. Frames and covers not conforming to this specification will not be accepted. The Commissioner of Transportation will have the final say as to whether or not the frames and covers meet specifications.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Engineering, and must be interpreted as part of these specifications.
- (d) Sample. Upon request, one complete manhole frame and cover of the manufacture intended to be furnished must be submitted within fifteen (15) business days after receipt of such a request from the Chief Procurement Officer. The samples must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois.
- (e) Warranty. The manufacturer shall warrant that the frames and covers meet the specifications and warrant the frames and covers for a period of one (1)

year from the date of delivery against defects which may occur during that period from normal and customary use. Any frame or cover which fails during this period must be replaced by the manufacturer at no cost to the City.

DESIGN

3. (a) The frames and covers shall each conform in detail to the designs shown on Drawings 872, 874 and 10927.
- (b) Each frame and cover shall weigh approximately as shown on the drawings.
- (c) Machining. The bearing surfaces of both the cover and the frame shall be machine finished as indicated on the drawings.
- (d) Workmanship. The frames and covers must be mutually interchangeable size for size, so that each lid will fit every frame neatly without jamming and with only such clearance as the drawings indicate. In addition, 24" & 30" covers must fit existing 24" & 30" frames, as shown on drawings 872, 874 and 10927. The castings shall be neat, true to pattern and free from cracks and casting flaws. No welding of defective castings will be permitted nor must the castings be painted.
- (e) Material. The frames and covers must be made of Class 30 Cast Iron described in the specifications for Gray Iron Castings of ASTM A48. No plugging of defective castings will be permitted.

TESTS

4. (a) Test bars of the metal used for the castings shall be made and tested for tensile and transverse strength in accordance with ASTM A48. The metal must be tested at the works of the manufacturer. The manufacturer must furnish a certified copy of all test data sheets to the City prior to delivery of the castings. Frames and covers shall each be considered a separate casting for determining the requirement of testing.

**ELECTRICAL SPECIFICATION 1459
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED NOVEMBER 14, 2104**

**POLE: ANCHOR BASE, CAST ALUMINUM,
FLORENTINE DESIGN
WITH HANDHOLE ENTRY**

SUBJECT

1. This specification states the requirements for either a 14' - 0" or a 10' - 0" cast aluminum anchor base pole. The pole will support either a single tenon mounted luminaire or a twin arm bracket which will, in turn, support two (2) tenon mounted luminaires. This pole will be served by underground cables.

GENERAL

2. (a) Specifications. The pole shall conform in detail to the requirements herein stated, and to the requirements of the following organizations as cited herein:

American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Poles not conforming to this specification will not be accepted.
- (c) Sample. One complete anchor-base pole of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (d) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, being an integral part of this specification cooperating to state the necessary requirements.
- (e) Bidders Drawings. Bidders must submit with their bids scale drawings of the anchor base pole intended to be furnished. The drawings must show details of the pole design including the handhole, grounding and anchoring. Although the luminaire and the twin arm bracket are each covered by separate specifications, the drawing must include every dimension necessary to show how all parts and components will fit each other, be easily installed and maintained, and be properly held in assembly.

- (f) Interchangeability. Each member shall be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar pole.
- (g) Design. The pole must conform in design and dimensions to drawing No. 873.
- (h) Warranty. The manufacturer shall warrant the performance and construction of the light poles to meet the requirements of this Specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the light poles have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

MAST

- 3. (a) Mast Size. The mast size must be either 14' - 0" in length or 10' - 0" in length. The mast must be a single cast piece. The entire assembly shall be structurally sound so that with the weight of a twin arm and two luminaires, the mast will not twist, rack, vibrate or otherwise deform when subjected to the severe vibrations of passing elevated trains or heavily loaded vehicles.
- (b) Mast Design. The mast design shall be as shown on City of Chicago standard drawing 873.
- (c) Material. The mast must be cast aluminum in accordance with ASTM B26/B26M, Grade 319. The castings shall be neat, true to pattern and free from cracks and casting flaws. No welding or plugging of defective castings will be permitted. Each mast shall be straight and centered on its longitudinal axis.
- (d) Mast Base. The mast base shall be an integral part of the mast casting.
 - 1. For the 14' -0" mast, the base must provide for mounting on a 15" bolt circle using (4) four 1-1/4 " anchor bolts. Anchor bolts, nuts and washers shall be provided by others. For the 10' - 0" mast, the base must provide for mounting on an 8" bolt circle using (3) three 3/4" anchor bolts.
 - 2. It must provide sufficient internal clearance for two 3" conduit entries and a 3/4" ground rod.

3. It must provide an entry of sufficient height and width to allow unobstructed access to all mounting bolts, ground clamp and wires with standard lineman's tools. The entry must be located such that personnel installing or maintaining the pole will be on the sidewalk facing oncoming traffic.
 4. It must provide an entry door whose appearance and fit is in consonance with the mast and base design both aesthetically and structurally. The door must be securely fastened in place with a sufficient number of 1/4" - 20 stainless steel allen head screws which will thread into a rigid door frame.
 5. It must provide a ground lug capable of terminating from one (1) to three (3) #6 AWG copper wires. The ground lug must be welded to the inside of the base immediately adjacent to the left side of the entry.
 6. It must provide a stainless steel identification tag securely mounted to the inside of the entry door. Information on the tag must be either stamped or embossed and must include manufacturer's name; date of manufacture; outside diameter at base; outside diameter at the top; bolt circle; and material description.
- (e) With pole set in place and the door securely fastened, there shall be no exposed wires, bolts or appurtenant hardware other than the door fasteners.
- (f) Tenon. A tenon must be provided at the top of the pole for attachment of either a single luminaire or a twin arm bracket. The tenon must be a minimum 3" I.P.S. pipe equivalent and must be sufficiently long to ensure positive, structurally sound mating between the mast and the attached device. In no case must the tenon be less than three inches (3").

WELDING

4. (a) General. Where welds are required and approved, each welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode and must describe the welding methods he proposes to use in fabricating the pole.
- (b) Certification. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed.
- (c) Testing. All welds of 5% of the poles in every lot must be inspected for

penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection shall be governed by the same conditions as in Section 9 (b). If the magnetic inspection process is used, the dry method with direct current must be employed. All transverse welds must be magnetized by the “prod” (circular magnetization) method.

PAINING

5. (a) Surface Preparation. Exterior surfaces must be prepared by Solvent Cleaning per SSPC -SP1 using a solvent recommended for aluminum surfaces such as Sherwin Williams MEK #R6K10. Solvent shall be used as per written instructions of the manufacturer to remove all oil, grease, dirt, and contaminants.
- (b) Primer Type. Within one hour of surface preparation, surfaces must be primed using a primer specifically recommended for aluminum surfaces and must be equivalent to Sherwin Williams Industrial Wash Primer #P60G2.
- (c) Primer Application.
 1. Aluminum surface temperature must be at least 60° F. and relative humidity must be less than 80% at time of primer application.
 2. After primer is thoroughly mixed, a minimum wet thickness must be applied to provide a 2 mil dry thickness.
 3. Primer must dry for a minimum of 24 hours after which a second primer coat must be applied.
 4. The second primer coat must dry for a minimum of 24 hours before the finish coat is applied.
- (d) Interior Primer. Interior surfaces must be cleaned as well as possible and given one coat of primer using a wand applicator where brushes or spray guns will not reach.
- (e) Finish Coat. Finish coat must be a polyurethane enamel specifically recommended for use over a primed aluminum surface.
 1. Pole must be painted in accordance with manufacturer’s written instructions.
 2. Two (2) coats of finish must be applied.
 3. Each coat must be a minimum of 1.5 mils dry thickness.

4. Color will be specified after bid award and color samples must be approved by the Commissioner.
- (f) Field Touch-up. The contractor shall supply a field touch-up kit for every twenty (20) poles or fraction thereof. The kit shall consist of a highly legible instruction sheet, one gallon of the recommended touch-up paint and all other materials required to touch-up twenty (20) light poles.
- (g) Alternate painting methods will be considered where the contractor can demonstrate to the satisfaction of the Commissioner that these methods have been in successful use for a five (5) year minimum period.

TESTING

6. (a) General. All completed masts shall be available for testing. Unless specifically authorized in writing, all tests must be at the works of the manufacturer. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the poles are shipped.
- (b) Requirements. The following tests must be included in the testing procedure:
 1. Bar tests as outlined in ASTM B26/B26M.
 2. With the mast base rigidly secured using the normal mast mountings, a 500 pound force must be incrementally applied, perpendicular to the mast, to an area approximately 4"x4" and 5' above the base. This force must then be applied a second time at approximately the same location. The mast must then be checked to insure that the mast is still securely fastened, that it is plumb, and that no cracks have developed in either the mast or base.
 3. Weld tests as described in welding section.
- (c) Acceptance. Tests must be made on 5% of all masts. If any of the masts fail to meet these tests, an additional three (3) masts must be tested for each failed mast. Should any of these additional masts fail to meet these test requirements, the entire lot will be subject to rejection. The Commissioner will decide, based on the nature of the failure, whether the entire lot will be rejected or whether the manufacturer may subject each mast to testing.

PACKAGING

7. (a) General. The poles shall be shipped in bundles weighing a maximum of 5,000 pounds. Each pole must be individually protected so that it can be bundled and unbundled without damage to the pole or its finish. Where poles

are delivered wrapped, specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of poles. All instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years.

- (b) Bundles. The bundles shall consist of poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling material shall be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two (2) high without breaking or shifting of the contents. Each bundle shall be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (c) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the pole must be carefully wrapped and securely attached to each bundle. Payment will be withheld for any bundle delivered without the appurtenant devices and hardware. Cracked, broken, chipped or damaged parts will be considered as an incomplete delivery as regards payment.
- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for twenty (20) poles. These units will be securely attached to a sufficient number of bundles to fulfill the touch-up paint requirements stated herein.

**ELECTRICAL SPECIFICATION 1460
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED NOVEMBER 14, 2014**

**MAST ARM: TWIN 36" ALUMINUM, FOR MOUNTING
TWO ACORN LUMINAIRES ON
AN ALUMINUM FLORENTINE STYLE LIGHT POLE**

SUBJECT

1. This specification states the requirements for a 36" aluminum twin mast arm for supporting two acorn luminaires on an aluminum Florentine style light pole.

GENERAL

2. (a) Specifications. The mast arms shall conform in detail to the requirements herein stated and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM designation number of which the most recently published revision will govern.
- (b) Acceptance. Mast arms not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation. They are integral parts of this specification cooperating to state necessary requirements.
- (d) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the mast arms and attachments proposed as the means for attaching these mast arms to poles. The drawings must give every dimension necessary to show how the parts will fit each other and be properly held in assembly.
- (e) Sample. One complete mast arm of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (f) Warranty. The manufacturer shall warrant the performance and construction of the arms to meet the requirements of this Specification and must warrant all parts, components, and appurtenances against defects due to design,

workmanship, or material developing within a period of five years after the arms have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

DESIGN

3. (a) Each 36" twin mast arm must be cast aluminum conforming to ASTM B26/B26M, Grade 319.
- (b) It shall conform in detail with the twin mast arm shown on drawing 873.
- (c) Castings shall have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited.
- (d) Mast arms must be straight and true along both the longitudinal and vertical axis so that it will provide a perfect, parallel vertical mounting for the two luminaires.
- (e) Mast arms shall be structurally rigid so that when mounted on a mast, fitted with the capitals and luminaires shown on drawing 873, and carrying two 4'x14" banners with each top securely fastened to one side of the mast arm, and each bottom securely fastened to the mast, neither an 80 m.p.h. AASHTO wind load, the vibration of a passing elevated train nor, the vibration of a heavily loaded vehicle will cause any twisting, racking or bouncing of the arm assembly in either the vertical or the horizontal plane.
- (f) The mast arm attachment to the mast shall provide the structural integrity to hold the mast arm firmly in place during the loading and vibration described above. Where set screws are used to secure the mast arm to the mast, a minimum of 3/16" thickness of metal must be provided where the set screws are inserted to minimize the possibility of stripping the threads when the set screws are tightened into place. The set screws must be 1/4"x20 stainless steel Allen Head screws and a minimum of four set screws must be provided.
- (g) The mast arm shall have a removable cap above the mast tenon to facilitate wiring from the fixture to the mast handhole. The cap must be securely held in place with a minimum of two 1/4-20 stainless steel Allen Head set screws in a minimum of 3/16" thickness of metal. The arm must be provided with a "J" hook close to the cap opening to support the luminaire wiring so that rubbing on the interior raceway will be minimized.

- (h) The interior of the mast arm shall provide a smooth, burr-free raceway for the luminaire wiring.

WELDING

- 4. (a) General. It is preferred that the mast arms are cast as a single unit. Where the contractor proposes to provide separate castings which are welded together, the contractor must provide detailed drawings and a sample for the review and written approval of the Commissioner. Appearance will be a major factor in the approval process.
- (b) Standards. Every weld shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings. Additionally, each bidder must submit with his proposal drawing, the sizes and types of welds, must state the type of electrode, and must describe the welding methods he proposes to employ in fabricating the mast arm.
- (c) Certification. All welds must be made by personnel who are certified for that type of welding. Welding by non-certified personnel will not be allowed.
- (d) All welds must be inspected for penetration, soundness and appearance by means of radiography.

PAINTING

- 5. (a) Surface Preparation. Exterior surfaces must be prepared by "Solvent Cleaning" per SSPC-SP1 using a solvent recommended for aluminum surfaces such as "Sherwin Williams MEK #R6K10." Solvent shall be used as per written instructions of manufacturer to remove all oil, grease, dirt and contaminants.
- (b) Primer Type. Within one hour of surface preparation, surfaces must be primed using a primer specifically recommended for aluminum surfaces such as "Sherwin Williams Industrial Wash Primer #P60G2."
- (c) Primer Application. Primer must be applied in accordance with written instructions of a manufacturer to produce a dry thickness film of 0.2 to 0.4 mils. Primer must dry for a minimum of 30 minutes and a maximum of 60 minutes before application of finish coat.
- (d) Finish Coat. Finish coat must be a polyurethane enamel specifically recommended for use over a primed aluminum surface.
 - 1. Mast arm must be painted in accordance with manufacturer=s written

instructions.

2. Two (2) coats of finish must be applied.
 3. Each coat must be a minimum of 1.5. mils dry thickness.
 4. Color will be specified after bid award and color samples shall be approved by the Commissioner.
- (e) Field Touch-up. The contractor must supply a field touch-up kit for every twenty (20) mast arms or fraction thereof. The kit must consist of a highly legible instruction sheet, one gallon of the recommended touch-up paint and all other material required to touch-up twenty (20) mast arms.
- (f) Alternate painting methods will be considered where the contractor can demonstrate to the satisfaction of the Commissioner that these methods have been in successful use for a five (5) year minimum period.

TESTING

6. (a) General. All completed mast arms shall be available for testing. Unless specifically authorized in writing, all tests must be at the works of the manufacturer. A record of every test must be made and a certified copy of the test record must be submitted to the Engineer of Electricity before the poles are shipped.
- (b) Requirements. The following tests must be included in the testing procedure:
1. Bar tests as outlined in ASTM B26/B26M.
 2. With the mast arm rigidly secured to a tenon equivalent to that of the pole using the normal mast arm mounting provision, a 300# test load must be applied perpendicular to one end of the mast arm in the vertical plane for approximately sixty seconds. The test must then be repeated on the other end of the mast arm.
 3. Using a clamp and a three-foot arm, the 300# test load must be applied to one end of the mast arm to create a twisting moment on the arm for approximately sixty seconds. The test must then be repeated on the other end of the mast arm.
 4. The 300# test load must then be applied perpendicular to one end of the mast arm in the horizontal plane for approximately sixty seconds. The test must then be repeated on the other end of the mast arm.

5. The mast arm mounting must not be adjusted or retightened during any of the above testing procedures.
 6. During the tests, the mast arm must not rack, twist, bend or deform in any manner using measurement criteria and tolerances which will be mutually agreed upon by the contractor and the Commissioner prior to testing. They must be based on normal testing procedures and the physical properties of the material.
 7. At the completion of the tests, the mast arm must be in precisely the same position it was in at the start of testing and must not be structurally or visibly deformed in any manner whatsoever. Where welds are used in the manufacture of the arms, they must be subjected to testing by means of radiography to insure that they have not been compromised.
- (c) Acceptance. Tests must be made on five percent of all the mast arms. If any of the mast arms fail to meet these tests, an additional three (3) mast arms must be tested for each failed mast arm. Should any of these additional mast arms fail to meet these test requirements, the entire lot will be subject to rejection. The Commissioner will then decide, based on the nature of the failures whether the entire lot will be rejected outright or whether the manufacturer may subject each mast arm to testing and those mast arms which fulfill the requirements will be accepted.

PACKAGING

7. (a) General. The mast arms shall be shipped in bundles of 20 mast arms. Each mast arm must be individually protected so that it can be bundled and unbundled without damage to the mast arm or its finish. Where mast arms are delivered wrapped, specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and installation of mast arms. All instructions must be printed on a fiber-based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of five (5) years.
- (b) Bundles. Bundles shall be arranged to form an approximately rectangular cylinder. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling materials shall be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting of contents or breaking. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable

of being stacked two (2) high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.

- (c) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the pole shall be carefully wrapped and securely attached to each bundle. Payment will be withheld for any bundle delivered without the appurtenant devices and hardware. Cracked, broken chipped or damaged parts will be considered as an incomplete delivery as regards payment.
- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for 20 mast arms. These units will be securely attached to each bundle.

**ELECTRICAL SPECIFICATION 1462
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED NOVEMBER 21, 2014**

**RIGID STEEL CONDUIT
(HOT DIPPED GALVANIZED)**

SCOPE

1. This specification describes rigid steel conduit, zinc coated. This specification also describes rigid steel conduit that is both zinc and PVC coated. The conduit will be used underground or on structure as a raceway for electrical cables.

GENERAL REQUIREMENTS

2.
 - (a) Rigid steel conduit must be zinc coated by the hot-dip process. Conduit must be furnished in 10 foot lengths, threaded on each end and with one coupling attached to one end and a protective cap at the other end.
 - (b) The conduit shall be manufactured according to Underwriters Laboratories Standard U.L. - 6 and must meet ANSI Standard C 80.1 and the requirements of NEC Article 344. In addition, conduit must be recognized as an equipment grounding conductor as per NEC Article 250. There will be no exceptions to meeting these standards.
 - (c) Acceptance. Conduit not conforming to this specification will be rejected. The Commissioner will be the final judge in determining if the conduit meets the specification.
 - (d) Sample. If requested by the Chief Procurement Officer, a sample of conduit must be submitted to the Engineer of Electricity within fifteen (15) business days of receipt of such a request.
 - (e) Warranty. The manufacturer shall warrant the construction and performance of the conduit to meet the requirements of this specification and shall warrant all parts and components against defects due to design, workmanship, or material developing within a period of one (1) year after the conduit has been delivered.

STEEL

3. Conduit shall be formed from steel suitable for use as an electrical raceway. It shall be structurally sound so that it will hang straight and true when supported by hangers in accordance with Chicago electrical code requirements and shall be capable of being field bent without deformation of the walls.

Conduit shall have a circular cross section sufficiently accurate to permit the cutting of threads in accordance with Table 2 and shall provide a uniform wall thickness throughout. All surfaces shall be smooth and free of injurious defects. The dimensions and weights of rigid steel conduit must be in accordance with Table 1.

THREADING AND CHAMFERING

4. Each length of conduit, and each nipple, elbow and bend must be threaded on both ends, and each end must be chamfered to remove burrs and sharp edges.

The number of threads per inch, and the length of the threaded portion at each end of each length of conduit, nipple and elbow must be as indicated in Table 2. The perfect thread must be tapered for its entire length, and the taper must be 3/4 inch per foot.

ZINC COATING

5. After all cutting, threading, and chamfering all conduit surfaces shall be thoroughly cleaned before application of zinc. The cleaning process shall leave the interior and exterior surfaces of the conduit in such a condition that the zinc will be firmly adherent and smooth.

The conduit must be hot dipped galvanized both inside and out to provide approximately two (2) ounces of zinc per square foot. This is equivalent to 3.4 mils of zinc coating. An additional interior coating to aid in the installation of wires is required.

COUPLINGS

6. (a) The outside surface of couplings shall be protected by means of a zinc coating. The zinc content of the coating on the outside surface must be equivalent to a minimum thickness of 3.4 mils.
- (b) Couplings shall be so made that all threads will be covered when the coupling is pulled tight on standard conduit threads.
- (c) Both ends of the coupling must be chamfered to prevent damage to the

starting threads.

- (d) The outside diameter, length and weight of coupling must be as indicated in Table 3.
- (e) Couplings must be straight tapped, except that the 2 1/2 inch and larger sizes may be taper-tapped.

PVC COATED (WHEN SPECIFIED)

- 7.
 - (a) Only hot dipped galvanized conduit, couplings, and fittings may be polyvinylchloride (PVC) coated.
 - (b) All conduit, couplings, and fittings must be cleaned before being coated.
 - (c) All conduit, couplings, and fittings must have a PVC coating applied to the exterior by dipping in liquid plastisol. The coating thickness must be a nominal 40 mils.
 - (d) All coated conduit, couplings, and fittings must conform to the requirements of NEMA Standard RN1- Section 3, "External Coatings". The latest revision will apply.

PACKING AND IDENTIFICATION

- 8. The pipe shall be delivered in bundles. Each length of conduit must be marked with the manufacturer's name or trademark. Securely attached to each bundle at two (2) locations on the bundle must be a weather resistant tag containing the following information:
 - a. conduit size
 - b. footage of bundle
 - c. gross weight of bundle
 - d. manufacturer's name

Precaution will be taken by the contractor in handling during shipment or delivery of conduit, and any conduit found to be damaged will not be accepted.

TEST AND INSPECTION

- 9. Galvanized rigid conduit must be capable of being bent cold into a quarter of a circle around a mandrel, the radius of which is four times the nominal size of the conduit, without developing cracks at any portion and without opening the weld.

The protective coatings used on the outside and inside surfaces of rigid steel conduit must be sufficiently elastic to prevent their cracking or flaking off when a finished sample of 2 inch conduit is tested within one year after the time of manufacture, by bending it into a half of a circle around a mandrel, the radius of which is 3 1/2 inches.

Tests on sizes other than 1/2 inch may be conducted within one year after the time of manufacture. If such tests are conducted, the conduit must be bent into a quarter of a circle around a mandrel, the radius of which is six times the nominal size of the conduit.

One of the following three test methods shall be employed for measuring the thickness or extent of the external zinc coating on conduit:

- (a) Magnetic test.
- (b) Dropping test.
- (c) Preece test (Material which will withstand four 1-minute immersions will be considered as meeting requirements as follows; the zinc content of the coating on the outside surface must be equivalent to a minimum thickness of 3.4 mils).

All tests and inspections must be made at the place of manufacture prior to shipment unless otherwise specified, and shall be so conducted as not to interfere with normal manufacturing processes.

Each length of conduit shall be examined visually both on the outside and inside to determine if the product is free from slivers, burrs, scale or other similar injurious defects (or a combination thereof), and if coverage of the coating is complete.

If any samples of rigid steel conduit tested as prescribed in this specification should fail, two additional samples must be tested, both of which must comply with the requirements of the specification.

All pipe which may develop any defect under tests, or which may before testing or on delivery be found defective, or not in accordance with these specifications, must be removed by the Contractor at his own expense; and such pipe so removed by the Contractor must be replaced by him within ten (10) days of such rejection with other pipe which will conform to these specifications.

TABLE 1

Design Dimension and Weights of Rigid Steel Conduit

Nominal or Trade Size of Conduit	Inside Diameter	Outside Diameter	Wall Thickness	Length Without Coupling	Minimum Weight of Ten Unit Length w/couplings
(Inches)	(Inches)	(Inches)	(Inches)	(Feet/Inches)	(Pounds)
1/2	0.622	0.840	0.109	9-11 1/4	79.00
3/4	0.824	1.050	0.113	9-11 1/4	105.0
1	1.049	1.315	0.133	9-11	153.0
1 1/4	1.380	1.660	0.140	9-11	201.0
1 1/2	1.610	1.900	0.145	9-11	249.0
2	2.067	2.375	0.154	9-11	334.0
2 1/2	2.469	2.875	0.203	9-10 1/2	527.0
3	3.068	3.500	0.216	9-10 1/2	690.0
3 1/2	3.548	4.000	0.226	9-10 1/4	831.0
4	4.026	4.500	0.237	9-10 1/4	982.0

NOTE: The applicable tolerances are:

Length: + 1/4 inch (without coupling)

Outside diameter: + 1/64 inch or -1/32 inch for the 1 1/2 inch and smaller sizes,
± 1 % for the 2 inch and larger sizes.

Wall thickness: - 12 1/2 %

TABLE 2**Dimensions of Threads**

Nominal or Trade Size of Conduit (Inches)	Threads per Inch	Pitch Diameter at end of Thread (Inches) Tapered 3/4 Inch per foot	Length of Thread (Inches)	
			Effective L2	Overall L4
1/2	14	0.7584	0.53	0.78
3/4	14	0.9677	0.55	0.79
1	11 1/2	1.2136	0.68	0.98
1 1/4	11 1/2	1.5571	0.71	1.01
1 1/2	11 1/2	1.7961	0.72	1.03
2	11 1/2	2.2690	0.76	1.06
2 1/2	8	2.7195	1.14	1.57
3	8	3.3406	1.20	1.63
3 1/2	8	3.8375	1.25	1.68
4	8	4.3344	1.30	1.73

NOTE: The applicable tolerances are:

Threaded Length (L4 Col 5): Plus or minus one thread

Pitch Diameter (Col 3): Plus or minus one turn is the maximum variation permitted from the gaging face of the working thread gages. This is equivalent to plus or minus one and one half turns from basic dimensions, since a variation of plus or minus one half turn from basic dimensions is permitted in working gages.

TABLE 3

Designed Dimensions and Weights of Couplings

Nominal or Trade Size of Conduit <u>(INCHES)</u>	Outside Diameter <u>(INCHES)</u>	Minimum Length <u>(INCHES)</u>	Minimum Weight <u>(POUNDS)</u>
1/2	1.010	1-9/16	0.115
3/4	1.250	1-5/8	0.170
1	1.525	2	0.300
1 1/4	1.869	2-1/16	0.370
1 1/2	2.155	2-1/16	0.515
2	2.650	2 1/8	0.671
2 1/2	3.250	3-1/8	1.675
3	3.870	3-1/4	2.085
3 1/2	4.500	3-3/8	2.400
4	4.875	3-1/2	2.839

**ELECTRICAL SPECIFICATION 1463
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 7, 2014**

**TRAFFIC SIGNAL MOUNTING BRACKETS FOR
MONOTUBE ARMS**

SUBJECT

1. This specification states the requirements for mounting brackets which will be used to secure traffic signals and illuminated signs to steel monotube mast arms.

GENERAL

2. (a) Specifications. The mounting brackets shall conform in detail to the requirements herein stated and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation number of which the most recently published revision will govern.
- (b) Acceptance. Mounting brackets not conforming to these specifications will not be accepted.
- (c) Sample. If requested by the Chief Procurement Officer, one complete mounting bracket must be submitted within 15 business days upon receipt of such a request. It must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (d) Warranty. Bracket must have a minimum 3 year warranty. The warranty must cover the material and workmanship. Any structural flaws or inability to maintain alignment will be deemed a failure and result in the warranty being invoked. The manufacturer will supply a new bracket for each failed bracket, at no cost to the City. The warranty will start from the date of delivery [date of acceptance for contract construction].

DESIGN

3. (a) General. The mounting bracket shall be designed such that no portion of the bracket is put into tension when it is attached to the mast arm with banding. The signal support tube will be attached to the bracket using compression type attachments. All materials must be corrosion resistant and designed to

be structurally sound. The signal support tube will be a slotted aluminum pipe of sufficient length to hold either 3, 4, or 5 section signal heads, or an illuminated sign. The slot must have a neoprene gasket to protect the cable. There must also be top and bottom brackets that hold the signal head assembly at each end to the tube. The bottom bracket will also be used as a cable runway.

- (b) Hardware. All components of the mounting brackets must be held firmly in place with stainless steel hardware.
- (c) Adjustments. Bracket shall allow for mounting and adjustment of signal faces in any direction desired on a fixed mast arm. Adjustments shall be made using standard hand tools. Neither mounting nor adjusting the bracket should require the use of a torque wrench.
- (d) Signal Mounting. Mounting hardware shall be available for use with standard 2, 3, and 5 signal head configurations; for use with optically programmed signal heads; and for use with illuminated signs.
- (e) Wiring. Bracket design shall allow for ease of installation of components and wiring. All wiring troughs and nipples must provide smooth, burr-free surfaces and adequate space for facile movement of nominal .5 inch diameter cable between the mast arm and the signal face.
- (f) Banding. Where banding is used to attach the mounting bracket to the mast arm, the banding must be .75 inch wide stainless steel.
- (g) Castings. Where castings are used for the brackets, they shall be smooth and free of defects.

TESTING

- 4. (a) General. At least 1% of the traffic signal mounting brackets in each order or contract shall be tested for rigidity and structural integrity.
- (b) Re-testing. If any mounting bracket fails any portion of the test, an additional 3% of the brackets must be tested. If an additional bracket fails, the entire lot will be rejected.
- (c) Tests.
 - 1. With five 12" signal head sections attached to the bracket, the assembly shall be mounted to a suitable and proper supporting structure.
 - 2. Using a calibrated dynamometer, a 100 pound force must be applied

for 60 seconds at the center of the bracket in the horizontal plane. At the completion of the test, there must be no movement of the assembly or deterioration of the bracket or appurtenant hardware.

3. Using a calibrated dynamometer, a 100 pound force must be applied to the top signal head section for 60 seconds in a direction which will pull the head away from the mounting post in the mounting post plane. During this time period, the mounting bracket castings must be struck 10 times with an 8 ounce flat head hammer at the point(s) which appear to be most vulnerable to stress. At the completion of the test, no movement of the assembly must have been observed and there must be no cracking of the castings or deterioration of the appurtenant hardware.
4. The above test must be repeated except that the force must be applied in a plane which is perpendicular to the mounting post plane.

PACKAGING

5. (a) Packing. Each bracket shall be packed in a suitable carton so secured that the bracket and parts will not be damaged during shipment, handling or storage.
- (b) Marking. Each carton containing the bracket and parts shall be clearly marked on the outside in letters not less than 3/8 inches tall with the legend: "TRAFFIC SIGNAL MONOTUBE BRACKET", the name of the manufacturer, the date of manufacture, the contract number, and the City commodity code.

**ELECTRICAL SPECIFICATION 1465
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JULY 12, 2006**

GROUND RODS

SUBJECT

1. This specification states requirements for ground rods and clamps to be used for ground electrodes in street lighting, traffic signal, and miscellaneous electrical circuits.

GENERAL

2. (a) Ground rods must be copper clad, steel rods suitable for driving into the ground without deformation of the rod or scoring, separation or other deterioration of the copper cladding.
- (b) Sample. If requested by the Chief Procurement Officer, the contractor must furnish one sample of the ground rod proposed to be furnished within fifteen (15) business days from receipt of such request. The sample ground rod must be delivered to the Division of Electrical Operations, 2451 S. Ashland Avenue, Chicago, Illinois 60608.
- (c) Warranty. The manufacturer shall warrant every ground rod against defects due to design, workmanship, or material developing within a period of one (1) year after the ground rod has been accepted. Any ground rod which fails during this period must be replaced by the contractor without expense to the City. The Commissioner of Transportation or his duly authorized representative will be the sole judge in determining which replacements are to be made.
- (d) The Commissioner will be the sole judge in determining whether the submitted ground rods meet the requirements of this specification. Ground rods not accepted must be removed at the sole expense of the contractor.

DESIGN

3. (a) The ground rods and couplings must meet the latest requirements of (National Electrical Manufacturer's Association) NEMA Standard GR-1, for copper bonded ground rod electrodes and couplings. The ground rods must also meet the requirements of (Underwriter's Laboratories) UL 467.
- (b) Ground rods shall be made of steel core suitable for driving into the earth without deformation.
- (c) A uniform covering of electrolytic copper, 10 mils in thickness, shall be metallically bonded to the steel core to provide a corrosion resistant, inseparable bond between the steel core and the copper overlay.
- (d) The finished rod must be of uniform cross-section; straight, and free of nicks, cuts or protuberances.
- (e) The rod must be pointed at one end and chamfered at the other.
- (f) All ground rods must be three-quarter inches (3/4") in diameter. The length shall be as specified in the order or in the plans. The length and diameter of the rod and the manufacturer must be clearly and permanently marked near the top of the rod (chamfered end).
- (g) All ground rods must have a ground clamp capable of accommodating a No. 6 AWG Copper Wire.

PACKING

4. (a) Ground rods must be packed in bundles with reinforced tape or plastic banding that will not damage the rods. Small bundles may then be bound in larger bundles held together with steel banding.
- (b) Ground clamps must be packed in a suitable carton. The carton must be labeled to indicate the contents.

**SPECIFICATION 1467
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JUNE 28, 2012**

ROD: ANCHOR, STEEL, WITH HARDWARE

SUBJECT

1. This specification states the requirements for steel anchor rods with hardware for street light pole foundations.

GENERAL

2. (a) Specifications. The anchor rods shall conform in detail to the requirements herein stated, and to the specifications of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (b) Drawing. The drawings mentioned herein are issued by the Department of Transportation, Division of Engineering, and are an integral part of this specification.

ANCHOR ROD

3. (a) Fabrication. Each anchor rod must be fabricated in conformity with City of Chicago drawings numbered 806, 811, 830 and 844.
- (b) Material. The rods must be fabricated from cold rolled carbon steel bar meeting the requirements of ASTM Specification A-36, except that the Specification must be modified to provide a minimum yield point of 55,000 psi (379 MPa).
- (c) Thread. The straight end of each rod must be threaded as shown on City of Chicago drawing for that size rod, and must be American Standard, National Coarse.

HARDWARE

4. Hardware furnished with the anchor rod shall be as shown on the applicable drawing. It must include two (2) hexagonal nuts, American Standard Regular, two (2) flat washers, type B, series W, and one (1) lock washer, steel, helical spring. The nuts must have a Class 2 or 3 fit.

FINISH

5. Galvanizing. The threaded end of each rod must be hot dipped galvanized for the distance shown on the applicable drawing. The thickness of the galvanized coating must not be less than 0.0021 inches. Each hexagonal nut and washer must be galvanized to the minimum thickness required by ASTM A-153, Class C, or ASTM B-454, Class 50. After galvanization, each anchor rod and nut must have a mating fit equivalent to the American Standard Class 2 or 3 fit for nuts and bolts.

TESTS

6. At the discretion of the Commissioner, anchor rods and hardware furnished under this specification will be subject to testing to determine compliance with the materials physical requirements.

INSPECTION

7. Final inspection must be made at point of delivery. Any anchor rods and hardware rejected must be removed by the Contractor at his sole expense.

**ELECTRICAL SPECIFICATION 1473
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 12, 2010**

**POLE MOUNTED CAST ALUMINUM BOX FOR MAIN
SERVICE DISCONNECT**

SCOPE

1. This specification states the requirements for a pole mounted, cast aluminum box intended for outdoor use on the City's Street Light and/or Traffic Control Systems as a main service disconnect. The box will be mounted on a Commonwealth Edison pole and will feed a separately mounted street light controller or traffic signal controller.

GENERAL

2. (a) Specification. The junction box shall conform in detail to the requirements stated herein, and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revisions will govern.
- (b) Drawing. The drawing mentioned herein is a drawing of the Department of Transportation, Division of Engineering, and must be interpreted as part of these specifications.
- (c) Acceptance. Junction boxes not conforming to this specification will not be accepted.
- (d) Sample. One complete junction box of the manufacture intended to be furnished, must be submitted within fifteen (15) business days after receipt of a request from the Chief Procurement Officer.

DESIGN

3. (a) Drawing. The junction box must conform in detail to the dimensions and requirements shown on Standard Drawing Number 893.
- (b) Material. The body and door must be castings of non-heat-treated aluminum silicon alloy conforming to ANSI alloy 443.0 of ASTM B26.

- (c) Assembly. Each junction box must consist of the body, door, gaskets, bronze eye-head bolts, bronze wing nuts and stainless-steel knurled pins furnished as described below, all completely assembled, painted and ready for installation.
- (d) Body. The body must be cast as shown in Drawing Number 893. The body must be complete with all drilled and tapped holes required for the mounting of any hardware required to make the box fully functional for a service disconnect.
- (e) Door. The door must be cast as in Drawing Number 893. The door must be furnished with a 1/2" x 3/16" sponge neoprene gasket cemented in place completely around the door jam. The door must be painted prior to cementing the gasket into its groove on the door.
- (f) Hardware. The hinge pins must be stainless steel. The eye-head bolts and wing nuts must be bronze.
- (g) Painting. The exterior surfaces of the junction box must be properly cleaned and given one (1) coat of an approved zinc chromate primer containing a minimum of ten percent (10%) iron oxide, and one (1) coat of black enamel. The paint must be approved prior to production.
- (h) Packing. Assembled junction boxes shall be suitably packed to prevent damage to painted surfaces during shipping and handling. All shipments must be fastened to and shipped on 48" x 48" hardwood, 4-way, non-returnable pallets. Total height must not exceed 64" and total weight must not exceed 2,000 pounds.

**ELECTRICAL SPECIFICATION 1475
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED SEPTEMBER 26, 2006**

CORD: TRAFFIC SIGNAL, EIGHT CONDUCTOR NO. 16 AWG, 600 VOLT

SUBJECT

1. This specification states the requirements for an eight (8) conductor number 16 AWG, electrical cable, to be installed in poles and conduit and used to electrically energize traffic signal faces at street intersections within the City of Chicago. The cable shall be flame retardant, have low acid gas content, good resistance to oil, moisture and mechanical abuse, and exhibit excellent heat aging and electrical characteristics.

GENERAL

2. (a) Specifications. The cable shall conform in detail to the requirements herein stated, and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number, the Underwriters Laboratories, Inc. Standard or Style number and any other recognized standardization group=s specifications referred to by the appropriate designation, of which the most recently published revision will govern.
- (b) Acceptance. Cable not conforming to this specification will not be accepted.
- (c) Warranty. The manufacturer shall warrant the cable to be first class material throughout. In addition to any other claims against them, if the cable is installed within six months of date of shipment, the manufacturer must replace any cable failing during normal and proper use within two years of date of installation. All replacements under this warranty must be made free of charge F.O.B. delivery point of the original contract.
- (d) Sample. If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be provided under this specification must be submitted to the attention of the Engineer of Electricity within fifteen (15) business days after receipt of such request.

CABLE

3. (a) Construction. This cable shall consist of stranded, coated, conductors each concentrically encased with a "free stripping," ethylene propylene rubber insulation. Suitable fillers shall be used to produce an essentially round cross-section. The insulated conductors and the fillers must be cabled with a suitable left-hand lay as close together as is consistent with forming a core of minimum diameter. A Mylar tape must be wrapped over the conductor assembly, and a jacket applied overall.
- (b) Outer Diameter. The maximum allowable outer diameter must be one-half (0.50) inch.
- (c) Sealing. Both ends of each length of cable must be thoroughly sealed to prevent the entrance of moisture or other foreign matter.

MARKING

4. (a) Conductors. Identification must be provided by colors in accordance with I.M.S.A. Standards.
- (b) Jacket. The outer jacket must be marked as follows: "8/C 16 AWG 600V 90°C LSZH, name of manufacturer and date of manufacture. The height of letters must not be less than 1/8 inch in height and the message must repeat at approximately two (2) foot intervals. A sequential footage marking must be located on the opposite side of the jacket. All marking must be perfectly legible with permanent white ink.

CONDUCTOR

5. (a) Material. Round, Soft or annealed, stranded copper wire in accordance with ASTM B-3 and B-8, and coated in accordance with ASTM B33 (tin coated) must be furnished.
- (b) Size. The stranded conductor must consist of stranded wires twisted with an appropriate lay to form a No. 16 AWG conductor with an approximate diameter of 0.048 inches.

INSULATION

6. (a) Type. The insulation must be an easily strippable low smoke zero halogen (LSZH) thermosetting polyolefin compound or ethylene propylene rubber (EPR), or equal meeting or exceeding the requirements of ICEA S-95-658 and the additional requirements of this specification.

- (b) Rating. The insulation must be rated for continuous duty at 90°C in accordance with U.L. AWM Style 3400.
- (c) Thickness. The insulated conductor must be circular in cross-section, concentric to the conductor, with a nominal insulation thickness of 0.031 inches (2/64") and a minimum spot thickness of 90% of the nominal thickness.
- (d) Initial Physical Requirements:
- | | |
|----------------------------------|-------|
| 1. Tensile strength, min., PSI | 1,600 |
| 2. Elongation at rupture, min. % | 250 |
- (e) Air Oven Exposure Test. After conditioning in an air oven at $158 \pm 1^\circ\text{C}$ for 168 hours using methods of test described in ASTM-D 573:
- | | |
|--|-----|
| Tensile strength, minimum percent of unaged value | .85 |
| Elongation at rupture, minimum percent of unaged value | .65 |
- (f) Mechanical Water Absorption:
- Gravimetric Method. After 168 hours in water at $70 \pm 1^\circ\text{C}$:

Water absorption, maximum, milligrams per square inch5.0
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- (g) Cold Bend Test Requirements. The completed cable must pass the "Cold-Bend," Long-Time Voltage Test on Short Specimens of ASTM D-470 except that the test temperature must be minus (-) 25°C.
- (h) Electrical Requirements:
- Voltage Test. The completed cable must meet an A.C. and D.C. voltage test in accordance with ASTM D-470 and D-2655.
 - Insulation Resistance. The completed cable must have an insulation resistance constant of not less than 20,000 when tested in accordance with methods shown in ASTM D-470.
- (i) Flexibility Tests. A sample length of insulated conductor must be formed in a loose coil, placed in a circulating air oven, and aged for 168 hours at $158^\circ\text{C} \pm 1^\circ\text{C}$. The sample must then be allowed to cool to room temperature for one (1) hour and tightly wrapped around a 3X metal mandrel. The sample must show no cracks and must pass the same voltage test specified for the "Cold-Bend Test."

JACKET

7. (a) Type. The jacket must be a thermosetting low smoke zero halogen (LSZH) polyolefin compound or chlorinated polyethylene (CPE), or equal meeting the physical and electrical requirements specified herein.
- (b) Rating. The jacket must be rated for continuous duty at 90° C.
- (c) Thickness. The jacket must be circular in cross-section, concentric with the insulation, must have an average thickness not less than 45 mils and a spot thickness not less than ninety percent (90%) of the average thickness.
- (d) Initial Physical Requirements:
- | | | |
|----|--|------|
| 1. | Tensile strength minimum PSI | 1800 |
| 2. | Elongation at rupture, minimum percent | 300 |
- (e) Air Oven Exposure Test. After conditioning in an air oven at $121 \pm 1^\circ\text{C}$ for 168 hours for LSZH or $136 \pm 1^\circ\text{C}$ for CPE:
- | | | |
|----|---|----|
| 1. | Tensile strength, minimum percent of unused value | 75 |
| 2. | Elongation at rupture, minimum percent of unaged valued | 55 |
- (f) Mechanical Water Absorption. After 168 hours at $70 \pm 1^\circ\text{C}$:
- | | | |
|----|-------------------------------------|----|
| 1. | Milligrams per square inch, maximum | 20 |
|----|-------------------------------------|----|

TESTING

8. (a) General. Tests shall be performed on insulation, jacket and completed cables in accordance with applicable standards as listed in this specification. Where standards are at variance with each other or with other portions of this specification, the most stringent requirements, as determined by the Engineer of Electricity will apply.

All tests must be conducted on cable produced for this order. Where cable insulation and/or jacket thickness preclude obtaining samples of sufficient size for testing, special arrangements must be made with the engineer to obtain samples of unprocessed materials directly from the extrusion feed bins which will be separately processed and prepared for tests.

- (b) Number of Tests. Insulation and jacket tests must be conducted on samples taken every 25,000 feet or fraction thereof of each conductor size. In no case must samples be taken closer than 15,000 feet apart.
- (c) Test Reports. No cable shall be shipped until certified copies of all factory tests have been reviewed and approved by the engineer.
- (d) Acceptance. Samples shall be taken from each reel and must successfully conform to all tests specified herein. Reels from which samples fail to conform, will be rejected.

PACKAGING

- 9. (a) Reels. The completed cord shall be delivered on sound, substantial reels. The ends of the cable must be securely fastened so that they will not become loose during shipment and handling.
- (b) Footage. The number of feet per reel must be five hundred (500) feet plus or minus ten percent ($\pm 10\%$).
- (c) Marking. A metal tag, or an approved indelible marking material such as alkyd enamel paint, must be used to mark the reel. The marking information must include, but not be limited to, the following: reel number, contract number, a description of the cord, and the footage of that particular reel.

**ELECTRICAL SPECIFICATION 1476
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 10, 2014**

**TRAFFIC SIGNAL: VEHICULAR, EIGHT-INCH
SINGLE FACE, SINGLE OR MULTIPLE-SECTION LED,
POLYCARBONATE HOUSING**

1. GENERAL REQUIREMENTS

- 1.1 This specification states the requirements for 8 inch, single face, single and multiple-section, traffic signals with polycarbonate housings, using an LED light source, for use in the traffic control system of the City of Chicago. Units include red ball, yellow ball, green ball, green arrow, yellow arrow, and red arrow.
- 1.2 Sample and Certified Test Reports. One complete signal, fully assembled and wired, of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- 1.3 Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:
- American Association of State Highway and Transportation Officials (AASHTO)
 - American Iron and Steel Institute (AISI)
 - American Society for Testing and Materials (ASTM)
 - Institute of Transportation Engineers (ITE)
 - National Electrical Manufacturers Association (NEMA)
 - Underwriters Laboratories (UL)
- 1.4 Approval. Approval will mean approval in writing by the Commissioner or his duly authorized representative.
- 1.5 Warranty. The manufacturer shall warrant the signals to meet the requirements of this specification, and shall warrant all equipment, components, parts and appurtenances against defective design, material and workmanship for a period of 3 years from date of delivery [date of acceptance for construction contract]. In addition, LED optical modules must carry a 7 year warranty against failure or loss of

color (chromaticity) and signal brightness (luminance) below minimum acceptable ITE standard levels from date of delivery [date of acceptance for contract construction]. In the event defects or failures occur during the warranty period, the manufacturer must replace all defective units, at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The LED warranty must cover all modules delivered in an order or installed by contract, and must include unit serial numbers. The warranty must be signed and dated by an official of the manufacturer who is empowered by the manufacturer to enter into such a warranty.

2. MATERIALS AND EQUIPMENT REQUIREMENTS

2.1 The traffic signal heads shall conform to ITE Standard "Vehicle Traffic Control Signal Heads" (VTCSH), in which the most recently published revision will govern.

2.2 Housing. The housing of each section must be one piece, ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with integral top, bottom, and sides, having a minimum thickness of 0.1 inch.

(a) The polycarbonate shall meet or exceed the following tests:

TEST	REQUIRED	METHOD
Specific gravity	1.17 minimum	ASTM D 792
Vicat Softening temp	310-320° F	ASTM D 1525
Brittleness temp.	-200° F	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile strength, yield	8,500 PSI	ASTM D 638
Elongation at yield	5.5-8.5%	ASTM D 638
Shear strength, yield	5,500 PSI min.	ASTM D 732
Izod impact strength (notched, .125" thick)	12-16 ft-lbs/in.	ASTM D 256
Fatigue strength (at 2.5 mm cycles)	950 PSI min.	ASTM D 671

(b) Assembly. A traffic signal section shall be comprised of the housing, hinged door, visor, optical module and all necessary gaskets and hardware. The traffic signal head shall be comprised of single face single sections assembled together, containing an internally mounted terminal block. The traffic signal sections shall be designed and constructed to permit sections to be assembled together, one above the other, forming a weatherproof and dust-tight unit.

(c) Individual sections shall be fastened together with a coupling washer assembly composed of 2 washers, 3 zinc plated bolts, nuts, and lock washers which lock the individual sections together. As an alternative, individual sections may be fastened together with 4 cadmium plated bolts, lock washers, and nuts.

- (d) Height. The overall height of an assembled traffic signal must be 14 inches ± 1 inch for a single-section signal and 42 inches ± 3 inches for a three-section signal.
- (e) Mounting. The traffic signal shall be designed for mounting with standard traffic signal brackets using 1.5 inch pipe size fittings.
- (f) Positioning Device. The top and bottom opening of each housing must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments. A total of 72 teeth must be provided in the serrated bosses to allow the signal face to be rotated 360° about its axis. The teeth shall be clean and well defined to provide positive positioning.
- (g) Hinges. The signal housing shall be sectional; one section for each optical unit. Each housing must have 4 integral hinge lugs, with stainless steel hinge pins (AISI 304 or equivalent), located on the left side for mounting the door. The hinge pins shall be straight and not protrude past the outside of the housing lugs. The housing must have 2 integral latching bolt lugs on the right side each with a stainless steel hinge pin to which a latching bolt (AISI 304 or equivalent), washer, and wing nut will be attached. The wing nuts must be captive. Each housing must be equipped with holes to be used for mounting backplates.
- (h) Door. The door shall be a one piece ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with a minimum thickness of 0.1 inch. Two hinge lugs on the left side and 2 sets of latch screw jaws centered on the right side, as viewed from the front of the signal, must be integrally cast with the housing door. The door must be hinged to the housing with 2 stainless steel hinge pins, drive fitted. Two stainless steel latch screws and wing nut and washer assemblies on the latch side of the housing body shall provide for opening and closing the door without the use of tools. The door must have holes with threaded metal inserts for stainless steel machine screws to secure the visor and the LED module. The inside of the door must be grooved to accommodate a one piece, air-cored ethylene propylene diene monomer (EPDM) gasket to provide a weatherproof and dust proof seal when the door is closed. The outside of the door must have an integral rim completely encircling the opening to prevent leakage between the door and the LED module. The rim must have four equally spaced tabs around the circumference with threaded metal inserts for the visor.
- (i) Visor. Each traffic signal shall have a visor for each signal indication (section). The visor shall be the tunnel type, 9.25 inches long, fabricated of ultraviolet stabilized polycarbonate resin of the specified color, injection molded. The visor shall fit tightly against the door and not permit any light leakage between the door and visor. All hardware necessary for, but not

limited to, attachment of the visor must be of stainless steel. The visor must have 4 mounting lugs for attaching the visor to the door. Screws must go through the visor lugs into the metal inserts in the door to secure the visor.

2.3 LIGHT EMITTING DIODE (LED) MODULES

- (a) Light emitting diode (LED) modules shall consist of an integral unit containing the following components: power leads, housing, matrix of light emitting diodes (LEDs) emitting monochromatic light of desired signal color, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 hertz power.
- (b) The LED module shall be of such dimensions as to permit mounting in any standard traffic signal housing, be interchangeable with incandescent optical units, and must include an appropriate gasket for this purpose. Gasketing provided must provide a watertight seal meeting existing ITE standards for signal heads, and exclude the infiltration of moisture into either the signal housing or into the LED optical unit case.
- (c) The LED module shall meet the applicable requirements of the ITE standards for Vehicle Traffic Control Signal Heads (VTCSH) Part 2: LED Vehicle Signal Modules, for color (chromaticity), signal brightness (luminance), and beam spread (luminance at various vertical and horizontal angles).
- (d) Minimum brightness of LED signal modules shall be in accordance with the luminous requirements in a standard testing procedure as defined by Section 4 of the VTCSH Part 2: LED Vehicle Signal Modules. During the required operating life of LED signal units, the luminance output of the units must not be less than 60% of the values specified in the standard.
- (e) The module indicator surface shall be 8 inches in diameter and be constructed of ultraviolet (UV) stabilized, impact resistant polycarbonate, acrylic or other approved material. The surface must be anti-glare, smooth texture, and clear.
- (f) Modules shall consist of LEDs uniformly distributed to present a homogeneous appearance on the indicator surface from a wide viewing angle.
- (g) LEDs shall be wired so that the loss of a single LED or a string of LEDs will not reduce the luminescence below the minimum requirement.
- (h) For purposes of this specification, failure of a single unit is defined as an occurrence where the luminescence of the signal measured in candela in standard test procedures is less than the required initial luminance or luminance at time points and conditions specified; or where minimum required brightness is achieved, but two or more series strings of LEDs or in

excess of 20% of LEDs are not operable.

- (i) Module power supply shall be constant current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker. Units must be fully operable over a range of 90 volts to 130 volts at 60 hertz \pm 3 hertz.
- (j) Surge protection: Each module must be provided with integral surge protection to withstand transient of 600 volts, 100 microsecond rise and 1 millisecond pulse width. The surge protector shall provide full electrical and physical protection to all unit components.
- (k) Maximum permissible power consumption at ambient conditions (nominal 120 volts, 60 hertz, 70°F.) must be 30 watts at a minimum 90% power factor. Power consumed must not vary by more than 10% from nominal power consumption over a voltage range of 105 volts to 125 volts, and over permissible environmental ranges.
- (l) Modules must be fully operable at temperature ranges of -40° F. (-40° C.) to +165° F. (+74° C.) at up to 100% relative humidity.
- (m) Modules shall be clearly marked on the back surface of the unit in a permanent manner showing information required for warranty and long term performance. Information to be shown must include manufacturer name, date of manufacture, electric power requirements, signal model type including color and indication type, and signal serial number.
- (n) The LED module shall be compatible with the traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal load switches and conflict monitors.
- (o) Modules shall meet applicable sections of Title 47, Sub-Part B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.
- (p) Total harmonic distortion (THD) induced into the voltage and current AC power line sine waves must not exceed 20%.
- (q) LED modules must meet the requirements of VTCSH Part 2: LED Vehicle Signal Modules Section 6.3.1 for signal burn-in.

2.4 Wiring. Each module must be furnished with 2 wire leads color coded as follows:

First Lead:

White Common

Second Lead:

Red	Red Section
Yellow	Yellow Section
Green	Green Section
Red with Black Tracer	Red Arrow
Yellow with Black Tracer	Yellow Arrow
Green with Black Tracer	Green Arrow

The leads must be No. 18 AWG stranded copper wire rated for 600 volt, 105°C., with thermoplastic insulation. The leads must connect to the terminal strip without being spliced. The ends of the leads must be stripped of 0.5 inches of insulation and tinned.

- 2.5 Terminal Strip. A dual-point, barrier type terminal strip with a solid base and pressure plate type connectors shall be securely attached at both ends to the housing body inside the "Green" section of the signal head.
- 2.6 Cable. One 11 foot length of flexible electric cord, medium duty, type SO, No. 16 AWG stranded copper conductor, color coded insulated with an overall jacket, must be furnished with each signal head. The number of conductors must include a neutral and one leg for each section. Both ends of each cable length must be carefully stripped of 6 inches of jacket and 1 inch of insulation, and each conductor properly tinned.
- 2.7 Gaskets. Wherever necessary to make a completely dustproof, moistureproof and weatherproof assembly of the housing and optical system, approved type gaskets of neoprene or silicone rubber shall be provided.

3. TESTING AND DOCUMENTATION REQUIREMENTS

- 3.1 Documentation. The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic signals being supplied meet or exceed the specification requirements. All LED modules shall be tested by a nationally recognized testing laboratory (NRTL), such as Intertek (ETL division), to demonstrate compliance with the latest ITE VTCSH specification. All LED modules shall have the testing laboratory's label attached.
- 3.2 Inspection. The signals shall be subject to inspection at the request of the Commissioner. Final inspection shall be made at point of delivery. Any signal rejected shall be removed, disposed of, and replaced by the contractor at his sole cost.

4. PACKAGING

- 4.1 Packing. Each traffic signal assembly shall be packed in a suitable carton so secured that the signal will not be damaged during shipment, handling or storage.
- 4.2 Marking. Each carton containing a traffic signal shall be clearly marked on the outside in letters not less than 3/8 inches tall with the legend: "TRAFFIC SIGNAL, EIGHT-INCH, LED, POLYCARBONATE@ and the number of Sections as required, the color and indication types, the name of the manufacturer, the date of manufacture, the pertinent Contract Number and the appropriate City Commodity Code Number.

**ELECTRICAL SPECIFICATION 1478
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
JULY 18, 1995**

**POLE: ORNAMENTAL, GASLIGHT, RICHMOND STYLE, 12'-0"
ALUMINUM, 10" BOLT CIRCLE**

SUBJECT

1. This specification states the requirements for 12'-0" Aluminum Anchor Base Poles. These poles will support a single, tenon mounted gas light style luminaire. These poles will be served by underground cables.

GENERAL

2. (a) Specifications. The poles shall conform in detail to the requirements herein stated, and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM designation number, of which the most recently published revisions will govern.
- (b) Acceptance. Poles not conforming to this specification will not be accepted.
- (c) Sample. One complete anchor-base pole of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (d) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Engineering, being an integral part of this specification cooperating to state the necessary requirements.
- (e) Bidders Drawings. Bidders must submit with their bids scale drawings of the anchor base pole intended to be furnished. The drawings must show details of the pole design including the handhole, grounding and anchoring. Although the luminaire is covered by a separate specification, the drawing must include every dimension necessary to show how all parts and components will fit each other, be easily installed and maintained and be properly held in assembly.
- (f) Interchangeability. Each member must be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar pole.

- (g) Design. The pole must conform in design and dimensions to City of Chicago Standard Drawing No. 895.

MASTS

3. (a) Mast size. The mast size must be 12'-0". The entire assembly shall be structurally sound so that with the weight of the specified luminaire, the mast will not twist, rack, vibrate or otherwise deform when subjected to the severe vibrations of passing heavily loaded vehicles. Specific written approval will be required for this assembly.
- (b) Mast Design. The mast design must be as shown on City of Chicago Standard Drawing 895.
- (c) Material. The mast must be made of sand castings of alloy no. 319 and extrusions of 6061T-6 structural grade aluminum conforming to ASTM B26/B26M, Grade 319. The castings and extrusions shall be neat, true to pattern and free from cracks and casting flaws. No welding or plugging of defective castings will be permitted. Each mast shall be straight and centered on its longitudinal axis.
- (d) Mast Base. The mast base must be an integral part of the mast casting.
1. It must provide for double nut mounting on a 10" bolt circle. 1" anchor bolts, nuts and washers will be provided by others. Any special hardware required must be provided by this contractor.
 2. It must provide sufficient internal clearance for two (2) 3" conduit entries and a 3/4" ground rod.
 3. It shall provide an entry of sufficient height and width to allow unobstructed access to all mounting bolts, ground clamp and wires with standard lineman's tools. The entry shall be located such that personnel installing or maintaining the pole will be on the sidewalk facing oncoming traffic.

4. It shall provide an entry door whose appearance and fit is in consonance with the mast and base design both aesthetically and structurally. The door must be securely fastened in place with a sufficient number of 1/4-20 stainless steel Allen head screws which will thread into a rigid door frame.
 5. It must provide a ground lug capable of terminating from one (1) to three (3) #6 AWG copper wires. The ground lug must be welded to the inside of the base immediately adjacent to the left side of the entry.
 6. It must provide a stainless steel identification tag securely mounted to the inside of the entry door. Information on the tag must be either stamped or embossed and must include manufacturer's name; date of manufacture; outside diameter at base; outside diameter at the top; bolt circle; and material description.
- (e) With pole set in place and the door securely fastened, there shall be no exposed wires, bolts or appurtenant hardware other than the door fasteners.
 - (f) Tenon. A tenon must be provided at the top of the pole for attachment of either a single luminaire or a twin arm bracket. The tenon must have an outside diameter of three (3) inches and be three (3) inches in height. It is preferred that the tenon be cast as part of the mast assembly.

WELDING

4. (a) General. Where welds are required and approved, each welded joint shall be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode and must describe the welding methods he proposes to use in fabricating the pole.
- (b) Certification. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed.
- (c) Testing. All welds of five percent (5%) of the poles in every lot must be inspected for penetration and soundness of the welds.

PAINTING

5. (a) Surface Preparation. Exterior surfaces must be prepared by "Solvent Cleaning" per SSPC-SP1 using a solvent recommended for aluminum surfaces. Solvent must be used as per written instructions of manufacturer to remove all oil, grease, dirt and contaminants.

- (b) Primer Type. Within one hour of surface preparation, surfaces must be primed using a primer specifically recommended for aluminum surfaces.
- (c) Primer Application.
1. Aluminum surface temperature must be at least 60° F and relative humidity must be less than 80% at time of primer application.
 2. After primer is thoroughly mixed, a minimum wet thickness must be applied to provide a 2-mil dry thickness.
 3. Primer must dry for a minimum of 24 hours after which a second primer coat must be applied.
 4. The second primer coat must dry for a minimum of 24 hours before the finish coat is applied.
- (d) Interior Primer. Interior surfaces shall be cleaned as well as possible and given one coat of primer using a wand applicator where brushes or spray guns will not reach.
- (e) Finish Coat. Finish coat must be a polyurethane enamel specifically recommended for use over a primed aluminum surface.
1. Pole shall be painted in accordance with manufacturer's written instructions.
 2. Two (2) coats of finish must be applied.
 3. Each coat must be a minimum of 1.5 mils dry thickness.
 4. Color will be specified in the plans or in the line item. Color samples must be approved by the Commissioner.
- (f) Field Touch-up. The contractor must supply a field touch-up kit for every twenty (20) poles or fraction thereof. The kit shall consist of a highly legible instruction sheet, one gallon of the recommended touch up paint and all other materials required to touch-up twenty (20) light poles.
- (g) Alternate painting methods will be considered where the contractor can demonstrate to the satisfaction of the Commissioner that these methods have been in successful use for a five (5) year minimum period.

TESTING

6. (a) General. All completed masts shall be available for testing. Unless specifically authorized in writing, all tests must be at the works of the manufacturer. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the poles are shipped.
- (b) Requirements. The following tests must be included in the testing procedures:
1. Bar tests as outlined in ASTM B26/B26M.
 2. With the mast base rigidly secured using the normal mast mountings, a 500-pound force must be incrementally applied, perpendicular to the mast, to an area approximately 4"x 4" and 5' above the base. This force must then be applied a second time at approximately the same location. The mast must then be checked to insure that the mast is still securely fastened, that it is plumb and that no cracks have developed in either the mast or base.
 3. Weld tests as described in "welding" section.
- (c) Acceptance. Tests must be made on five percent of all the masts. If any of the masts fail to meet these tests, an additional three (3) masts must be tested for each failed mast. Should any of these additional masts fail to meet these test requirements, the entire lot will be subject to rejection. The Commissioner will then decide, based on the nature of the failure, whether the entire lot will be rejected outright or whether the manufacturer may subject each mast to testing, and those masts which fulfill the requirements will be accepted.

PACKAGING

7. (a) General. The poles shall be shipped in bundles weighing a maximum of 5,000 pounds, and having a maximum cross section area of 6'0" x 6'-0". Each pole must be individually protected so that it can be bundled and unbundled without damage to the pole or its finish. Where poles are delivered wrapped, specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of poles. All instructions must be printed on a fiber-based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years.
- (b) Bundles. The bundles must consist of poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2"x4" min.),

non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted. It will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two (2) high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.

- (c) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the pole must be carefully wrapped and securely attached to each bundle. Payment will be withheld for any bundle delivered without the appurtenant devices and hardware. Cracked, broken, chipped or damaged parts will be considered as an incomplete delivery as regards payment.
- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for twenty (20) poles. These units will be securely attached to a sufficient number of bundles to fulfill the touch-up paint requirements stated herein.

**ELECTRICAL SPECIFICATION 1482
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 23, 2010**

**CABLE: TELECOMMUNICATIONS
HYBRID FIBER OPTIC**

SUBJECT

1. This specification states the requirements for a hybrid fiber optic cable, a single-mode fiber optic pigtail, and a multi-mode fiber optic pigtail. All cable shall be classified as outside plant cable. All cable must be dielectric.

GENERAL

2.
 - (a) The fiber optic cable shall conform to the requirements of the American National Standards Institute (ANSI), the Electronics Industries Association (EIA), and to the Telecommunications Industries Association (TIA).
 - (b) Sample. If requested by the Chief Procurement Officer, a three-foot section of the cable proposed to be provided under this specification, must be submitted within fifteen (15) business days after receipt of such a request. The sample should be sent to the attention of the Engineer of Electricity.
 - (c) Warranty. The manufacturer shall warrant the performance and construction of the cable to meet the requirements of this specification and shall warrant the cable against defects due to design, material, or workmanship developing within a period of one year after the cable has been accepted.
 - (d) Acceptance. The Commissioner or his representative will decide if the cable proposed meets the specification. If an alternate cable is presented, the Commissioner or his authorized representative will decide if the alternate is equal to or better than the specified cable.

CABLE CONSTRUCTION

3.
 - (a) The central member of the cable must be reinforced plastic rod designed to prevent buckling of the cable.
 - (b) The cable shall be suitable for direct installation into a duct bank or conduit.

- (c) Dielectric fillers will be used as needed to lend symmetry and roundness to the cross-section of the cable. Cable diameter will be a nominal 11mm.
- (d) Buffer Tube Filler. Each buffer tube will be filled with a water blocking gel or a water blocking dry yarn. The filler must be non-hygrosopic, non-nutritive to fungus, electrically non-conductive, and homogeneous. The filler must be free from dirt and foreign matter. If gel is used, it must be readily removable with conventional, non-toxic solvents.
- (e) Cable Core Filler. A water blocking dry yarn must be used to fill the cable core interstices.
- (f) Pigtail fiber optic cable must be of dry water blocked construction, using yarns manufactured for the purpose.
- (g) Each fiber within the buffer tubes must be free floating, so that all mechanical or environmentally induced stress will be placed on the cable but not on the fibers.
- (h) The fibers and buffer tubes must be color coded in compliance with EIA/TIA 598, "Color Coding of Fiber Optic Cable".

1. Blue	7. Red
2. Orange	8. Black
3. Green	9. Yellow
4. Brown	10. Violet
5. Slate	11. Rose
6. White	12. Aqua
- (i) Each buffer tube shall contain only fiber of one diameter. Single-mode fiber cannot be in the same buffer tube as multi-mode fiber. Multi-mode fibers of different diameters cannot be in the same buffer tube. A buffer tube cannot contain more than 12 fibers.
- (j) Coloring of fibers and buffer tubes shall be steadfast, and not be subject to bleeding or fading due to normal temperature variations and other environmental influences.
- (k) Tensile strength will be provided by the central core member and aramid yarns.
- (l) The cable must contain at least one ripcord under the jacket.
- (m) The cable shall be provided in continuous lengths. Each fiber must be pulled from the same optical waveguide form and must be free from splices. Each optical fiber must consist of a doped silica core surrounded by a concentric

silica cladding.

- (n) **Cable Jacket.** The outer jacket must be constructed of medium density polyethylene 1.4mm in thickness. The polyethylene must contain carbon black to provide ultraviolet light protection.
- (o) **Cable Marking.** The cable must be black with a yellow stripe, to differentiate it from electrical cable. A permanent marking must be employed on the outer jacket which will show the manufacturer's name and date of manufacture. A numerical sequence must be marked on the outer jacket, at intervals no greater than 3 meters. The cable must be identified as to the number of fibers and the mode of the fibers. The height of the markings must be 2.5 mm nominal.

FIBER REQUIREMENTS

4. (a) Single-Mode Specifications.

Optical Wavelength	1310nm and 1550 nm
Optical Attenuation	@ 1310 nm: ≤ 0.5 dB/km @ 20° C. @ 1550 nm: ≤ 0.4 dB/km @ 20° C.
Fiber Core Diameter	9.1 ± 0.4 μ m @ 1310 nm
Fiber Coating Diameter	250 ± 10 μ m
Fiber Cladding Diameter	125 ± 2 μ m

(b) Multi-Mode Specifications.

Optical Wavelength	850 nm and 1300 nm
Optical Attenuation	@ 850 nm: ≤ 3.5 dB/km @ 20° C. @ 1300 nm: ≤ 1.5 dB/km @ 20° C.
Fiber Core Diameter	62.5 ± 2.5 μ m
Fiber Coating Diameter	250 ± 15 μ m
Fiber Cladding Diameter	125 ± 1.0 μ m
Coating/ Cladding Concentricity	≤ 6 μ m

HYBRID FIBER OPTIC CABLE

5. (a) On a 30-fiber cable, there will be five (5) buffer tubes, each with six (6) fibers. The second buffer tube (orange) will contain six (6) multi-mode fibers. The other buffer tubes will each contain six (6) single mode fibers.
- (b) **TESTS.** Fiber optic cable tests must be per EIA/TIA 455, Fiber Optic Test Procedures (FOTPs):

Compressive Loading Resistance: 220 N/cm per FOTP 41
Minimum bending radius:

Installation	20 times cable diameter
Static	10 times cable diameter

Temperature:

Installation	-30° C. to +70° C.
Operation	-40° C. to +70° C.

Humidity: 0 to 100%

Tensile Strength (FOTP 33):

Installation	2700 N (600 lbf)
Static	600 N (125 lbf)

Fluid Penetration: FTOP 82 in accordance with ICEA 696

Compound Drip per FOTP 81

Cyclic Flexing per FOTP 104

Cyclic Impact per FOTP 25

- (c) Each fiber shall be tested for attenuation. Test results must be provided with each reel of cable. Attenuation must be within the limits specified, or the cable will be rejected.

FIBER OPTIC PIGTAILS

6. (a) General. The optical pigtail shall consist of multiple fibers in a loose tube, factory connectorized on one end, suitable for installation in an indoor/outdoor duct run. Each fiber must be individually furcated in a 2 mm sub unit. The fibers must then be contained in a flame retardant and UV resistant thermoplastic outer jacket. The multi-fiber pigtail must be provided in 200-foot lengths. The connectorized end must have a factory installed ST connection for each fiber. Dry water blocking must be used for these cables.
- (b) Single-mode Pigtail. This cable will contain 8 single mode fibers.
- (c) Multi-mode Pigtail. This cable will contain 8 multi-mode fibers.

PACKAGING

7. (a) Cable Ends. Each cable end on a reel will be available for testing after delivery. Each cable end must be shipped sealed to prevent moisture

penetration.

- (b) Cable Label. Each cable reel must have a durable weatherproof label which shows the actual length of cable on the reel and the attenuation of each fiber.

**ELECTRICAL SPECIFICATION 1484
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 6, 2014**

**TRAFFIC SIGNAL FLASHER: EIGHT-INCH
SINGLE FACE, ONE-SECTION,
POLYCARBONATE, LED**

1. GENERAL REQUIREMENTS

- 1.1 This specification states the requirements for an eight-inch, single face, one-section, traffic signal flasher with polycarbonate housing, using LED light source, for use in advance of a traffic signal intersection or for identifying an in-street permanent obstacle. Units will include one eight inch yellow ball section. A flasher located within the section will be provided.
- 1.2 Sample and Certified Test Reports. One complete signal, fully assembled and wired, of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- 1.3 Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:
- American Association of State Highway and Transportation Officials (AASHTO)
 - American Iron and Steel Institute (AISI)
 - American Society for Testing and Materials (ASTM)
 - Institute of Transportation Engineers (ITE)
 - National Electrical Manufacturers Association (NEMA)
 - Underwriters Laboratories (UL)
- 1.4 Approval. Approval will mean approval in writing by the Commissioner or his duly authorized representative.
- 1.5 Warranty. The manufacturer shall warrant the signals to meet the requirements of this specification, and shall warrant all equipment, components, parts and appurtenances against defective design, material and workmanship for a period of 3 years from date of delivery [date of acceptance for contract construction]. In

addition, LED optical units must carry a 7 year warranty against failure or loss of color (chromaticity) and signal brightness (luminance) below minimum acceptable ITE standard levels from date of delivery [date of acceptance on contract construction]. In the event defects or failures occur in the LED units during the warranty period, the manufacturer must replace all defective units, at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The LED warranty must cover all units delivered in an order or installed by contract, and must include unit serial numbers. The warranty must be signed and dated by an official of the manufacturer who is empowered by the manufacturer to enter into such a warranty.

2. MATERIALS AND EQUIPMENT REQUIREMENTS

2.1 The traffic signal heads shall conform to ITE Standard "Vehicle Traffic Control Signal Heads" (VTCSH), in which the most recently published revision will govern.

2.2 Housing. The housing of each section must be one piece, ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with integral top, bottom, and sides, having a minimum thickness of 0.1 inch.

(a) The polycarbonate shall meet or exceed the following tests:

TEST	REQUIRED	METHOD
Specific gravity	1.17 minimum	ASTM D 792
Vicat Softening temp	310-320° F	ASTM D 1525
Brittleness temp.	-200° F	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile strength, yield	8,500 PSI	ASTM D 638
Elongation at yield	5.5-8.5%	ASTM D 638
Shear strength, yield	5,500 PSI min.	ASTM D 732
Izod impact strength (notched, .125 inches thick)	12-16 ft-lbs/in.	ASTM D 256
Fatigue strength (at 2.5 mm cycles)	950 PSI min.	ASTM D 671

(b) Assembly. A traffic signal section shall be comprised of, but not limited to, the housing, hinged door, visor, optical unit and all necessary gaskets and hardware. The head shall be a traffic signal comprised of a single face, containing an internally mounted solid-state flasher and terminal block.

(c) Height. The overall height of an assembled traffic signal shall be 14 inches ± 1 inch.

(d) Mounting. The traffic signal shall be designed for mounting with standard traffic signal brackets using 1.5 inch pipe size fittings.

- (e) Positioning Device. The top and bottom opening of each housing must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments. A total of 72 teeth must be provided in the serrated bosses to allow the signal face to be rotated 360° about its axis. The teeth shall be clean and well defined to provide positive positioning.
- (f) Hinges. The signal housing shall be sectional. Each housing must have four integral hinge lugs, with stainless steel hinge pins (AISI 304 or equivalent), located on the left side for mounting the door. The hinge pins shall be straight and not protrude past the outside of the housing lugs. The housing must have two integral latching bolt lugs on the right side each with a stainless steel hinge pin to which a latching bolt (AISI 304 or equivalent), washer, and wing nut will be attached. The wing nuts must be captive. Each housing must be equipped with holes to be used for mounting backplates.
- (g) Door. The door shall be a one piece ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with a minimum thickness of 0.1 inch. Two hinge lugs on the left side and 2 sets of latch screw jaws centered on the right side, as viewed from the front of the signal, must be integrally cast with the housing door. The door must be hinged to the housing with 2 stainless steel hinge pins, drive fitted. Two stainless steel latch screws and wing nut and washer assemblies on the latch side of the housing body shall provide for opening and closing the door without the use of tools. The door must have holes with threaded metal inserts for stainless steel machine screws to secure the visor and the LED module. The inside of the door must be grooved to accommodate a one piece, air-cored EPDM (ethylene propylene diene monomer) gasket to provide a weatherproof and dust proof seal when the door is closed. The outside of the door must have an integral rim completely encircling the opening to prevent leakage between the door and the module. The rim must have 4 equally spaced tabs around the circumference with threaded metal inserts for the visor.
- (h) Visor. Each traffic signal shall have a visor. The visor shall be the tunnel type, 9.25 inches long, fabricated of ultraviolet stabilized polycarbonate resin of the specified color, injection molded. The visor shall fit tightly against the door and not permit any light leakage between the door and visor. All hardware necessary for, but not limited to, attachment of the visor must be of stainless steel. The visor must have 4 mounting lugs for attaching the visor to the door. Screws must go through the visor lugs into the metal inserts in the door to secure the visor.

2.3 LIGHT EMITTING DIODE (LED) MODULES

- (a) Light emitting diode (LED) optical modules shall consist of an integral unit

containing the following components: power leads, housing, matrix of light emitting diodes (LEDs) emitting monochromatic light of desired signal color, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 hertz power.

- (b) The LED module shall be of such dimensions as to permit mounting in any standard traffic signal housing. Gasketing provided must provide a watertight seal meeting existing ITE standard for signal heads, and exclude the infiltration of moisture into either the signal housing or into the LED module unit case.
- (c) The LED module shall meet the applicable requirements of the ITE standards for Vehicle Traffic Control Signal Heads (VTCSH) Part 2: LED Vehicle Signal Modules, for color (chromaticity), signal brightness (luminance), and beam spread (luminance at various vertical and horizontal angles).
- (d) Minimum brightness of LED signals shall be in accordance with the luminous requirements in a standard testing procedure as defined by Section 4 of the VTCSH Part 2: LED Vehicle Signal Modules. During the required operating life of LED signals, the luminance output of the units must not be less than 60% of the values specified in the standard.
- (e) The LED module indicator surface shall be constructed of ultraviolet (UV) stabilized, impact resistant polycarbonate, acrylic, or other approved material. The surface must be anti-glare, smooth texture, and clear.
- (f) Modules shall consist of LEDs uniformly distributed to present a homogeneous appearance on the face of the unit from a wide viewing angle.
- (g) LEDs shall be wired so that the loss of a single LED or a string of LEDs will not reduce the luminescence below the minimum requirement.
- (h) For purposes of this specification, failure of a single unit is defined as an occurrence where the luminescence of the signal measured in candela in standard test procedures is less than the required initial luminance or luminance at time points and conditions specified; or where minimum required brightness is achieved, but two or more series strings of LEDs or in excess of 20% of LEDs are not operable.
- (i) Module power supply shall be constant current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker. Modules must be fully operable over a range of 90 volts to 130 volts at 60 hertz \pm 3 hertz.
- (j) Surge protection: Each module must be provided with integral surge protection to withstand transient of 600 volt, 100 microsecond rise and 1

millisecond pulse width. The surge protector shall provide full electrical and physical protection to all unit components.

- (k) Maximum permissible power consumption at ambient conditions (nominal 120 volts, 60 hertz, 70° F.) must be 30 watts at a minimum 90% power factor. Power consumed must not vary by more than 10% from nominal power consumption over a voltage range of 105 volts to 125 volts, and over permissible environmental ranges.
 - (l) Modules must be fully operable at temperature ranges of -40° F. (-40°C.) to +165° F. (+74°C.) at up to 100% relative humidity.
 - (m) Modules shall be clearly marked on the back surface of the unit in a permanent manner showing information required for warranty and long term performance. Information to be shown must include manufacturer name, date of manufacture, electric power requirements, signal model type including color and indication type, and signal serial number.
 - (n) The LED module shall be compatible with the traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal load switches and conflict monitors.
 - (o) Modules shall meet applicable sections of Title 47, Sub-Part B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.
 - (p) Total harmonic distortion (THD) induced into the voltage and current AC power line sine waves must not exceed 20%.
 - (q) LED optical modules must meet the requirements of VTCSH Part 2: LED Vehicle Signal Modules Section 6.3.1 for signal burn-in.
- 2.4 Flasher. A solid-state flashing device shall be installed in the housing. This device must meet NEMA standards for Traffic Control Systems, TS-1. This device must be wired to the LED signal module so as to provide flashing of the module. The unit must function according to ITE standards.

- 2.5 Wiring. Each LED module must be furnished with 2 leads color coded as follows:

First Lead Wire:

White

Common

Second Lead Wire:

Yellow

Yellow Section

The leads must be No. 18 AWG stranded copper wire, rated for 600 volt, 105° C., with a thermo-plastic insulation. The leads must connect to the terminal strip without being spliced. The ends of the leads must be stripped of 0.5 inches of insulation and tinned.

- 2.6 **Terminal Strip.** A dual-point, barrier type terminal strip with a solid base and pressure plate type connectors shall be securely attached at both ends to the housing body inside the housing.
- 2.7 **Cable.** One 11 foot length of flexible electric cord, medium duty, type SO, No. 16 AWG stranded copper conductor, color coded, rubber insulated, neoprene jacketed, must be furnished with each signal head. The number of conductors must be 2. Both ends of each cable length must be carefully stripped of 6 inches of jacket and 1 inch of insulation, and each conductor properly tinned.
- 2.8 **Gaskets.** Wherever necessary to make a completely dustproof, moistureproof and weatherproof assembly of the housing and optical system, approved type gaskets of neoprene or silicone rubber shall be provided.

3. TESTING AND DOCUMENTATION REQUIREMENTS

- 3.1 **Documentation.** The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic signals being supplied meet or exceed the specification requirements. All LED modules shall be tested by a nationally recognized testing laboratory (NRTL), such as Intertek (ETL division), to demonstrate compliance with the latest ITE VTCSH specification. All LED modules shall have the testing laboratory's label attached.
- 3.2 **Inspection.** The signals shall be subject to inspection at the request of the Commissioner. Final inspection shall be made at point of delivery. Any signal rejected shall be removed, disposed of, and replaced by the contractor at his sole cost.

4. PACKAGING

- 4.1 **Packing.** Each traffic signal assembly shall be packed in a suitable carton so secured that the signal will not be damaged during shipment, handling or storage.

- 4.2 Marking. Each carton containing a traffic signal shall be clearly marked on the outside in letters not less than 3/8 inches tall with the legend: "TRAFFIC SIGNAL FLASHER, EIGHT-INCH, SINGLE FACE, ONE-SECTION, POLYCARBONATE, LED, the name of the manufacturer, the date of manufacture, the pertinent Contract Number and the appropriate City Commodity Code Number.

**ELECTRICAL SPECIFICATION 1487
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED NOVEMBER 14, 2014**

**POLE: ORNAMENTAL, LOOP STYLE, 10 FOOT
15" BOLT CIRCLE; STEEL, 7 GAUGE**

SUBJECT

1. This specification states the requirements for an ornamental street light pole. These poles will support a twin mast arm bracket which will in turn, support two tenon mounted luminaires. A split pedestal base will be provided to cover the bottom 43.75" of the pole. This pole will be served by underground cables.

GENERAL

2. (a) Specifications. The poles shall conform in detail to the requirements herein, stated, and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM Designation, of which the most recently published revisions will govern.
- (b) Acceptance. Poles not conforming to this specification will not be accepted.
- (c) Sample. One complete anchor-base pole of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (d) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Engineering, being an integral part of this specification cooperating to state the necessary requirements.
- (e) Bidders Drawings. Bidders must submit with their bids scale drawings for the anchor base pole intended to be furnished. The drawings must show details of the pole design including the handhole, grounding and anchoring. Although the luminaire, the twin arm bracket and the split pedestal base are each covered by separate specifications, the drawing must include every dimension necessary to show how all parts and components will fit each other, be easily installed and maintained and be properly held in assembly.
- (f) Interchangeableness. Each member including the handhole doors in the pole

and the split pedestal base must be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar pole.

- (g) Design. The pole must conform in design and dimensions to Drawing 911.
- (h) Warranty. The manufacturer shall warrant the performance and construction of the light poles to meet the requirements of this Specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the light poles have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

MASTS

- 3. (a) Mast Size. The mast size must be 10'-0" and must provide a 0.14" per foot taper. The mast diameter at a point 44" above the base must be 7.25". The mast must be rolled to provide a 16-flute pattern.
- (b) Mast Design. The mast design must be as shown on Drawing 911.
- (c) Material. The mast must be 7 gauge carbon steel in accordance with ASTM A595, Grade A and must provide a 0.14" per foot taper. The flutes must be neat, true to pattern and free from cracks and flaws. Each mast must be straight and centered on its longitudinal axis.
- (d) Mast Base. The mast base must be a 1" thick steel plate of low alloy, high strength steel conforming to ASTM A 595, grade C, ASTM A 588 or ASTM A 606.
 - 1. It must provide for mounting on a 15" bolt circle using 1" to 1 1/4" anchor bolts, nuts and washers provided by others. Any special hardware required must be provided by the Contractor.
 - 2. It must provide sufficient internal clearance for two 3" conduit entries and a 3/4" ground rod.
 - 3. The mast must be inserted into the base to a maximum depth which will still allow for an adequate weld to be made between the bottom of the mast and the plate. A circumferential weld must be made between the mast and the base at both the top and underside of the

plate.

- (e) Provision for Ground. A 1/2-13 square nut must be welded to the inside of the mast on the handhole entry frame for a ground connection.
- (f) Entry. A vertical door frame carrying a removable door providing access to the interior of the mast must be welded into a close fitting opening centered approximately 15" above the bottom of the base. The door frame must be formed and welded of steel with cross section not less than 1-1/2" wide by 1/4" thick so as to adequately reinforce the opening of the mast. The internal horizontal clearance of the door frame must be 4"; its internal vertical height must be 8". Its upper and lower ends must be semi-circular meeting its straight sides tangentially. The frame must be drilled and tapped top and bottom to accept 1/4-20 hex head stainless steel machine screws.
- (g) Door. The removable door must be formed of sheet steel approximately 1/8" thick. It must fit the door frame closely and be dished so that it will stay in proper position even if its locking screws must be slightly loosened. The door must be drilled top and bottom to accept the 1/4 -20 hex head stainless steel machine screws which will fasten the door to the door frame. Half sections of 3/8" x 1" tubing must be welded to the door concentric with the drilled holes to prevent removal of machine screws after installation. Alternate methods will be subject to approval by the Commissioner or his fully authorized representative.
- (h) Tag. To each pole must be attached immediately above the handhole by mechanical means and not by adhesive, a stainless steel tag with a stamped or embossed legend which must include the pole outside diameter at the base, the overall length, and the gauge; i.e., 8.75" x 10'-7 gauge.
- (i) With pole set in place and the door securely fastened, there must be no exposed wires, bolts or appurtenant hardware other than the door fasteners.
- (j) Tenon. A tenon must be provided at the top of the pole for attachment of a twin mast arm bracket. The tenon diameter must be a minimum 5" I.P.S. pipe equivalent and must be sufficiently long to ensure positive, structurally sound mating between the mast and the attached device. The Tenon must be factory assembled to the mast. The finished mast must give the appearance of a single, homogeneous mast and the entire assembly must be structurally sound so that with the weight of a twin mast arm and two luminaires, the mast will not twist, rack, vibrate or otherwise deform when subjected to the severe vibrations of passing elevated trains or heavily loaded vehicles.

WELDING

4. (a) General. Where welds are required and approved, each welded joint must be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode and must describe the welding methods he proposes to use in fabricating the pole.
- (b) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed.
- (c) Testing. All welds of 5% of the poles in every lot must be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection will be governed by the same conditions as in the testing section. If the magnetic inspection process is used, the dry method with direct current must be employed. All transverse welds must be magnetized by the "prod" (Circular Magnetization) method.

PAINTING

5. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove oils and grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10. Included in this process, the pretreatment process and the painting process must be the interior base section of the mast to a minimum height of 12".
- (c) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Exterior Coat. A thermosetting, weathering, Polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform 8-mil thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400° Fahrenheit to form a high molecular weight fusion bonded finish.
- (e) Alternate Methods. Alternate powder coat methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.
- (f) Interior coat. The interior metal surfaces must be powder coated with a thermoplastic hydrocarbon resin. The resin must be applied at a temperature

of approximately 200° Fahrenheit to a minimum thickness of 3 mils. The interior thermoplastic coat must overlap the interior, thermosetting base coat by approximately 6". Alternate interior coatings may be used subject to prior approval of the Commissioner.

- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure per ASTM B117 in a 5% Na Cl (by weight) solution at 95° Fahrenheit and 95% relative humidity without blistering. Before test, the panel must be scribed with an "X" down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "single spot measurement" in an area of two square inches must not be less than 7.0 mils.
- (i) Color. Color must be gloss black. A color sample must be submitted for approval prior to fabrication. This color sample must include the manufacturer's name and the manufacturer's color name as well as any other information required to purchase the same color for the mast arms, luminaire and the split pedestal base.
- (j) Field Touch-up. The Contractor must supply a field touch-up kit for every 20 poles or fraction thereof. The kit must consist of a highly legible instruction sheet, one gallon of the recommended touch-up paint and all other materials required to touch-up 20 light poles.

TESTING

- 6. (a) General. All completed masts shall be available for testing. Unless specifically authorized in writing, all tests must be performed at the manufacturer's plant. A record of every test must be made and a certified copy must be submitted to the Commissioner before the poles are shipped.
- (b) Requirements. The following tests must be included in the testing procedure:
 - 1. Coupon tests as outlined in ASTM A53 and A595, A588 or A606.
 - 2. With the mast base rigidly secured using the normal mast mountings, a 1000 pound force must be incrementally applied, perpendicular to the mast at the tenon. This force must then be applied a second time at approximately the same location. The mast must then be checked to insure that the mast is still securely fastened; that it is plumb; and that no cracks have developed in either the mast, tenon or base.

3. Perform Weld tests as described in "welding" section.
- (c) Acceptance. Tests must be made on 5% of all masts. If any of the masts fail to meet these tests, an additional three masts must be tested for each failed mast. Should any of these additional masts fail to meet these test requirements, the entire lot will be subject to rejection. The Commissioner will then decide, based on the nature of the failure, whether the entire lot will be rejected outright or whether the manufacturer may subject each mast to testing, and those masts which fulfill the requirements will be accepted.

PACKAGING

7. (a) General. The poles shall be shipped in bundles weighing a maximum of 5,000 pounds. Each pole must be individually protected so that it can be bundled and unbundled, without damage to the pole or its finish. Where poles are delivered wrapped, specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of poles. Instructions must be printed on a fibre based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years.
- (b) Bundles. The bundles shall consist of poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (c) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the poles must be carefully wrapped and securely attached to each bundle. Payment will be withheld for any bundle delivered without the appurtenant devices and hardware. Cracked, broken, chipped or damaged parts will be considered as an incomplete delivery as regards payment.
- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for twenty (20) poles. These units will be securely attached to a sufficient number of bundles to fulfill the touch-up paint requirements stated herein.

**ELECTRICAL SPECIFICATION 1488
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 6, 2014**

PEDESTAL BASE: ORNAMENTAL, FOR 10 FOOT LOOP STYLE POLE

SUBJECT

1. This specification states the requirements for an ornamental pedestal base (Clamshell) for mounting on the ornamental 10 foot Loop Style light pole. This base will be manufactured of fiberglass and will not have doors.

GENERAL

2. (a) Specifications. The pedestal bases shall conform in detail to the requirements herein stated, and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (b) Acceptance. Bases not conforming to this specification will not be accepted. Whenever “approval” and “approved” are used in this specification they will mean approval by the Commissioner. The Commissioner’s approval must be secured prior to proceeding with the manufacture of the bases. The Commissioner will be the sole judge in determining if the submitted bases are in compliance with the specification. The Commissioner’s decision will be final.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Engineering, being an integral part of this specification cooperating to state the necessary requirements.
- (d) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the pedestal bases and any necessary attachments. The drawings must give every dimension necessary to show how the parts will fit each other and be properly held in assembly. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted. If so requested by the City, these drawings will be submitted in electronic format, preferably Microstation 95. Failure to provide drawings in this format will be cause for rejecting the submittal.

- (e) Sample. One complete pedestal base of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (f) Products. Bases must be products of established manufacturers, such as Shakespeare Company, W.J. Whatley, Incorporated, or an approved equal.
- (g) Warranty. The manufacturer shall warrant the performance and construction of the bases to meet the requirements of this specification and shall warrant all parts and appurtenances against defects due to design, workmanship, or material developing within a period of three years after the bases have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, or failure or fading of the surface color. The warranty must be furnished in writing guaranteeing replacement, including cost of shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.
- (h) Design. The bases must conform to the design and dimensions of Standard Drawing 911.

CONSTRUCTION OF BASE

- 3. (a) Each pedestal base must be formed of a fiberglass composite consisting of a polyester resin and containing a minimum of 65% fiberglass by weight. The resin must contain no clay fibers. The composite must be UV and weather resistant. Alternate materials may be considered. Each base half must be permanently marked on the inside identifying it as a base for the Loop Pole.
- (b) The base must conform in detail and dimensions to Standard Drawing 911.
- (c) The two halves of the clamshell must be identical to each other. They must be perfectly matched and when installed there must be no more than a 0.125 inch gap between the inside top of the assembled base and the outside surface of the mast.
- (d) Once installed, the base should be designed to remain in place without the use of set screws. An installed base should not be able to be shifted or rotated.
- (e) The color of the base must be gloss black and must match the color of existing and proposed Loop Poles. The resin must contain color pigment throughout. The pigment must be even throughout the base. A finish coat of urethane enamel must be applied to the surface of the base to a minimum dry thickness of 1.5 mils. The resin color must match the enamel color. A paint

sample on fiberglass must be submitted for approval prior to production. The paint manufacturer's name and any information necessary to acquire the same color for the pole must be provided. The contractor must supply one quart of touch-up paint for every 50 bases ordered.

- (f) The texture of the fiberglass base exterior must resemble that of a cast iron base. Acceptance of the aesthetic appearance of the base will be by the Commissioner.
- (g) The two halves of the clamshell must be affixed by means of screws. The screws must fit so that the halves of the base are drawn together as the screws are tightened. The halves should fit snug against each other. Threaded stainless steel inserts in the base must be used to affix the screws. The screws must not detract from the appearance of the base. Other methods of attachment may be considered. Any method of attachment must be approved by the Commissioner.

TESTING

- 4. General. All completed split pedestal bases shall be available for testing. Unless specifically authorized in writing, all tests must be at the manufacturer's plant. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the units are shipped. Tests shall be standardized according to ASTM requirements or other suitable organization's standards. The manufacturer must provide evidence that the bases and doors are structurally sound and are able to withstand the normal abuse of salt spray, freeze-thaw cycles, and exposure to moisture. The bases must be impact resistant and must be resistant to UV damage.

PACKAGING

- 5. (a) General. The split pedestal bases must be shipped on pallets with at least six units per pallet. Each base must be individually protected so that it can be bundled and unbundled without damage to the base or its finish. Where bases are delivered wrapped, specific instructions must be securely attached to each pallet indicating the proper methods of storage. In addition, each pallet must contain specific instructions on the installation of the split pedestal bases. Instructions must be printed on a fibre-based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of five years. The pallets must be labeled in 3/8 inch high lettering indicating the type of base as "FIBERGLASS BASE FOR LOOP LIGHT POLE", the part number, the manufacturer, the date of manufacture, and the contract number.
- (b) Hardware. Any hardware not attached to the bases must be carefully wrapped

and securely attached to each pallet. Hardware must be packaged in a clear bag with a label indicating the type of hardware and the quantity.

- (c) Touch-up Paint. Touch-up paint must be packaged in units sufficient for the number of bases on each pallet.

**ELECTRICAL SPECIFICATION 1489
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
JUNE 9, 1997**

**MAST ARM: ORNAMENTAL, FOR LOOP STYLE POLE, FOR MOUNTING
TWO ACORN LUMINAIRES, ALUMINUM**

SUBJECT

1. This specification states the requirements for an ornamental aluminum twin mast arm for supporting two acorn luminaires on both the Loop pole and the Extended Loop pole.

GENERAL

2. (a) Specifications. The mast arms shall conform in detail to the requirements herein stated, and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (b) Acceptance. Mast Arms not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Engineering, being an integral part of this specification cooperating to state the necessary requirements.
- (d) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the mast arms and attachments proposed as the means for attaching these mast arms to poles. The drawings must give every dimension necessary to show how the parts will fit each other and be properly held in assembly.
- (e) Sample. One complete mast arm of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (f) Warranty. The manufacturer shall warrant that the mast arms meet the requirements of this specification and shall warrant the mast arms against any defects or failures that may occur within five years of delivery. Any defective mast arm must be replaced by the manufacturer at no cost to the City.

DESIGN

3. (a) Each twin mast arm must be cast aluminum conforming to ASTM B26/B26M, Grade 319.
- (b) It must conform in detail with the twin mast arm shown on Drawing 911.
- (c) Castings must have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited.
- (d) Mast arms must be straight and true along both the longitudinal and vertical axis so that they will provide a perfect, parallel vertical mounting for the two luminaires.
- (e) Mast arms must be structurally rigid so that when mounted on a mast, fitted with the capitals and luminaires shown on Drawing 911, and carrying two 4' x 14" banners with each top securely fastened to one side of the mast arm and each bottom securely fastened to the mast, neither an 80 m.p.h. AASHTO wind load, the vibration of a passing elevated train, nor the vibration of a heavily loaded vehicle will cause any twisting, racking or bouncing of the arm assembly in either the vertical or the horizontal plane.
- (f) The mast arm attachment to the mast must provide the structural integrity to hold the mast arm firmly in place during the loading and vibration described above. Where set screws are used to secure the mast arm to the mast, a minimum of 3/16" thickness of metal must be provided where the set screws are inserted to minimize the possibility of stripping the threads when the set screws are tightened into place. The set screws must be 1/4" x 20 stainless steel Allen head screws and a minimum of three set screws must be provided.
- (g) An access point near the top of the mast arm must be provided to facilitate wiring from the fixture to the mast handhole. The access point cover must be in architectural consonance with the mast arm and must be securely held in place with a minimum of two 1/4" x 20 stainless steel allen head set screws in a minimum of 3/16" thickness of metal. At this access point, a "J" hook must be provided to support the luminaire wiring so that rubbing on the interior raceway will be minimized.
- (h) The interior of the mast arm must provide a smooth, burr-free raceway for the luminaire wiring.
- (i) The mast arm must provide two 3"O.D. x 3" long tenons for attachment of the luminaires.

WELDING

4. (a) General. It is preferred that the mast arm be cast as a single unit. Where the Contractor proposes to provide separate castings which are welded together, the Contractor must provide detailed drawings and a sample for the specific written approval of the Commissioner. Appearance will be a major factor in the approval process.
- (b) Standards. Every weld must be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings. Additionally, each bidder must submit with his proposal drawing the sizes and types of welds, must state the type of electrode, and must describe the welding methods he proposes to employ in fabricating the mast arm.
- (c) Certification. All welds must be made by personnel who are certified for that type of welding. Welding by non-certified personnel will not be allowed.
- (d) All welds must be inspected for penetration, soundness and appearance by means of radiography.

PAINTING

5. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove oils and grease.
- (b) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized phosphate wash and must be dried by convection heat.
- (c) Exterior and Interior Coat. A thermosetting, weathering, Polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform eight-mil thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400° Fahrenheit to form a high molecular weight fusion bonded finish.
- (d) Alternate Methods. Alternate painting methods may be reviewed and tested on a case by case basis. However, no painting method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.
- (e) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% Na Cl (by weight) solution at 95° Fahrenheit and 95% relative humidity without blistering. Before test, the panel must be scribed with an "X" down to bare metal.

- (f) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "single spot measurement" in an area of two square inches must be not less than 7.0 mils.
- (g) Color. Color must be gloss black. A color sample must be submitted for approval prior to fabrication. The color sample must include the manufacturer's name and the manufacturer's color name as well as any other information which will be required to purchase the same color for the mast, mast arm and luminaires.
- (h) Field Touch-up. The Contractor must supply a field touch-up kit for every 20 bases or fraction thereof. The kit must consist of a highly legible instruction sheet, one gallon of the recommended touch-up paint and all other material required to touch-up 20 mast arms.

TESTING

- 6. (a) General. All completed mast arms shall be available for testing. Unless specifically authorized in writing, all tests must be at the manufacturer's plant. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the arms are shipped.
- (b) Requirements. The following tests must be included in the testing procedure:
 - 1. Bar tests as outlined in ASTM B26/B26M.
 - 2. With the mast arm rigidly secured to a tenon equivalent to that of the pole and using the normal mast arm mounting provision, a 300-pound test load must be applied perpendicular to one end of the mast arm in the vertical plane for approximately 60 seconds. The test must then be repeated on the other end of the mast arm.
 - 3. The 300-pound test load must then be applied to one end of the mast arm to create a twisting moment on the arm for approximately 60 seconds. The test must then be repeated on the other end of the mast arm.
 - 4. The 300-pound test load must then be applied perpendicular to one end of the mast arm in the horizontal plane for approximately 60 seconds. The test must then be repeated on the other end of the mast arm.
 - 5. The mast arm mounting must not be adjusted or retightened during any of the above testing procedures.

6. During the tests, the mast arm must not rack, twist, bend or deform in any manner using measurement criteria and tolerances which will be mutually agreed upon by the Contractor and the Commissioner prior to testing. They must be based on normal testing procedures and the physical properties of the material.
 7. At the completion of these tests, the mast arm must be in precisely the same position it was in at the start of testing and must not be structurally or visibly deformed in any matter whatsoever. Where welds are used in the manufacture of the arms, they must be subjected to testing by means of radiography to ensure that they have not been compromised.
- (c) Acceptance Tests must be made on 5% of all the mast arms. If any of the mast arms fail to meet these tests, an additional three mast arms must be tested for each failed mast arm. Should any of these additional mast arms fail to meet these test requirements the entire lot will be subject to rejection. The Commissioner will then decide, based on the nature of the failure, whether the entire lot will be rejected outright or whether the manufacturer may subject each mast arm to testing, and those mast arms which fulfill the requirements will be accepted.

PACKAGING

7. (a) General. The mast arms shall be shipped on pallets of 6 mast arms. Each base must be individually protected so that it can be bundled and unbundled without damage to the mast arm or its finish. Where mast arms are delivered wrapped, specific instructions must be securely attached to each pallet indicating the proper methods of storage. In addition, each pallet must contain specific instructions on the installation of the mast arms. Instructions must be printed on a fiber-based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of five years. Any pallets, in which either mast arms or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the pallet to its original destination at no cost to the City of Chicago.
- (b) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the mast arm must be carefully wrapped and securely attached to each pallet. Payment will be withheld for any pallet delivered without the appurtenant devices and hardware. Cracked, broken, chipped or damaged parts will be considered as an incomplete delivery as regards payment.
- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for the number for 20 mast arms. These units will be securely attached to each bundle.

**ELECTRICAL SPECIFICATION 1491
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 28, 1997**

**POLE: ORNAMENTAL, ELECTROLIER STYLE,
ALUMINUM, 15" BOLT CIRCLE**

SUBJECT

1. This specification states the requirements for a cast aluminum anchor base pole in the historic electrolier style. The specification includes the pole base, mast, and luminaire arms. An entire assembly would include one base with the mast, six luminaire arms, and all necessary hardware. The luminaire is not part of this specification.

GENERAL

2. (a) Specifications. The Poles shall conform in detail to the requirements herein stated and to the applicable specifications and methods of testing of the American Society for Testing and Materials (ASTM) and to the structural requirements of the American Association of State Highway and Transportation Officials (AASHTO). The pole must conform to all details of Drawing Number 914.
- (b) Acceptance. Poles not conforming to this specification will not be accepted.
- (c) Sample. One complete pole of the manufacture intended must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (d) Qualifications. The fabricator must submit to the City evidence of successful experience in the fabrication of ornamental metal similar to that indicated. The fabricator must submit evidence of sufficient capacity to produce the required units.
- (e) Bid Drawings. Bidders must submit, with their bids, scale drawings of the pole and appurtenances to be furnished. The shop drawings must show fabrication and installation details, including thicknesses, welds, fasteners, and any other pertinent information.
- (f) Quality. All castings must be carefully and correctly detailed. The City may

reject any casting that is not, in the City's opinion, of adequate quality.

- (g) Warranty. The manufacturer shall warrant that the pole and arms meet the requirements of this specification and shall warrant the poles and arms for a period of five (5) years against defects or failures occurring during normal wear and use. The Commissioner of Transportation will determine which poles or arms have not performed as required under this warranty. Any poles and arms deemed unsatisfactory will be replaced by the manufacturer at no cost to the City.

POLES AND ARMS

- 3. (a) Patterns. The Patterns used for casting are the property of the City of Chicago. The successful bidder is responsible for obtaining the patterns from the City and for returning the patterns upon request of the City, or upon completion of the contract. During the term of the contract the successful bidder is responsible for maintaining the patterns so that sharp detailed castings are obtained. (The patterns are available from Ted Terek, High Tech Pattern, Butler, Wisconsin, Phone 414-781-2455.)
- (b) Fasteners. All fasteners must be stainless steel of the dimension indicated on Drawing Number 914.
- (c) Aluminum. The pole and arms must be manufactured of cast aluminum meeting the requirements of ASTM B26, Grade 319.
- (d) Welding. Each welded joint shall be made in conformity with the standards of the American Welding Society. Welders must have proper certification for the welding operations required.
- (e) Painting. All aluminum must be shot-blasted prior to painting. All surfaces must be cleaned with an alkaline detergent to remove oil and grease. A primer must be applied within six hours of surface preparation. All aluminum must be primed with Sherwin Williams Industrial Wash Primer #60G2 or approved equal. A minimum wet thickness must be applied to provide a 2 mil dry thickness. The primer must dry for a minimum of 24 hours after which a second primer coat must be applied. All surfaces must be primed.

The finish coat shall be Sherwin Williams Polane B Polyurethane Enamel or approved equivalent. The finish coat must be applied per manufacturer's instructions. Two coats of finish must be applied. Each coat must be a minimum of 1.5 mils thickness. The finish coat must be a semi-gloss bronze to match Sherwin Williams #F63 Bronze.

TESTING

4. (a) General. All poles shall be available for testing. All testing must take place at the place of manufacture. A certified copy of each test must be submitted to the City before shipping.
- (b) Structural. The pole assembly must be constructed to conform to all current AASHTO structural and loading requirements. The manufacturer must physically test 5% of the pole assemblies on any one order. The manufacturer must create a testing procedure that will verify the design load requirements. Certified test results must be presented to the City.
- (c) Welds. All welds of 5% of the pole assemblies must be inspected for penetration and soundness. Welds must be tested by the magnetic particle inspection method or by radiography.
- (d) Acceptance. If any pole assembly fails any test, it will be decided by the City, based on the nature of the failure, whether the entire order will be rejected, or whether the manufacturer will be required to subject each pole assembly to testing.

PACKAGING

5. (a) General. The pole assemblies shall be shipped in bundles weighing a maximum of 5,000 pounds. Each piece must be individually wrapped and protected from shifting or damage. Materials such as lumber, non-marring banding, and other appropriate bundling materials must be used so that there will be no shifting or breakage of contents. Each bundle must be capable of being lifted by a fork lift truck and the bundles must be shipped on a flat bed truck.
- (b) Hardware. Any hardware not attached to the pole or poles arms must be carefully wrapped. Payment will be withheld for any delivery missing any hardware. Damaged parts will be considered as an incomplete delivery as regards payment.

**ELECTRICAL SPECIFICATION 1493
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 6, 2014**

**TRAFFIC SIGNAL: VEHICULAR, TWELVE-INCH
SINGLE FACE, SINGLE OR MULTIPLE-SECTION,
POLYCARBONATE, LED OR INCANDESCENT**

1. GENERAL REQUIREMENTS

- 1.1 This specification states the requirements for twelve-inch, single face, single and multiple-section, traffic signals with polycarbonate housings, using LED or incandescent light source, for use in the traffic control system of the City of Chicago. Units include red ball, yellow ball, green ball, red arrow, yellow arrow, green arrow, red bicycle, yellow bicycle, green bicycle, white vertical bar, and white horizontal bar.
- 1.2 Sample and Certified Test Reports. One complete signal, fully assembled and wired, of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- 1.3 Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:
- American Association of State Highway and Transportation Officials (AASHTO)
 - American Iron and Steel Institute (AISI)
 - American Society for Testing and Materials (ASTM)
 - Institute of Transportation Engineers (ITE)
 - National Electrical Manufacturers Association (NEMA)
 - Underwriters Laboratories (UL)
- 1.4 Approval. Approval will mean approval in writing by the Commissioner or his duly authorized representative.
- 1.5 Warranty. The manufacturer shall warrant the signals to meet the requirements of this specification, and shall warrant all equipment, components, parts and appurtenances against defective design, material and workmanship for a period of 3

years from date of delivery [date of acceptance for contract construction]. In addition, LED optical modules must carry a 7 year warranty against failure or loss of color (chromaticity) and signal brightness (luminance) below minimum acceptable ITE standard levels from date of delivery [date of acceptance for contract construction]. In the event defects or failures occur in the units during the warranty period, the manufacturer must replace all defective units, at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The warranty must cover all units delivered in an order or installed by contract, and must include unit serial numbers. The warranty must be signed and dated by an official of the manufacturer who is empowered by the manufacturer to enter into such a warranty.

2. MATERIALS AND EQUIPMENT REQUIREMENTS

2.1 The traffic signal heads shall conform to ITE Standard "Vehicle Traffic Control Signal Heads" (VTCSH), in which the most recently published revision will govern.

2.2 Housing. The housing of each section must be one piece, ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with integral top, bottom, and sides, having a minimum thickness of 0.1 inch.

(a) The polycarbonate shall meet or exceed the following tests:

TEST	REQUIRED	METHOD
Specific gravity	1.17 minimum	ASTM D 792
Vicat Softening temp	310-320° F	ASTM D 1525
Brittleness temp.	-200° F	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile strength, yield	8,500 PSI	ASTM D 638
Elongation at yield	5.5-8.5%	ASTM D 638
Shear strength, yield	5,500 PSI min.	ASTM D 732
Izod impact strength (notched, .125" thick)	12-16 ft-lbs/in.	ASTM D 256
Fatigue strength (at 2.5 mm cycles)	950 PSI min.	ASTM D 671

(b) Assembly. A traffic signal section shall be comprised of, but not limited to, the housing, hinged door, visor, optical unit and all necessary gaskets and hardware. The multi-section, single face, traffic signal shall be comprised of single face single sections assembled together, containing an internally mounted terminal block. Arrow indications must be shipped as single sections. The traffic signals shall be designed and constructed to permit sections to be assembled together, one above the other, forming a weatherproof and dust-tight unit.

(c) Individual sections shall be fastened together with a coupling washer

assembly composed of 2 washers, 3 zinc plated bolts, nuts, and lock washers which lock the individual sections together. As an alternative, individual sections may be fastened together with 4 cadmium plated bolts, lock washers, and nuts.

- (d) Height. The overall height of an assembled traffic signal must be 14 inches ± 1 inch for a single-section signal, 42 inches ± 3 inches for a three-section signal, and 70 inches ± 5 inches for a five-section signal.
- (e) Mounting. The traffic signal shall be designed for mounting with standard traffic signal brackets using 1.5 inch pipe size fittings.
- (f) Positioning Device. The top and bottom opening of each housing must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments. A total of 72 teeth must be provided in the serrated bosses to allow the signal face to be rotated 360° about its axis. The teeth shall be clean and well defined to provide positive positioning.
- (g) Hinges. The signal housing shall be sectional; one section for each optical unit. Each housing must have 4 integral hinge lugs, with stainless steel hinge pins (AISI 304 or equivalent), located on the left side for mounting the door. The hinge pins shall be straight and not protrude past the outside of the housing lugs. The housing must have 2 integral latching bolt lugs on the right side each with a stainless steel hinge pin to which a latching bolt (AISI 304 or equivalent), washer, and wing nut will be attached. The wing nuts must be captive. Each housing must be equipped with holes to be used for mounting backplates.
- (h) Door. The door shall be a one piece ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with a minimum thickness of 0.1 inch. Two hinge lugs on the left side and 2 sets of latch screw jaws centered on the right side, as viewed from the front of the signal, must be integrally cast with the housing door. The door must be hinged to the housing with 2 stainless steel hinge pins, drive fitted. Two stainless steel latch screws and wing nut and washer assemblies on the latch side of the housing body shall provide for opening and closing the door without the use of tools. The door must have holes with threaded metal inserts for stainless steel machine screws to secure the visor and the lens. The inside of the door must be grooved to accommodate a one piece, air-cored ethylene propylene diene monomer (EPDM) gasket to provide a weatherproof and dust proof seal when the door is closed. The inside of the door must have 4 equally spaced threaded metal inserts for the lens attachment. The outside of the door must have an integral rim completely encircling the lens opening to prevent leakage between the door and the lens. The rim must have 4 equally spaced tabs around the circumference with threaded metal inserts for the visor.

- (i) Visor. Each traffic signal shall have a visor for each signal indication (section). The visor shall be the tunnel type, 9.25 inches long, fabricated of ultraviolet stabilized polycarbonate resin of the specified color, injection molded. The visor shall fit tightly against the door and not permit any light leakage between the door and visor. All hardware necessary for, but not limited to, attachment of the visor must be of stainless steel. The visor must have 4 mounting lugs for attaching the visor to the door. Screws must go through the visor lugs into the metal inserts in the door to secure the visor.

2.3 The traffic signal heads shall be provided with incandescent or LED optical modules as specified in the line item [or Contract Plans].

2.3.1 INCANDESCENT OPTICAL UNITS

- (a) Incandescent Optical Unit. The incandescent optical unit consists of the lens, reflector and lamp holder. The optical unit and visor shall be designed as a whole so as to eliminate the return of outside rays entering the unit from above the horizontal (known as sun phantom). The optical unit shall be designed and assembled so that no light can escape from one indication to another.
- (b) Lenses. The red, green, and yellow polycarbonate lenses must be round with a nominal 12 inch diameter and shall conform to all requirements set forth under the heading "Traffic Signal Lenses" in the ITE standard. The red, green, and yellow arrow lenses must be round with a nominal 12 inch diameter and the outside surface must be covered, except for the arrow, with a dull or dark grey opaque material of a thickness sufficient to totally hide the light from a 2000-lumen lamp placed behind it operating at rated voltage. The opaque material shall be hard and durable and shall be bonded such that it will not peel or flake when subject to the heat of a signal lamp or when the lens is washed. The shape and size of the arrow shall meet ITE standards. The arrow shall appear uniformly illuminated when viewed from angles usually encountered in service, whatever may be the angular position of the lens in the signal section. The lens must be enclosed by an air-cored EPDM gasket providing a weather proof and dust proof seal between the lens, door, and reflector assembly. The gasketed lens must be secured to the housing door by 4 stainless steel screws (AISI 304 or equivalent) and clamps equally spaced around the lens opening. The door must have threaded metal inserts to receive the screws.
- (c) Reflector. The reflector shall be fabricated of high-purity, clad-type aluminum sheet formed to a parabolic shape and cut to fit in a circular polycarbonate, hinged frame for rigid mounting within the housing. The circular rim of the reflector shall be mounted in such a way as to seal the internal optical system by being compressed against the lens gasket when the signal door is closed. The reflecting surface must be an "ALZAK" class SI

specular finish having a minimum reflectivity of 82% and a protective oxide coating. The reflector must have an opening in the back to accommodate the lamp holder.

- (d) Lamp Holder. The lamp holder must have a heat, moisture, and weatherproof molded phenolic housing designed to accommodate a standard 133 watt, 3 inch light center length, incandescent lamp. The lamp holder shall be so designed that it can be readily rotated and positively positioned to provide proper lamp filament orientation and focus. The inner brass shell, or ferrule, of the lamp holder must have a grip to prevent the lamp from working loose due to vibration. A gasket must be furnished at the junction of the lamp holder and the reflector.

2.3.2 LIGHT EMITTING DIODE (LED) OPTICAL MODULES

- (a) Light emitting diode (LED) optical modules shall consist of an integral unit containing the following components: power leads, housing, matrix of light emitting diodes (LEDs) emitting monochromatic light of desired signal color, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 hertz power.
- (b) The LED module shall be of such dimensions as to permit mounting in any standard traffic signal housing, be interchangeable with incandescent optical units, and must include appropriate gasket for this purpose. Gasketing provided must provide a watertight seal meeting existing ITE standard for signal heads, and exclude the infiltration of moisture into either the signal housing or into the LED optical unit case.
- (c) The LED module shall meet the applicable requirements of the ITE standards for Vehicle Traffic Control Signal Heads (VTCSH) Part 2: LED Vehicle Signal Modules, for color (chromaticity), signal brightness (luminance), and beam spread (luminance at various vertical and horizontal angles).
- (d) Minimum brightness of LED signal units shall be in accordance with the luminous requirements in a standard testing procedure as defined by Section 4 of the VTCSH Part 2: LED Vehicle Signal Modules. During the required operating life of LED signal units, the luminance output of the units must not be less than 60% of the values specified in the standard.
- (e) The module indicator surface shall be constructed of ultraviolet (UV) stabilized, impact resistant polycarbonate, acrylic, or other approved material. The surface must be anti-glare, smooth texture, and clear.
- (f) Modules shall consist of LEDs uniformly distributed to present a homogeneous appearance on the indicator face from a wide viewing angle.

- (g) LEDs shall be wired so that the loss of a single LED or a string of LEDs will not reduce the luminescence below the minimum requirement.
- (h) For purposes of this specification, failure of a single unit is defined as an occurrence where the luminescence of the signal measured in candela in standard test procedures is less than the required initial luminance or luminance at time points and conditions specified; or where minimum required brightness is achieved, but 2 or more series strings of LEDs or in excess of 20% of LEDs are not operable.
- (i) Module power supply shall be constant current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker. Units must be fully operable over a range of 90 volts to 130 volts at 60 hertz \pm 3 hertz.
- (j) Surge protection: Each module must be provided with integral surge protection to withstand transient of 600 volt, 100 microsecond rise and 1 millisecond pulse width. The surge protector shall provide full electrical and physical protection to all unit components.
- (k) Maximum permissible power consumption at ambient conditions (nominal 120 volts, 60 hertz, 70°F.) must be 30 watts at a minimum 90% power factor. Power consumed must not vary by more than 10% from nominal power consumption over a voltage range of 105 volts to 125 volts, and over permissible environmental ranges.
- (l) Modules must be fully operable at temperature ranges of -40°F. (-40°C.) to +165° F. (+74°C.) at up to 100% relative humidity.
- (m) Modules shall be clearly marked on the back surface of the unit in a permanent manner showing information required for warranty and long term performance. Information to be shown must include manufacturer name, date of manufacture, electric power requirements, signal model type including color and indication type, and signal serial number.
- (n) The LED module shall be compatible with the traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal load switches and conflict monitors.
- (o) Modules shall meet applicable sections of Title 47, Sub-Part B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.
- (p) Total harmonic distortion (THD) induced into the voltage and current AC

power line sine waves must not exceed 20%.

- (q) LED modules must meet the requirements of VTCSH Part 2: LED Vehicle Signal Modules Section 6.3.1 for signal burn-in.

- 2.4 Wiring. Each lamp holder must be furnished with two (2) leads color coded as follows:

First Lead Wire:

White	Common
-------	--------

Second Lead Wire:

Red	Red Section
Yellow	Yellow Section
Green	Green Section
Green with Black Tracer	Green Arrow Section
Yellow with Black Tracer	Yellow Arrow Section
Red with Black Tracer	Red Arrow Section
Green with White Tracer	Green Bicycle Section
Yellow with White Tracer	Yellow Bicycle Section
Red with White Tracer	Red Bicycle Section
Any Other Colors	Bus Sections

The leads must be No. 18 AWG stranded copper wire rated at 600 volt, 105° C., with thermo-plastic insulation. The leads must connect to the terminal strip without being spliced. The ends of the leads must be stripped of 0.5 inches of insulation and tinned.

- 2.5 Terminal Strip. A dual-point, barrier type terminal strip with a solid base and pressure plate type connectors shall be securely attached at both ends to the housing body inside the "Green" section of the signal head, or other approved section within a multiple section head.
- 2.6 Cable. One 11 foot length of flexible electric cord, medium duty, type SO, No. 16 AWG stranded copper conductor, color coded, rubber insulated, neoprene jacketed, must be furnished with each signal head. The number of conductors must include a neutral and one leg for each section. Both ends of each cable length must be carefully stripped of 6 inches of jacket and 1 inch of insulation, and each conductor properly tinned.
- 2.7 Gaskets. Wherever necessary to make a completely dustproof, moistureproof and weatherproof assembly of the housing and optical system, approved type gaskets of neoprene or silicone rubber shall be provided.

3. TESTING AND DOCUMENTATION REQUIREMENTS

- 3.1 Documentation. The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic signals being supplied meet or exceed the specification requirements. All LED modules shall be tested by a nationally recognized testing laboratory (NRTL), such as Intertek (ETL division), to demonstrate compliance with the latest ITE VTCSH specification. All LED units shall have the testing laboratory's label attached.
- 3.2 Inspection. The signals shall be subject to inspection at the request of the Commissioner. Final inspection shall be made at point of delivery. Any signal rejected shall be removed, disposed of, and replaced by the contractor at his sole cost.

4. PACKAGING

- 4.1 Packing. Each traffic signal assembly shall be packed in a suitable carton so secured that the signal will not be damaged during shipment, handling or storage.
- 4.2 Marking. Each carton containing a traffic signal shall be clearly marked on the outside in letters not less than 3/8 inch tall with the legend: "TRAFFIC SIGNAL, TWELVE-INCH, POLYCARBONATE" or "TRAFFIC SIGNAL, TWELVE INCH, POLYCARBONATE, LED OPTICS" and the number of Sections as required, the color and indication types, the name of the manufacturer, the date of manufacture, the pertinent Contract Number and the appropriate City Commodity Code Number.

**ELECTRICAL SPECIFICATION 1495
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 7, 2014**

**TRAFFIC SIGNAL MOUNTING BRACKET
POLYCARBONATE, SIDE OF POLE**

SCOPE

1. This specification states the requirements for polycarbonate brackets designed for mounting traffic and pedestrian signal heads from the side of poles.

GENERAL REQUIREMENTS

2. (a) Sample and Certified Test Reports. One complete signal bracket of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (b) Standards. Equipment furnished under this specification must meet the appropriate requirements of the following standards, as required within the body of this specification:

American Association of State Highway and Transportation Officials (AASHTO)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
National Electrical Manufacturers Association (NEMA)
- (c) Approval. Approval will mean approval in writing by the Commissioner or his/her duly authorized representative.
- (d) Warranty. The manufacturer shall warrant the signal bracket to meet the requirements of this specification, and shall warrant all equipment, components, parts and appurtenances against defective design, material and workmanship for a period of 3 years from date of delivery [date of acceptance for contract construction]. In the event defects and failures

become apparent during this period, the manufacturer must replace the defective brackets at no expense to the City. This warranty must be evidenced by a letter or certificate of warranty submitted to the City at the time final delivery is made.

MATERIAL

- 3. (a) The bracket must be one piece, ultra violet stabilized polycarbonate resin of the specified color, injection molded complete with integral top, bottom, and sides.
- (b) The polycarbonate formulation used must provide these physical properties (Tests may be performed on separately molded specimens).

<u>TEST</u>	<u>REQUIRED</u>	<u>METHOD</u>
Specific gravity	1.17 minimum	ASTM D 792
Vicat Softening temp	310-320° F	ASTM D 1525
Brittleness temp.	-200° F	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile strength, yield	8,500 PSI	ASTM D 638
Elongation at yield	5.5-8.5%	ASTM D 638
Shear strength, yield	5,500 PSI min.	ASTM D 732
Izod impact strength (notched, 1/8" thick)	12-16 ft-lb/in.	ASTM D 256
Fatigue strength (at 2.5 mm cycles)	950 PSI min.	ASTM D 671

- (c) Glass. The polycarbonate may be glass impregnated to increase strength.

POSITIONING DEVICE

- 4. The top and bottom opening of the bracket must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments to eliminate undesirable rotation or misalignment of the signal head between sections. A total of 72 teeth must be provided in the serrated bosses to allow the signal head to be rotated 360° about its axis. The teeth must be clean and sharp to provide positive positioning with the grooves of the signal head.

HARDWARE

- 5. The mounting brackets must be provided complete with 1 polycarbonate shim(.25 inches thick), one 1.5 inch chase nipple with rubber gasket, and 1 pinnacle cap with rubber gasket.

DIMENSIONS

6. The bracket must have nominal dimensions of 12 inches long, by 6 inches high, by 3 inches wide.

WIRING SPACE

7. The bracket must have an integral molded wireway with a minimum 1.5 inch diameter opening.

DESIGN STRENGTH

8. The bracket must be designed to support a 12 inch, single face, five-section, polycarbonate signal head.

TESTING AND DOCUMENTATION REQUIREMENTS

9. (a) Documentation. The contractor must provide certified manufacturing and testing documentation to demonstrate that the brackets being supplied meet or exceed the specification requirements.
- (b) Inspection. The brackets will be subject to inspection at the request of the Commissioner. Final inspection must be made at point of delivery. Any bracket rejected must be removed, disposed of, and replaced by the contractor at his sole cost.

PACKAGING

10. (a) Each bracket must be packed in a suitable carton so secured that the bracket will not be damaged during shipment, handling, or storage.
- (b) Marking. Each carton containing brackets must be clearly marked on the outside in letters not less than 3/8 inch tall with the legend: "POLYCARBONATE SIGNAL BRACKET, SIDE OF POLE" the appropriate City Commodity Code Number, the name of the manufacturer, the date of manufacture, and the pertinent contract number.

**ELECTRICAL SPECIFICATION 1496
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 7, 2014**

**TRAFFIC SIGNAL FLASHER: TWELVE-INCH
SINGLE FACE, TWO-SECTION,
POLYCARBONATE, LED**

1. GENERAL REQUIREMENTS

- 1.1 This specification states the requirements for a twelve-inch, single face, two-section, traffic signal flasher with polycarbonate housing, using LED light source, for use in advance of a traffic signal intersection or for identifying an in-street permanent obstacle. Units will include 2 sections, each with a 12 inch yellow ball indication. A flasher located within one of the sections will alternately flash each yellow ball.
- 1.2 Sample and Certified Test Reports. One complete signal, fully assembled and wired, of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- 1.3 Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:
- American Association of State Highway and Transportation Officials (AASHTO)
 - American Iron and Steel Institute (AISI)
 - American Society for Testing and Materials (ASTM)
 - Institute of Transportation Engineers (ITE)
 - National Electrical Manufacturers Association (NEMA)
 - Underwriters Laboratories (UL)
- 1.4 Approval. Approval will mean approval in writing by the Commissioner or his duly authorized representative.
- 1.5 Warranty. The manufacturer shall warrant the signals to meet the requirements of this specification, and shall warrant all equipment, components, parts and appurtenances against defective design, material and workmanship for a period of 3 years from date of delivery [date of acceptance for contract construction]. In

addition, LED modules must carry a 7 year warranty against failure or loss of color (chromaticity) and signal brightness (luminance) below minimum acceptable ITE standard levels from date of delivery [date of acceptance for contract construction]. In the event defects or failures occur in the units during the warranty period, the manufacturer must replace all defective units, at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The warranty must cover all units delivered in an order or installed by contract, and must include LED module serial numbers. The warranty must be signed and dated by an official of the manufacturer who is empowered by the manufacturer to enter into such a warranty.

2. MATERIALS AND EQUIPMENT REQUIREMENTS

2.1 The traffic signal heads shall conform to ITE Standard "Vehicle Traffic Control Signal Heads" (VTCSH), in which the most recently published revision will govern.

2.2 Housing. The housing of each section must be one piece, ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with integral top, bottom, and sides, having a minimum thickness of 0.1 inch.

(a) The polycarbonate shall meet or exceed the following tests:

TEST	REQUIRED	METHOD
Specific gravity	1.17 minimum	ASTM D 792
Vicat Softening temp	310-320° F	ASTM D 1525
Brittleness temp.	-200° F	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile strength, yield	8,500 PSI	ASTM D 638
Elongation at yield	5.5-8.5%	ASTM D 638
Shear strength, yield	5,500 PSI min.	ASTM D 732
Izod impact strength (notched, .125" thick)	12-16 ft-lbs/in.	ASTM D 256
Fatigue strength (at 2.5 mm cycles)	950 PSI min.	ASTM D 671

(b) Assembly. A traffic signal section shall be comprised of, but not limited to, the housing, hinged door, visor, optical unit and all necessary gaskets and hardware. The two-section, single face, traffic signal shall be comprised of single face single sections assembled together, containing an internally mounted solid-state flasher and terminal block. The traffic signals shall be designed and constructed to permit sections to be assembled together, one above the other, forming a weatherproof and dust-tight unit.

(c) Individual sections shall be fastened together with a coupling washer assembly composed of 2 washers, 3 zinc plated bolts, nuts, and lock washers which lock the individual sections together. As an alternative, individual

sections may be fastened together with 4 cadmium plated bolts, lock washers, and nuts.

- (d) Height. The overall height of an assembled traffic signal must be 28 inches ± 2 inches.
- (e) Mounting. The traffic signal shall be designed for mounting with standard traffic signal brackets using 1.5 inch pipe size fittings.
- (f) Positioning Device. The top and bottom opening of each housing must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments. A total of 72 teeth must be provided in the serrated bosses to allow the signal face to be rotated 360° about its axis. The teeth shall be clean and well defined to provide positive positioning.
- (g) Hinges. The signal housing shall be sectional; one section for each optical unit. Each housing must have 4 integral hinge lugs, with stainless steel hinge pins (AISI 304 or equivalent), located on the left side for mounting the door. The hinge pins shall be straight and not protrude past the outside of the housing lugs. The housing must have 2 integral latching bolt lugs on the right side each with a stainless steel hinge pin to which a latching bolt (AISI 304 or equivalent), washer, and wing nut will be attached. The wing nuts must be captive. Each housing must be equipped with holes to be used for mounting backplates.
- (h) Door. The door shall be a one piece ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with a minimum thickness of 0.1 inch. Two hinge lugs on the left side and 2 sets of latch screw jaws centered on the right side, as viewed from the front of the signal, must be integrally cast with the housing door. The door must be hinged to the housing with 2 stainless steel hinge pins, drive fitted. Two stainless steel latch screws and wing nut and washer assemblies on the latch side of the housing body shall provide for opening and closing the door without the use of tools. The door must have holes with threaded metal inserts for stainless steel machine screws to secure the visor and the LED module. The inside of the door must be grooved to accommodate a one piece, air-cored ethylene propylene diene monomer (EPDM) gasket to provide a weatherproof and dust proof seal when the door is closed. The outside of the door must have an integral rim completely encircling the opening to prevent leakage between the door and the LED module. The rim must have four equally spaced tabs around the circumference with threaded metal inserts for the visor.
- (i) Visor. Each traffic signal shall have a visor for each signal indication section. The visor shall be the tunnel type, 9.25 inches long, fabricated of ultraviolet stabilized polycarbonate resin of the specified color, injection molded. The visor shall fit tightly against the door and not permit any light leakage

between the door and visor. All hardware necessary for attachment of the visor must be of stainless steel. The visor must have four mounting lugs for attaching the visor to the door. Screws must go through the visor lugs into the metal inserts in the door to secure the visor.

2.3 LIGHT EMITTING DIODE (LED) OPTICAL MODULES

- (a) Light emitting diode (LED) optical modules shall consist of an integral unit containing the following components: power leads, housing, matrix of light emitting diodes (LEDs) emitting monochromatic light of desired signal color, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 hertz power.
- (b) The LED module shall be of such dimensions as to permit mounting in any standard traffic signal housing. Gasketing provided must provide a watertight seal meeting existing ITE standard for signal heads, and exclude the infiltration of moisture into either the signal housing or into the LED module unit case.
- (c) The LED module shall meet the applicable requirements of the ITE standards for Vehicle Traffic Control Signal Heads(VTCSH) Part 2: LED Vehicle Signal Modules, for color (chromaticity), signal brightness (luminance), and beam spread (luminance at various vertical and horizontal angles).
- (d) Minimum brightness of LED signal modules shall be in accordance with the luminous requirements in a standard testing procedure as defined by Section 4 of the VTCSH Part 2: LED Vehicle Signal Modules. During the required operating life of LED signal modules, the luminance output of the units must not be less than 60% of the values specified in the standard.
- (e) The module indicator surface shall be constructed of ultraviolet (UV) stabilized, impact resistant polycarbonate, acrylic, or other approved material. The surface must be anti-glare, smooth texture, and clear.
- (f) Modules shall consist of LEDs uniformly distributed to present a homogeneous appearance on the face of the lens from a wide viewing angle.
- (g) LEDs shall be wired so that the loss of a single LED or a string of LEDs will not reduce the luminescence below the minimum requirement.
- (h) For purposes of this specification, failure of a single unit is defined as an occurrence where the luminescence of the signal measured in candela in standard test procedures is less than the required initial luminance or luminance at time points and conditions specified; or where minimum required brightness is achieved, but 2 or more series strings of LEDs or in excess of 20% of LEDs are not operable.

- (i) Module power supply shall be constant current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker. Units must be fully operable over a range of 90 volts to 130 volts at 60 hertz \pm 3 hertz.
 - (j) Surge protection: Each unit must be provided with integral surge protection to withstand transient of 600 volt, 100 microsecond rise and 1 millisecond pulse width. The surge protector shall provide full electrical and physical protection to all unit components.
 - (k) Maximum permissible power consumption at ambient conditions (nominal 120 volts, 60 hertz, 70° F.) must be 30 watts at a minimum 90% power factor. Power consumed must not vary by more than 10% from nominal power consumption over a voltage range of 105 volts to 125 volts, and over permissible environmental ranges.
 - (l) Modules must be fully operable at temperature ranges of -40° F. (-40° C.) to +165° F. (+74° C.) at up to 100% relative humidity.
 - (m) Modules shall be clearly marked on the back surface of the unit in a permanent manner showing information required for warranty and long term performance. Information to be shown must include manufacturer name, date of manufacture, electric power requirements, signal model type including color and indication type, and signal serial number.
 - (n) The LED module shall be compatible with the traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal load switches and conflict monitors.
 - (o) Modules shall meet applicable sections of Title 47, Sub-Part B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.
 - (p) Total harmonic distortion (THD) induced into the voltage and current AC power line sine waves must not exceed 20%.
 - (q) LED modules must meet the requirements of VTCSH Part 2: LED Vehicle Signal Modules Section 6.3.1 for signal burn-in.
- 2.4 Flasher. A solid-state flashing device shall be installed in one section. This device must meet NEMA standards for Traffic Control Systems, TS-1. This device must be wired to the 2 LED signal modules so as to provide alternate flashing of the modules. The unit must function according to ITE standards.

- 2.5 Wiring. Each LED module must be furnished with 2 wire leads color coded as follows:

White	Common
Yellow	Yellow Section

The wires must be No. 18 AWG stranded copper wire rated at 600 volt, 105°C., with thermo-plastic insulation. The leads must connect to the terminal strip without being spliced. The ends of the leads must be stripped of 0.5 inches of insulation and tinned.

- 2.6 Terminal Strip. A dual-point, barrier type terminal strip with a solid base and pressure plate type connectors shall be securely attached at both ends to the housing body inside one of the sections.
- 2.7 Cable. One 11 foot length of flexible electric cord, medium duty, type SO, No. 16 AWG stranded copper conductor, color coded, rubber insulated, neoprene jacketed, must be furnished with each signal head. The number of conductors must be 2. Both ends of each cable length must be carefully stripped of 6 inches of jacket and 1 inch of insulation, and each conductor properly tinned.
- 2.8 Gaskets. Wherever necessary to make a completely dustproof, moistureproof and weatherproof assembly of the housing and optical system, approved type gaskets of neoprene or silicone rubber shall be provided.

3. TESTING AND DOCUMENTATION REQUIREMENTS

- 3.1 Documentation. The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic signals being supplied meet or exceed the specification requirements. All LED modules shall be tested by a nationally recognized testing laboratory (NRTL), such as Intertek (ETL division), to demonstrate compliance with the latest ITE VTCSH specification. All LED units shall have the testing laboratory's label attached.
- 3.2 Inspection. The signals shall be subject to inspection at the request of the Commissioner. Final inspection shall be made at point of delivery. Any signal rejected shall be removed, disposed of, and replaced by the contractor at his sole cost.

4. PACKAGING

- 4.1 Packing. Each traffic signal assembly shall be packed in a suitable carton so secured that the signal will not be damaged during shipment, handling or storage.
- 4.2 Marking. Each carton containing a traffic signal shall be clearly marked on the

outside in letters not less than 3/8 inch tall with the legend: "TRAFFIC SIGNAL FLASHER, LED, TWELVE-INCH, TWO-SECTION, POLYCARBONATE", the name of the manufacturer, the date of manufacture, the pertinent Contract Number and the appropriate City Commodity Code Number.

**ELECTRICAL SPECIFICATION 1504
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 6, 2014**

**CHICAGO 2000 PEDESTRIAN POLE: 12'-0", 11 GAUGE FLUTED, TAPERED
STEEL FOR 15" BOLT CIRCLE**

SUBJECT

1. This specification states the requirements for an Anchor Base Chicago 2000 Pedestrian Pole. This pole will support a tenon mounted luminaire. A split pedestal base described under a different material specification, will be provided to cover the bottom nominal 31" of the pole. This pole will be served by underground cables.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual light pole dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted, and will be rejected as an incomplete submittal. These drawings must also be submitted in electronic format in Microstation 95, if requested; failure to provide drawings in this format will be cause for rejecting the submittal.

Dimensions must include but will not be limited to: mast height, width, taper, and fluting; base plate length, width, thickness, and bolt circle; handhold length, width, plan location, and height above base plate; component attachment plan locations and heights above baseplate including luminaire tenon.

Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required for components including but not limited to: handhole and luminaire tenon.

Welds must include but will not be limited to locations, sizes, and types of welds in accordance with the WELDING Section of this Specification.

- (b) Manufacturer's catalog cut sheets showing light pole designation(s), characteristics, and catalog number(s).

- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly, orientation, installation, component access and wiring, and numeric tolerances for torquing the foundation anchor bolts to the light pole base plate.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled anchor-base pole with integral components, of the manufacture intended to be furnished, will be submitted within fifteen (15) business days from receipt of notice.
- (f) Warranty. The manufacturer must warrant the performance and construction of these light poles to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the light poles have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, failure of any weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to this Contract and to the City, of any light pole assembly, or any component parts thereof, which, as determined by the Commissioner, would develop aforesaid failures. The warranty must accompany submittal information. Any light pole or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified will be incidental to this contract.

GENERAL

- 3. (a) Products. Light poles and component equipment must be the products of established manufacturers, and must be suitable for the service required. Light pole or component equipment items which are proposed as similar or identical must be the products of a single manufacturer. Masts will be manufactured by Union Metal Corporation, Valmont Industries Incorporated, or an approved equal.
- (b) Specifications. The poles must conform in detail to the requirements herein stated, and to the requirements of the following organizations as cited herein:

American Association of State Highway and Transportation Officials
(AASHTO)

American Society for Testing and Materials (ASTM)

American Welding Society (AWS)
Society for Protective Coatings (SSPC)

- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The pole must conform in design and dimensions to Standard Drawing 928.
- (e) Approval. Whenever “approval” and “approved” are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of these light poles.
- (f) Commissioner’s Review. The Commissioner will be the sole judge in determining if the submitted light poles are in compliance with this specification. The Commissioner’s decision will be final

MAST

- 4. (a) Mast Size. The mast size will be nominally 12'-0" as shown on Standard Drawing 928. The mast diameter at the bottom must be 6.61".
- (b) Mast Design. The mast must be tapered at 0.14" per foot. The 12'-0" long mast must be of monotube construction and must be rolled on a mandrel to provide a 16-flute pattern. The flutes must be neat, true to pattern, and free from cracks and flaws. Each mast must be straight and centered on its' longitudinal axis. The mast must utilize a single longitudinal weld, 70% minimum penetration, in accordance with the WELDING Section of this Specification. There must be no lateral welds in the mast other than at the base plate and at the luminaire tenon, unless noted otherwise on the Contract Drawings.
- (c) Material. The mast must be 11 gauge carbon steel in accordance with ASTM A595, Grade A.
- (d) Mast Base. The mast base must be a 1" thick steel plate of low alloy, high strength steel conforming to ASTM A 595, grade C, ASTM A 588 or ASTM A 606.
 - 1. The base must be attached to the mast so that the bearing surface of the base is at right angles to the longitudinal axis of the mast. The vertical center line of the seam must be positioned 135° counter-clockwise from the vertical center line of the handhold door frame.

2. The mast must be inserted into the base to a maximum depth which will still allow for an adequate weld to be made between the bottom of the mast and the plate. A circumferential weld must be made between the mast and the base at both the top and underside of the plate.
 3. The base plate must have four (4) 1 1/2" wide slots to accommodate 1 1/4" diameter anchor bolts. The slots must be 3 inches long along the circumference. The mast must provide for mounting on a 15" bolt circle using 1 1/4" anchor bolts, nuts and washers provided by others. Any special hardware required to facilitate installation must be provided under this contract.
- (e) Provision for Ground. A 1/2" - 13 square nut must be welded to the inside of the mast on the handhole entry frame for a ground connection.
- (f) Entry. A vertical doorframe carrying a removable door providing access to the interior of the mast must be welded into a close fitting opening centered approximately 16" above the bottom of the base. The doorframe must be formed and welded of steel with cross section not less than 1-1/2" wide by 1/4" inch thick so as to adequately reinforce the opening of the mast. The internal horizontal clearance of the doorframe must be 4"; its internal vertical height must be 8". Its upper and lower ends must be semi-circular meeting its straight sides tangentially. The frame must have two welded tabs; one at the top and one at the bottom of the door frame. The top hole must be located 13/16 of an inch from the top of the opening. The bottom hole must be located 13/16 of an inch from the bottom of the opening. These tabs must be drilled to accept a 1/4 inch screw. Stainless steel spring clips must be mounted to the tabs. These clips must be made to accept 1/4" -20 machine screws. The entry must in all respects be identical to handhole openings on poles that have already been installed and accepted by the City.
- (g) Door. The removable door must be formed of sheet steel approximately 1/8" thick. It must fit the doorframe closely and be dished so that it will stay in proper position even if its locking screws may be slightly loosened. The door must be drilled top and bottom to accept the 1/4" - 20 hex head stainless steel screws which will fasten the door to the doorframe. All doors must be interchangeable. Doors must fit pole handholes of like poles that have already been installed and accepted by the City. Alternate methods may be subject to approval by the Commissioner or his fully authorized representative.
- (h) Tag. A stainless steel tag must be attached to each pole immediately below the handhole by mechanical means and not by adhesive. The stainless steel tag must have an embossed legend which must include the pole outside diameter at the base, the overall length, and the gauge; i.e. 6.375" x 12'-0" - 11 gauge.

- (i) Interchangeability. Each member including the handhole doors in the pole and all component equipment must be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar pole.
- (j) Tenon. A tenon must be provided at the top of the pole for attachment of a luminaire. The tenon diameter must be a 3" O.D. I.P.S. pipe equivalent and must be sufficiently long to ensure positive, structurally sound mating between the mast and the attached device. In no case will the tenon be more than 3" long. The tenon must be factory assembled to the mast. The finished mast must give the appearance of a single, homogeneous mast and the entire assembly must be structurally sound so that with the weight of a luminaire, the mast will not twist, rack, vibrate or otherwise deform when subjected to the severe vibrations of wind loading, passing elevated trains or heavily loaded vehicles.
- (k) Luminaire Mounting Height. The luminaire mounting height indicates the height necessary to provide a distance of 14.0 feet from the top of the light pole foundation to the light source center of the luminaire.
- (l) Structural Requirements. The mast shall be manufactured in accordance with AASTHO's 1994 version of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". The shaft must be designed for 80 MPH wind loading with a 30% gust factor.

HARDWARE

- 5. All the hardware necessary to complete the assembly of the pole must be furnished. All hardware will be stainless steel or equal corrosion-resistant metal, or as noted in these specifications, subject to approval.

WELDING

- 6. (a) General. Where welds are required and approved, each welded joint must be thoroughly cleaned of flux and spatter, and must be made in conformity with the standards of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, in conformity with the proper interpretation of the standard welding symbols of the American Welding Society. The bidder's proposal must state the type of electrode and must describe the welding methods proposed for use in fabricating the pole.
- (b) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed.

Certifications for welding personnel must be included with the submittal information package for review.

- (c) Testing. All welds of 5% of the poles in every lot must be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection will be governed by the same conditions as in the TESTING Section. If the magnetic inspection process is used, the dry method with direct current must be employed. All transverse welds must be magnetized by the “prod” (Circular Magnetization) method. Longitudinal welds may be magnetized by either circular or longitudinal magnetization. Proposed weld inspection method must be included with the submittal information package for review.

PAINTING

- 7. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove oils and grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a “near white” surface in accordance with SSPC-SP10. Included in this process, the pretreatment process and the painting process will be the interior base section of the mast to a minimum height of 12".
- (c) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Exterior Coat. A thermosetting, weathering, Polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform 8 mil thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400°F to form a high molecular weight fusion bonded finish.
- (e) Alternate Methods. Alternate powder coat methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.
- (f) Interior Coat. The interior metal surfaces must be powder coated with a thermoplastic hydrocarbon resin containing corrosion inhibitors. The resin must be formulated for full application over untreated metal surfaces. The resin must be applied at a temperature of approximately 200°F to a minimum thickness of 3 mils. The interior thermoplastic coat must overlap the interior, thermosetting base coat by approximately 6". Alternate interior coatings may be used subject to prior approval of the Commissioner.

- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure per ASTM B117 in a 5% Na Cl (by weight) solution at 95°F and 95% relative humidity without blistering. Before test, the panel must be scribed with an “X” down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, “Measurement of Dry Paint Thickness with Magnetic Gauges,” except that the lowest “single spot measurement” in an area of two square inches must be not less than 7.0 mils.
- (i) Color. Color must be gloss black unless noted otherwise on the order. A 4" square color chip sample must be submitted for approval prior to fabrication. The chip sample must be of the same material as the pole mast, and must include the manufacturer’s name and the manufacturer’s color name as well. The sample must also include any other information required to purchase the same color for the split pedestal base.

TESTING

- 8. (a) Testing. Structural testing must be conducted on 5% of the manufacturer’s production masts for each order in which the quantity of masts is 20 or more. The testing must include coupon tests, load tests, and weld tests. All testing must be certified by the manufacturer, or an independent lab.
- (b) The selection of pole masts must be a random selection from the entire completed lot of pole masts on the order.
- (c) Material Test. Coupon tests as outlined in ASTM A53 and A 595, A588, or A606.
- (d) Load tests for masts as described herein. With base rigidly anchored, a test load of 1000 pounds must be applied at a point approximately two feet (2' - 0") from the free end. The load must be applied at right angles to the center line of the mast and in the same vertical plane. The deflection must not be greater than 13". Within one (1) minute after the test load is released, measurement will be made of the set taken by the mast. This set must not be greater than 1.0". The deflection measurement device must be reset to zero and the test load must be reapplied. The deflection must not change from the deflection noted in the first test by more than ±5%. No measurable set must be noted within one (1) minute after test load is released. The mast must then be checked to insure that it is still securely fastened, that it is plumb, and that no cracks have developed in either the mast or base plate.
- (e) Weld tests as described in the WELDING Section of this Specification.

SHIPMENT AND DELIVERY

9. (a) General. The poles must be carefully inspected at the factory prior to shipment to assure that the poles are complete and free of defects. When poles are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the poles. All hardware must be packaged in a clear container and labeled.
- (b) Packaging. The poles must be shipped in bundles weighing a maximum of 5,000 pounds. Each pole must be individually wrapped so that it can be bundled and unbundled without damage to the pole or its finish. Each pole wrapping must be clearly labeled, using 2 inch letters identifying the pole type, manufacturer, and date of manufacture. Specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of poles. Instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years.
- (c) Bundles. The bundles will consist of poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.) non-marring banding, and other appropriate bundling materials will be used to make a rigid, long lasting bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a forklift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (d) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the pole must be carefully wrapped and securely attached to each bundle. Payment will be withheld for any units provided without the appropriate appurtenant devices and hardware. Cracked, broken, chipped or damaged units will also be considered as incomplete quantities as regards payment.

**ELECTRICAL SPECIFICATION 1505
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JULY 17, 2006**

**CHICAGO 2000 LIGHT POLE: ANCHOR BASE, 32'-6", 7 GAUGE FLUTED,
TAPERED STEEL FOR 15" BOLT CIRCLE**

SUBJECT

1. This specification states the requirements for an Anchor Base Chicago 2000 Light Pole. The pole must support single or twin, simplex mounted mast arm(s) and teardrop luminaire(s). A split pedestal base will be provided to cover the bottom nominal 40" of the pole. A finial will be mounted at the top of the pole. This pole will be served by underground cables.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual light pole dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted and will be rejected as an incomplete submittal. These drawings must also be submitted in electronic format in MicroStation 95, if requested; failure to provide drawings in this format will be cause for rejecting the submittal.

Dimensions must include but will not be limited to: mast height, width, taper, and fluting; base plate length, width, thickness, and bolt circle; handhole length, width, and height above base plate; component attachment plan locations and heights above baseplate including simplex brackets, finial top, banner arms, and flower basket rosettes; and all decorative bracelet heights above base plate.

Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required for components including but not limited to: handhole; simplex brackets; finial top; banner arm attachments and finials; flower basket rosettes; and all decorative bracelets. All components must be clearly identified on the drawings.

Welds must include but will not be limited to: locations, sizes, and types of welds in accordance with the WELDING Section of this Specification.

- (b) Manufacturer's catalog cut sheets showing light pole designation(s), characteristics, and catalog number(s).

- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly, orientation, installation, component access and wiring, and numeric tolerances for torquing the foundation anchor bolts to the light pole base plate.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled anchor-base pole with integral components, or one mast head and finial, or ornamental bracelets, of the manufacture intended to be furnished, must be submitted for review within fifteen (15) business days from receipt of notice.
- (f) Warranty. The manufacturer must warrant the performance and construction of these light poles to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the light poles have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, failure of any weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to this Contract and to the City, of any light pole assembly, or any component parts thereof, which, as determined by the Commissioner, would develop aforesaid failures. The warranty must accompany submittal information. Any light pole or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified will be incidental to this contract.

GENERAL

- 3. (a) Products. Light pole masts and component equipment must be the products of a single, established manufacturer, and must be suitable for the service required. Light pole masts or component equipment items which are proposed as similar or identical must be the products of a single manufacturer. Masts will be manufactured by Union Metal Corporation, Valmont Industries Incorporated, or an approved equal.
- (b) Specifications. The pole shall conform in detail to the requirements herein stated and to the requirements of the following organizations as cited herein:

American Association of State Highway and Transportation Officials (AASHTO)

American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)

- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The pole must conform in design and dimensions to corresponding Standard Drawings 930, 930C, and 724.
- (e) Approval. Whenever “approval” and “approved” are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of these light poles.
- (f) Commissioner’s Review. The Commissioner will be the sole judge in determining the submitted light pole compliance with this Specification. The Commissioner’s decision will be final.

MAST

- 4. (a) Mast Size. The mast size must be nominally 32'-6" as shown on Standard Drawing 930. The mast diameter at the bottom must be 10".
- (b) Mast Design. The mast must be tapered at 0.14" per foot. The 32'-6" long mast must be of monotube construction and must be rolled on a mandrel to provide a 16-flute pattern. The flutes must be neat, true to pattern, and free from cracks and flaws. Each mast must be straight and centered on its' longitudinal axis. The mast must utilize a single longitudinal weld, 70% minimum penetration, in accordance with the WELDING Section of this Specification. There must be no lateral welds in the mast other than at the base plate and at the flower basket rosettes.
- (c) Material. The mast must be 7 gauge, high strength low alloy steel in accordance with ASTM A595, Grade A.
- (d) Mast Base. The mast base must be a 1¼" thick steel plate of low alloy, high strength steel conforming to ASTM A 595, Grade C, ASTM A 588 or ASTM A 606.
 - 1. The base must be attached to the mast so that the bearing surface of the base is at right angles to the longitudinal axis of the mast. The vertical center line of the seam must be positioned 135° counter-clockwise from the vertical center line of the mast arm support plates.
 - 2. The mast must be inserted into the base to a maximum depth which will still allow for an adequate weld to be made between the bottom

of the mast and the plate. A circumferential weld must be made between the mast and the base at both the top and underside of the plate.

3. The base plate must have four (4) 1 1/2" wide slots to accommodate 1 1/4" diameter anchor bolts. The slots must be a total of three inches long measured along the circumference. The mast must provide for mounting on a 15" bolt circle using 1 1/4" anchor bolts, nuts and washers provided by others. Any special hardware required to facilitate installation must be provided under this contract.
- (e) Provision for Ground. A 1/2" - 13 square nut must be welded to the inside of the mast on the handhole entry frame for a ground connection.
- (f) Entry. A vertical doorframe carrying a removable door providing access to the interior of the mast must be welded into a close fitting opening centered approximately 24" above the bottom of the base. The doorframe must be formed and welded of steel with cross section not less than 1-1/2" wide by 1/4" inch thick so as to adequately reinforce the opening of the mast. The internal horizontal clearance of the doorframe must be 4"; its internal vertical height must be 8". Its upper and lower ends must be semi-circular meeting its straight sides tangentially. The frame must have two welded tabs; one at the top and one at the bottom of the door frame. The top hole must be located 13/16 of an inch from the top of the opening. The bottom hole must be located 13/16 of an inch from the bottom of the opening. These tabs must be drilled to accept a 1/4 inch screw. Stainless steel spring clips must be mounted to the tabs. These clips must be made to accept 1/4"-20 machine screws. The entry must in all respects be identical to handhole openings on poles that have already been installed and accepted by the City.
- (g) Door. The removable door must be formed of sheet steel approximately 1/8" thick. It must fit the doorframe closely and be dished so that it will stay in proper position even if its locking screws become slightly loosened. The door must be drilled top and bottom to accept the 1/4" - 20 hex head stainless steel screws which will fasten the door to the doorframe. All doors must be interchangeable. Doors must fit pole handholes of like poles that have already been installed and accepted by the City. Alternate methods will be subject to approval by the Commissioner or his fully authorized representative.
- (h) Tag. A stainless steel tag must be attached to each pole immediately below the handhole by mechanical means and not by adhesive. The stainless steel tag must have an embossed legend which must include the pole outside diameter at the base, the overall length, and the gauge; i.e. 10" x 32'-6" - 7 gauge.

- (i) Interchangeability. Each member including the handhole doors in the pole and all component equipment must be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar pole.
- (j) Simplex Brackets. Two simplex mast arm support plates must be provided opposite each other as shown on the Drawings, and in accordance with Standard Drawing No. 659. The mast arm support plates must be made of cast steel conforming to the requirements for Grade 65-35 cast steel of ASTM A27, or equivalent, subject to approval. They must neatly fit the external surfaces of the fluted mast. Each mast arm support plate must have a hollow protuberance, the hole of which must be approximately equivalent to two (2) inches in diameter, extending into the interior of the pole providing a smooth surface for the lamp cables to rest upon. Each mast arm support plate must be designed so that it will carry the mast arm and hold it in the proper position for fastening the mast arm to the mast. The design of the mast arm support plates must be a two (2) bolt type as shown on Drawing No. 659. The brackets must be factory assembled to the mast. The finished mast must give the appearance of a single, homogeneous mast and the entire assembly must be structurally sound so that with the weight of the mast arm(s) and luminaire(s), the mast will not twist, rack, vibrate or otherwise deform when subjected to the severe vibrations of wind loading, passing elevated trains or heavily loaded vehicles.
- (k) Flower Basket Rosettes. The pole must be equipped with flower basket rosettes welded to the pole at the factory. Other flower basket attachments are not integral to the pole and are optional.
- (l) Luminaire Mounting Height. The luminaire mounting height indicates the height necessary to provide a distance of 30.0 feet from the top of the light pole foundation to the light source center of the luminaire.

BANNER AND BASKET ATTACHMENTS (Optional)

- 5. (a) Optional Attachments. Banner arm attachments and flower basket attachments must be provided as an option. These items must be provided only if ordered as a separate line item. All attachments must be manufactured to properly fit the pole shaft. All castings and parts must be permanently labeled on the back. The label must clearly identify the part and the pole it is to be used for.
- (b) Banner Arms. Banner arms, bracelets, couplings, and hardware necessary to attach banners must be provided. The appearance and dimensions of these items are shown on Standard Drawings 930, 930B, and 930C. Unless otherwise noted, the banner arms must be constructed of a light weight material flexible enough to withstand the loads presented by the appropriate

size banners under ASSTHO wind loadings. The banner arms must have an approximate outside diameter of 1-3/4".

- (c) Flower Basket Attachments. The bracelet and all necessary hardware for attaching a flower basket must be provided. The appearance and dimensions of these items are shown on the Standard Drawings.

FINIAL TOP (Optional)

- 6. (a) Design. The finial mast top must include different pieces assembled together to resemble a single, uniform casting. The pieces must include a top, two side pieces and a side finial ball as shown on Standard Drawings 930, 930B, and 930C. Two sets of end covers for the arms should be included to accommodate the possible use of two arms. The top must be essentially conical with a globe-shaped lower-end and have a minimum wall thickness throughout of not less than 5/32 inches. The cone portion must meet the skirted portion of the top in a smooth filet, and the skirt must enclose the top 7/8 inches of the mast. Three stainless steel, or other similar approved material, set screws not less than 5/16 inches long must be equally spaced in tapped holes around the skirt and must hold the top securely in place atop the mast. The design of the top must be as shown on the Standard Drawings. All castings and parts must be permanently labeled on the back of the part. The part label must clearly identify the part and the pole it is intended for. All mast heads and finials must have the appearance as shown on the Standard Drawings. The dimensions on the drawings are for attachment to the Chicago 2000 Gateway pole. Mast heads and finials for combination traffic poles, 11" or 12.5" poles, must be sized accordingly.
- (b) Material. The top finial must be made of aluminum alloy 356-F per ASTM B108. The top must have smooth surfaces, neat edges and corners and be free of fins, holes or other casting flaws.
- (c) Finish. Tops must be painted as herein specified. The color shall be black.

HARDWARE

- 7. All the hardware necessary to complete the assembly of the pole must be furnished. All hardware must be stainless steel, or equal corrosion-resistant metal, subject to approval.

WELDING

- 8. (a) General. Where welds are required and approved, each welded joint must be thoroughly cleaned of flux and spatter, and must be made in conformity with the standards of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, in

conformity with the proper interpretation of the standard welding symbols of the American Welding Society. The bidder's proposal must state the type of electrode and must describe the welding methods proposed for use in fabricating the pole.

- (b) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed. Certifications for welding personnel must be included with the submittal information package for review.
- (c) Testing. All welds of 5% of the poles in every lot must be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection will be governed by the same conditions as in the TESTING Section. If the magnetic inspection process is used, the dry method with direct current must be employed. All transverse welds must be magnetized by the "prod" (Circular Magnetization) method. Longitudinal welds may be magnetized by either circular or longitudinal magnetization. Proposed weld inspection method must be included with the submittal information package for review.

PAINING

- 9. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove oils and grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10. Included in this process, the pretreatment process and the painting process must be the interior base section of the mast to a minimum height of 12".
- (c) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Exterior Coat. A thermosetting, weathering, Polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform 8 mil thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400°F to form a high molecular weight fusion bonded finish.
- (e) Alternate Methods. Alternate powder coat methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.

- (f) Interior Coat. The interior metal surfaces must be powder coated with a thermoplastic hydrocarbon resin containing corrosion inhibitors. The resin must be formulated for full application over untreated metal surfaces. The resin must be applied at a temperature of approximately 200°F to a minimum thickness of 3 mils. The interior thermoplastic coat must overlap the interior, thermosetting base coat by approximately 6". Alternate interior coatings may be used subject to prior approval of the Commissioner.
- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure per ASTM B117 in a 5% NaCl (by weight) solution at 95°F and 95% relative humidity without blistering. Before test, the panel must be scribed with an "X" down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "single spot measurement" in an area of two square inches must be not less than 7.0 mils.
- (i) Color. Color must be gloss black unless noted otherwise in the order. A 4" square color chip sample must be submitted for approval prior to fabrication. The chip sample must be of the same material as the pole mast, and must include the manufacturer's name and the manufacturer's color name as well. The sample must also include any other information required to purchase the same color for the mast arm(s), flower baskets, and the cast aluminum finial and split pedestal base.

STRUCTURAL REQUIREMENTS

- 10. The pole must be manufactured in accordance with AASHTO's 1994 version of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." The shaft and base plate assembly must be designed to meet AASHTO's 1994 criteria for 80 MPH wind loading with a 30% gust factor. The mast must be designed to support twin gateway mast arms with twin gateway luminaires of not less than 65 pounds each and having an effective projected area (EPA) of not less than 1.70 square feet each with twin gateway luminaire fitters of not less than 50 pounds each and having an EPA of not less than 0.73 square feet each. In addition, the mast must be able to support twin banners 6 feet high by 1.5 feet wide each; and twin flower baskets weighing 75 pounds each and having an EPA of not less than 3.0 square feet each.

TESTING

- 11. (a) Testing. Structural testing must be conducted on 5% of the manufacturer's production masts for each order in which the quantity of masts is 20 or more.

The testing must include coupon tests, load tests, and weld tests. All testing must be certified by the manufacturer.

- (b) The selection of pole masts must be a random selection from the entire completed lot of pole masts required for the Contract. Selections from partial lots will not be allowed.
- (c) Coupon tests as outlined in ASTM A53 and A 595, A588, or A606.
- (d) Load tests for masts. With base rigidly anchored, a test load of 1500 pounds must be applied at a point approximately two feet (2'-0") from the free end. The load must be applied at right angles to the center line of the mast and in the same vertical plane. The deflection must not be greater than 30". Within one (1) minute after the test load is released, measurement must be made of the set taken by the mast. This set must not be greater than 2.5". The deflection measurement device must be reset to zero and the test load must be reapplied. The deflection must not change from the deflection noted in the first test by more than $\pm 5\%$. No measurable set must be noted within one (1) minute after test load is released. The mast must then be checked to ensure that it is still securely fastened, that it is plumb, and that no cracks have developed in either the mast or base plate.
- (e) Load tests for masts arm supports. With gateway mast arms rigidly anchored, a test load of 300 pounds must be applied to each mast arm at a point approximately seven feet (7'-0") from the pole mast. The load must be applied at right angles to the center line of the mast arm and in the same vertical plane. Each mast arm support must then be checked to ensure that it is still securely fastened and that no cracks have developed in either mast arm support bracket or the weld.
- (f) Load tests for flower basket rosettes. With base rigidly anchored, a test load of 150 pounds must be applied to each rosette ring. The load must be applied at right angles to the center line of the mast and in the same vertical plane. Each rosette must then be checked to ensure that it is still securely fastened and that no cracks have developed in either the ring, rosette, or rosette weld.
- (g) Weld tests as described in the WELDING Section of this Specification.

PACKAGING

- 12. (a) General. The poles must be carefully inspected at the factory prior to shipment to assure that the poles are complete and free of defects. When poles are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the poles. All pole hardware must be packaged in a clear container

and labeled. Castings and parts must be packaged in clearly labeled boxes. Parts hardware must be packaged in clear containers, properly labeled.

- (b) Pole Packaging. The poles must be shipped in bundles weighing a maximum of 5,000 pounds. Each pole must be individually wrapped and protected so that it can be bundled and unbundled without damage to the pole or its finish. Each pole wrapping must be labeled using permanent ink in two-inch letters identifying the pole type, height, and gauge. Specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of poles. Instructions must be printed on a fiber-based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years.
- (c) Pole Bundles. The bundles must consist of poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.) non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two high without breaking or shifting of the contents. Each bundle must be capable of being lifted by a forklift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (d) Pole Hardware. Any appurtenant devices and hardware not attached to the pole must be carefully wrapped and securely attached to each bundle. Payment will be withheld for any units provided without the appropriate appurtenant devices and hardware. Cracked, broken, chipped or damaged units will also be considered as incomplete quantities as regards payment.
- (e) Castings and Parts. Castings and parts, such as the finial, banner brackets, etcetera, must be individually wrapped and packaged in boxes. Hardware must be packaged in a clear package, clearly labeled. The label must identify each piece of hardware and the quantity of each, as well as what part the hardware is intended for. An individual box must contain like part types and the related hardware (i.e. the upper banner bracelet halves and hardware must be boxed separately from the lower banner bracelet halves and hardware). Each box must be labeled with 3/8" letters identifying the manufacturer, the casting or part numbers, the part name, the date of manufacture, the City contract number, and the City Commodity code.

ELECTRICAL SPECIFICATION 1506
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED December 13, 2019

POLE: ORNAMENTAL, EXTENDED LOOP STYLE, 16 FOOT
15" BOLT CIRCLE; STEEL, 7 GAUGE

SUBJECT

1. This specification states the requirements for an ornamental street light pole. These poles will support a twin mast arm bracket which will in turn, support two tenon mounted luminaires. A split pedestal base will cover the bottom of the pole. This pole will be served by underground cables. The luminaire mounting height will be 23 feet when the pole and arm are fully assembled.

GENERAL

2. (a) Specifications. The poles must conform in detail to the requirements herein stated, and to the requirements of the following organizations as cited herein:
American Association of State Highway and Transportation Officials (AASHTO)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Poles not conforming to this specification will not be accepted.
- (c) Sample. One complete anchor-base pole of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon receipt of notice from the Chief Procurement Officer.
- (d) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (e) Bidders Drawings. Bidders must submit with their bids scale drawings for the pole intended to be furnished. The drawings must show details of the pole design including the handholes, grounding and anchoring. Although the luminaires, the twin arm bracket, and the base are each covered by separate specifications, the drawings must include every dimension necessary to show how all parts and components will fit each other, be easily installed and maintained and be properly held in assembly. The successful bidder must submit these drawings in electronic format in Microstation 95, if requested;

failure to provide drawings in this format will be cause to reject the bid.

- (f) Interchangeableness. Each member including the handhole doors in the pole, the luminaire twin arm assembly, and the split pedestal base must be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar pole.
- (g) Design. The pole must conform in design and dimensions to Drawings 929 and 929A.
- (h) Structural Requirements. The pole must be manufactured in accordance with AASHTO's 1994 "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". The pole must be designed to meet AASHTO's 1994 criteria for 80 MPH wind loading with a 30% gust factor with the twin arm and acorn luminaires attached.
- (i) Warranty. The manufacturer must warrant the construction of the poles and related parts to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the parts have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, failure of any weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to the City, of any light pole assembly, or component parts thereof. The warranty must accompany any submittal information.

MASTS

- 3. (a) Mast Size. The mast size must be 16'-0" and must provide a 0.14" per foot taper. The mast must be rolled to provide a 16-flute pattern.
- (b) Mast Design. The mast design must be as shown on Drawing 929 and 929A.
- (c) Material. The mast must be 7-gauge high strength low alloy steel in accordance with ASTM A595, Grade C. The shaft must have a 0.14" per foot taper. The flutes must be neat, true to pattern and free from cracks and flaws. Each mast must be straight and centered on its longitudinal axis.
- (d) Mast Base. The mast base must be a 1" thick steel plate of low alloy, high strength steel conforming to ASTM A 595, grade C, ASTM A 588 or ASTM A 606.
 - 1. The base plate must have four 1 ½" wide by 3" long (measured along the circumference) slots for a 15" bolt circle using 1 ¼" anchor bolts. Anchor bolts, nuts, and washers to be provided by others. Any special hardware required must be provided by the Contractor.
 - 2. It must provide sufficient internal clearance for two 3" conduit entries and a ¾" ground rod.

3. The mast must be inserted into the base to a maximum depth which will still allow for an adequate weld to be made between the bottom of the mast and the plate. A circumferential weld must be made between the mast and the base at both the top and underside of the plate.
- (e) Provision for Ground. A ½"-13 square nut must be welded to the inside of the mast on the handhole entry frame for a ground connection.
 - (f) Entry. A vertical door frame carrying a removable door providing access to the interior of the mast must be welded into a close-fitting opening centered approximately 15" above the bottom of the base. The door frame must be formed and welded of steel with cross section not less than 1-1/2" wide by 1/4" thick so as to adequately reinforce the opening of the mast. The internal horizontal clearance of the door frame must be 4"; its internal vertical height must be 8". Its upper and lower ends must be semi-circular meeting its straight sides tangentially. The frame must have two welded tabs; one at the top and one at the bottom of the door frame. The top hole must be located 13/16 of an inch from the top of the opening. The bottom hole must be located 13/16 of an inch from the bottom of the opening. These tabs must be drilled to accept a 1/4-inch screw. Stainless steel spring clips must be mounted to the tabs. These clips must be made to accept 1/4"-20 machine screws. The entry must in all respects be identical to handhole openings on poles that have already been installed and accepted by the City.
 - (g) Door. The removable door must be formed of sheet steel approximately 1/8" thick. It must fit the door frame closely and be dished so that it will stay in proper position even if its locking screws become slightly loosened. The door must be drilled top and bottom to accept the 1/4" -20 hex head stainless steel screws which will fasten the door to the door frame. All doors must be interchangeable. Doors must fit pole handholes of like poles that have already been installed and accepted by the City. Alternate methods will be subject to approval by the Commissioner or his fully authorized representative.
 - (h) Tag. To each pole must be attached immediately below the handhole by mechanical means and not by adhesive, a stainless-steel tag with an embossed legend which must include the pole outside diameter at the base, the overall length, and the gauge.
 - (i) With pole set in place and the door securely fastened, there must be no exposed wires, bolts or appurtenant hardware other than the door fasteners.
 - (j) Tenon. A tenon must be provided at the top of the pole for attachment of a twin mast arm bracket. The tenon must consist of one 5" I.P.S. pipe 3 inches long and one pipe of 2.5" diameter 20" long, as shown on Standard Drawing 929. The tenon must provide positive, structurally sound mating between the mast and the attached device. The tenon must be factory assembled to the mast. The finished mast must give the appearance of a single, homogeneous mast and the entire assembly must be structurally sound so that with the

weight of a twin mast arm and two luminaires, the mast will not twist, rack, vibrate or otherwise deform when subjected to the severe vibrations of passing elevated trains or heavily loaded vehicles.

- (k) Flower Basket Rosettes. The pole must be equipped with flower basket rosettes welded to the pole as shown on Standard Drawings 929 and 929A. Other than the rosettes, no permanent attachments using welds or drilled and tapped holes will be allowed for the flower basket attachments.

BANNER ARMS, FLOWER BASKET BRACKETS, AND BRACELETS (Optional)

- 4. Under a separate item, banner arms, bracelets and attachments as shown on Standard Drawings 929 and 929A will be provided. Unless otherwise noted, the banner arms must be constructed of a lightweight material which will withstand the loading of banners under 1994 ASSTHO wind conditions. Banner arms must have an outside diameter of 1-3/4". Banner arms must be attached by means of stainless-steel banding. Banner arm bracelets must be attached with set screws. Flower basket bracelets and base bracelets must be attached with set screws and must conform to Standard Drawings 929 and 929A. No permanent attachments using welds, drilled and tapped holes, etcetera should be provided for the banner arm or flower basket attachments. All castings and parts must be permanently identified on the back side.

WELDING

- 5. (a) General. Where welds are required and approved, each welded joint must be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode and must describe the welding methods he proposes to use in fabricating the pole.
- (b) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed.
- (c) Testing. All welds of 5% of the poles in every lot must be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection will be governed by the same conditions as in the testing section. If the magnetic inspection process is used, the dry method with direct current must be employed. All transverse welds must be magnetized by the "prod" (Circular Magnetization) method.

PAINING

6. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove oils and grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10. Included in this process, the pretreatment process and the painting process must be the interior base section of the mast to a minimum height of 12".
- (c) Chemical Pretreatment. The cleaned metal surfaces must then be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Primer Coat. All exterior surfaces are to be coated with Tnemec 90-97 corrosion-inhibiting zinc-rich aromatic urethane to a minimum dry film thickness of 2.5 mils (.0025"). The aromatic urethane is to consist of a zinc dust content not less than 83% by weight in dried film. The coating shall be airless-spray applied and moisture cured.
- (e) Finish Coat. All exterior surfaces are to be subsequently coated with Tnemec Endura-Shield II 1074 aliphatic acrylic polyurethane to a minimum dry film thickness of 3.0 mils (.003"). The coating shall be airless-spray applied and cured in a gas-fired convection oven by heating the steel substrate to between 150° Fahrenheit and 220° Fahrenheit.
- (f) Interior Coat. Interior surfaces are to be coated with red oxide rust inhibitive alkyd primer to a dry film thickness of 1.5 mils.
- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl (by weight) solution at 95°F and 95% relative humidity without blistering. Before test, the panel must be scribed with an "X" down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "single spot measurement" in an area of two square inches must be not less than 7.0 mils.
- (i) Color. Color must be gloss black. A color sample must be submitted for approval prior to fabrication. This color sample must include the manufacturer's name and the manufacturer's color name as well as any other information required to purchase the same color for the mast arms, luminaire and the fiberglass split pedestal base.

TESTING

7. (a) General. All completed masts must be available for testing. Unless specifically authorized in writing, all tests must be performed at the manufacturer's plant. A record of every test must be made, and a certified copy must be submitted to the Commissioner before the poles are shipped.
- (b) Requirements. The following tests must be included in the testing procedure:
1. Coupon tests as outlined in ASTM A53 and A595, A588, or A606.
 2. With the mast base rigidly secured using the normal mast mountings, a 1000-pound force must be incrementally applied, perpendicular to the mast at the tenon. This force must then be applied a second time at approximately the same location. The mast must then be checked to ensure that the mast is still securely fastened; that it is plumb; and that no cracks have developed in either the mast, tenon or base.
 3. Perform Weld tests as described in "welding" section.
- (c) Acceptance. Tests must be made on 5% of all masts. If any of the masts fail to pass these tests, an additional three masts must be tested for each failed mast. Should any of these additional masts fail to pass these test requirements, the entire lot will be subject to rejection. The Commissioner will then decide, based on the nature of the failure, whether the entire lot will be rejected outright or whether the manufacturer may subject each mast to testing, and those masts which fulfill the requirements will be accepted.

PACKAGING

8. (a) General. The poles must be shipped in bundles weighing a maximum of 5,000 pounds. Each pole must be individually wrapped and protected so that it can be bundled and unbundled, without damage to the pole or its finish. Each pole wrapping must be permanently marked using 2-inch lettering identifying the pole type. Specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of the poles. Instructions must be printed on a fiber-based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years. All pole hardware must be packaged in labeled containers and enclosed with the appropriate bundles. Castings and parts for the banners and flower baskets must be packaged in clearly labeled boxes. Parts hardware must be packaged in clear containers, properly labeled.
- (b) Pole Bundles. The bundles must consist of poles laid base to top to form an approximately rectangular cylinder. Materials such as lumber (2" x 4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be

subject to approval. Any bundles, in which either poles or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two high without breaking or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.

- (c) Pole Hardware. Any appurtenant devices and hardware not attached to the poles must be carefully wrapped and securely attached to each bundle. Payment will be withheld for any bundle delivered without the appurtenant devices and hardware. Cracked, broken, chipped or damaged parts will be considered as an incomplete delivery as regards payment.
- (d) Castings and Parts. Castings and parts for the banners and flower basket attachments must be individually wrapped and packaged in boxes. Hardware must be packaged in a clear package, clearly labeled. The label must identify each piece of hardware and the quantity of each, as well as what part the hardware is for. An individual box must contain like part types and the related hardware (i.e. the upper banner bracelet halves and hardware must be boxed separately from the lower banner bracelet halves and hardware). Each box must be labeled with 3/8" lettering identifying the manufacturer, the casting or part numbers, the part name, the date of manufacture, the City contract number, and the City commodity code.

**ELECTRICAL SPECIFICATION 1512
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 6, 2014**

SPLIT PEDESTAL BASE: FOR CHICAGO 20000 PEDESTRIAN POLE

SUBJECT

1. This specification states the requirements for a split pedestal base (Clamshell) for installation on a 12'-0" fluted, tapered steel pedestrian light pole. This specification will address the requirements for a split fiberglass base without doors.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual split pedestal base dimensions and details. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted, and will be rejected as an incomplete submittal. If requested by the City, these drawings must also be submitted in electronic format in Microstation 95; failure to provide drawings in this format will be cause for rejecting the submittal.

Dimensions must include but will not be limited to: base height, width, pattern, and fluting. Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required.

- (b) Manufacturer's catalog cut sheets showing split pedestal base designation, and catalog number.
- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly, orientation, and installation.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled split pedestal base with hardware and all components, of the manufacture intended to be furnished, shall be submitted for review within fifteen (15) business days from receipt of notice. The sample base must be coordinated with an existing pedestrian light pole for accuracy of fit.

- (f) Warranty. The manufacturer must warrant the performance and construction of these split pedestal bases to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the bases have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, or failure or fading of the surface color. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to the City, of any split pedestal base, which, as determined by the Commissioner, would develop aforesaid failures. Any split pedestal base, or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified must be incidental to this contract.

GENERAL

3. (a) Products. Split pedestal bases must be the products of established manufacturers and must be suitable for the service required. Split pedestal bases which are proposed must be the products of a single manufacturer. Fiberglass bases must be manufactured by Shakespeare Company, W.J. Whatley, Incorporated, or an approved equal.
- (b) Specifications. The split pedestal bases must conform in detail to the requirements herein stated, and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The base must conform in design and dimensions to Standard Drawing 928.
- (e) Approval. Whenever "approval" and "approved" are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of the split pedestal bases.
- (f) Commissioner's Review. The Commissioner will be the sole judge in determining the submitted split pedestal bases compliance with this specification. The Commissioner's decision will be final.

CONSTRUCTION OF FIBERGLASS BASE

4. (a) Each pedestal base must be formed of a fiberglass composite consisting of a polyester resin and containing a minimum of 65% fiberglass by weight. The resin must contain no clay fibers. The composite must be UV and weather resistant. Alternate materials may be considered. Each base half must be permanently marked on the inside identifying it as a base for a pedestrian pole.
- (b) The split pedestal base must conform in detail and dimensions to Standard Drawing 928.
- (c) The two halves of the clamshell must be identical to each other. They must be perfectly matched and when installed there shall be no more than a 0.125 inch gap between the inside top of the assembled base and the outside surface of the mast.
- (d) Once installed, the base should be designed to remain in place without the use of set screws. An installed base should not be able to be shifted or rotated.
- (e) The color of the base must be gloss black and must match the color of existing and proposed Chicago 2000 pedestrian poles. The resin must contain color pigment throughout. The pigment must be even throughout the thickness of the base. A finish coat of urethane enamel must be applied to the surface of the base to a minimum dry thickness of 1.5 mils. The resin color must match the enamel color. A paint sample on fiberglass must be submitted for approval prior to production. The paint manufacturer's name and any information necessary to acquire the same color for the pole must be provided. The contractor must supply one quart of touch-up paint for every 50 bases ordered.
- (f) The texture of the fiberglass base exterior surface must be equal to that of a cast iron base. Acceptance of the aesthetic appearance of the base will be by the Commissioner.
- (g) The two halves of the shroud must be affixed by means of screws as shown on Standard Drawing 928. The screws must fit so that the halves of the base are drawn together so that the edges of the base fit snug against each other. Threaded stainless steel inserts in the base must be used to affix the screws. The screws must not detract from the appearance of the base. Other methods of attachment may be considered. Any method of attachment must be approved by the Commissioner.

TESTING

5. (a) Testing. All completed fiberglass bases must be available for testing. Unless specifically authorized in writing, all tests must be at the manufacturer's

plant. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the units are shipped. Tests shall be standardized according to ASTM requirements or other suitable organization's standards. The manufacturer must provide evidence that the bases are structurally sound and are able to take the normal abuse of salt spray, freeze-thaw cycles, and exposure to moisture. The bases must be impact resistant and must be resistant to UV damage.

PACKAGING

6. (a) **General.** The split pedestal bases must be carefully inspected at the factory prior to shipment to assure that the bases are complete and free of defects. When bases are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the bases. All hardware must be packaged in a clear container and labeled as to size, quantity, and part association.
- (b) **Packaging.** The split pedestal bases must be shipped on pallets with at least six units per pallet. Each base must be individually wrapped and protected so that it can be bundled and unbundled without damage to the base or its finish. The base wrapping must be labeled to identify the base. Specific instructions must be securely attached to each pallet indicating the proper methods of storage. In addition, each pallet must contain specific instructions on the installation of the split pedestal bases. Instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years. The pallets must be labeled in 3/8 inch high lettering indicating the type of base as "FIBERGLASS BASE FOR PEDESTRIAN POLE", the part number, the manufacturer, the date of manufacture, and the contract number.
- (c) **Hardware.** Any hardware not attached to the bases must be carefully wrapped and securely attached to each pallet. Hardware must be packaged in a clear bag with a label indicating the type of hardware and quantity. Payment will be withheld for any units provided without the appropriate hardware, or for any missing or improper packaging or labeling. Cracked, broken, chipped or damaged units will also be considered as incomplete quantities as regards payment.
- (d) **Touch-up Paint.** Touch-up paint and appurtenant materials must be packaged in units sufficient for the number of bases on each pallet. These units will be securely attached to each pallet.

**ELECTRICAL SPECIFICATION 1513
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 7, 2014**

SPLIT PEDESTAL BASE: FOR CHICAGO 2000 LIGHT POLE

SUBJECT

1. This specification states the requirements for a split pedestal base (Clamshell) for installation on a 10 inch by 32 foot- 6 inch tapered fluted Chicago 2000 light pole. This specification will address the requirements for a split fiberglass base without doors.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual split pedestal base dimensions and details. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted, and will be rejected as an incomplete submittal. If requested by the City, these drawings must also be submitted in electronic format in Microstation 95; failure to provide drawings in this format will be cause for rejecting the submittal.

Dimensions must include but will not be limited to: base height, width, pattern, and fluting. Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required.

- (b) Manufacturer's catalog cut sheets showing split pedestal base designation, and catalog number.
- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly, orientation, and installation.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled split pedestal base with hardware and all components, of the manufacture intended to be furnished, shall be submitted for review within fifteen (15) business days from receipt of notice. The sample base must be coordinated with an existing Chicago 2000 light pole for accuracy of fit.

- (f) Warranty. The manufacturer must warrant the performance and construction of these split pedestal bases to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the bases have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, or failure or fading of the surface color. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to the City, of any split pedestal base, which, as determined by the Commissioner, would develop aforesaid failures. Any split pedestal base, or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified must be incidental to this contract.

GENERAL

3. (a) Products. Split pedestal bases must be the products of established manufacturers and must be suitable for the service required. Split pedestal bases which are proposed must be the products of a single manufacturer. Fiberglass bases must be manufactured by Shakespeare Company, W.J. Whatley, Incorporated, or an approved equal.
- (b) Specifications. The split pedestal bases must conform in detail to the requirements herein stated, and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The base must conform in design and dimensions to Standard Drawings 930 and 930A.
- (e) Approval. Whenever "approval" and "approved" are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of the split pedestal bases.
- (f) Commissioner's Review. The Commissioner will be the sole judge in determining the submitted split pedestal bases compliance with this specification. The Commissioner's decision will be final.

CONSTRUCTION OF FIBERGLASS BASE

4. (a) Each pedestal base must be formed of a fiberglass composite consisting of a polyester resin and containing a minimum of 65% fiberglass by weight. The resin must contain no clay fibers. The composite must be UV and weather resistant. Alternate materials may be considered. Each base half must be permanently marked on the inside identifying it as a base for a Chicago 2000 light pole.
- (b) The split pedestal base must conform in detail and dimensions to Standard Drawings 930 and 930A.
- (c) The two halves of the clamshell must be identical to each other. They must be perfectly matched and when installed there shall be no more than a 0.125 inch gap between the inside top of the assembled base and the outside surface of the mast.
- (d) Once installed, the base should be designed to remain in place without the use of set screws. An installed base should not be able to be shifted or rotated.
- (e) The color of the base must be gloss black and must match the color of existing and proposed Chicago 2000 light poles. The resin must contain color pigment throughout. The pigment must be even throughout the thickness of the base. A finish coat of urethane enamel must be applied to the surface of the base to a minimum dry thickness of 1.5 mils. The resin color must match the enamel color. A paint sample on fiberglass must be submitted for approval prior to production. The paint manufacturer's name and any information necessary to acquire the same color for the pole must be provided. The contractor must supply one quart of touch-up paint for every 50 bases ordered.
- (f) The texture of the fiberglass base exterior surface must be equal to that of a cast iron base. Acceptance of the aesthetic appearance of the base will be by the Commissioner.
- (g) The two halves of the shroud must be affixed by means of screws as shown on the Standard Drawings. The screws must fit so that the halves of the base are drawn together so that the edges of the base fit snug against each other. Threaded stainless steel inserts in the base must be used to affix the screws. The screws must not detract from the appearance of the base. Other methods of attachment may be considered. Any method of attachment must be approved by the Commissioner.

TESTING

5. (a) Testing. All completed fiberglass bases must be available for testing. Unless specifically authorized in writing, all tests must be at the manufacturer's

plant. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the units are shipped. Tests shall be standardized according to ASTM requirements or other suitable organization's standards. The manufacturer must provide evidence that the bases are structurally sound and are able to take the normal abuse of salt spray, freeze-thaw cycles, and exposure to moisture. The bases must be impact resistant and must be resistant to UV damage.

PACKAGING

6. (a) **General.** The split pedestal bases must be carefully inspected at the factory prior to shipment to assure that the bases are complete and free of defects. When bases are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the bases. All hardware must be packaged in a clear container and labeled as to size, quantity, and part association.
- (b) **Packaging.** The split pedestal bases must be shipped on pallets with at least six units per pallet. Each base must be individually wrapped and protected so that it can be bundled and unbundled without damage to the base or its finish. The base wrapping must be labeled to identify the base. Specific instructions must be securely attached to each pallet indicating the proper methods of storage. In addition, each pallet must contain specific instructions on the installation of the split pedestal bases. Instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years. The pallets must be labeled in 3/8 inch high lettering indicating the type of base as "FIBERGLASS BASE FOR CHICAGO 2000 LIGHT POLE", the part number, the manufacturer, the date of manufacture, and the contract number.
- (c) **Hardware.** Any hardware not attached to the bases must be carefully wrapped and securely attached to each pallet. Hardware must be packaged in a clear bag with a label indicating the type of hardware and quantity. Payment will be withheld for any units provided without the appropriate hardware, or for any missing or improper packaging or labeling. Cracked, broken, chipped or damaged units will also be considered as incomplete quantities as regards payment.
- (d) **Touch-up Paint.** Touch-up paint and appurtenant materials must be packaged in units sufficient for the number of bases on each pallet. These units will be securely attached to each pallet.

**ELECTRICAL SPECIFICATION 1514
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 7, 2014**

CHICAGO 2000 MAST ARM: 8-FOOT, STEEL

SUBJECT

1. This specification covers the requirements for an 8-foot straight steel mast arm and decorative scroll for supporting a teardrop street light luminaire on a Chicago 2000 light pole or other pole fitted for a simplex attachment.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual mast arm and scroll dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted, and will be rejected as an incomplete submittal. These drawings must also be submitted in electronic format in Microstation 95, if requested by the City; failure to provide drawings in this format will be cause for rejecting the submittal.

Dimensions must include but will not be limited to: mast arm length, diameter, and ornamentation; attachment plate length, width, thickness, and bolt circle; scroll length, cross section dimensions, and shape.

Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required for components including but not limited to: attachment plates; ornamentation; and arm attachments.

Welds must include but will not be limited to: locations, sizes, and types of welds in accordance with the WELDING Section of this specification.

- (b) Manufacturer's catalog cut sheets showing mast arm and scroll designation(s), characteristics, and catalog number(s).
- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly,

orientation, installation, component access and wiring, and numeric tolerances for torquing the attachment plate bolts to the light pole mast arm support plate.

- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled gateway mast arm with scroll and integral components, of the manufacture intended to be furnished, must be submitted for review within fifteen (15) business days from receipt of notice.
- (f) Warranty. The manufacturer must warrant the performance and construction of these mast arms and scrolls to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the mast arms and scrolls have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, failure of any weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to this Contract and to the City, of any mast arm assembly, or any component parts thereof, which, as determined by the Commissioner, would develop aforesaid failures. The warranty must accompany submittal information. Any mast arm or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified will be incidental to this contract.

GENERAL

- 3. (a) Products. Mast arms and component equipment must be the products of established manufacturers, and must be suitable for the service required. Mast arm or component equipment items which are proposed as similar or identical must be the products of a single manufacturer. Mast arms must be manufactured by Union Metal Corporation, Valmont Industries Incorporated, Millerbernd Manufacturing Company, or an approved equal.
- (b) Specifications. The mast arm and scroll must conform in detail to the requirements herein stated and to the requirements of the following organizations as cited herein:

American Association of State Highway and Transportation Officials (AASHTO)

American Society for Testing and Materials (ASTM)

American Welding Society (AWS)

Society for Protective Coatings (SSPC)

- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The mast arm and scroll must conform in design and dimensions to Standard Drawings 930 and 930C.
- (e) Approval. Whenever “approval” and “approved” are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of these mast arms and scrolls.
- (f) Commissioner’s Review. The Commissioner will be the sole judge in determining the submitted mast arms compliance with this specification. The Commissioner’s decision will be final.

ARM DESIGN

- 4. (a) 8-Foot Mast Arm. Each 8-foot mast arm must be fabricated from a continuous, single piece, two (2) inch "extra strong" steel pipe conforming to the requirements of ASTM A53, Table X2. It must conform in detail with the mast arm shown on Standard Drawings 930 and 930C.
- (b) Mast Arm Attachment. The mast arm attachment to be welded to all mast arms must conform to Standard Drawing 724. It must be a steel forging per ASTM A668, Class D, or cast steel conforming to the requirements for Grade 65-35 cast steel of ASTM A27, or it can be fabricated from weathering steel plate. It must be so designed that it may be fitted over the mast arm supports on the pole and be held by the mast arm supports in proper position without other support. Provision must be made for fastening the attachment to each mast arm support by two special screws and washers as noted in the HARDWARE Section of this Specification.
- (c) Entryway for Wires. A drilled opening lined with a neoprene grommet having inserted therein a neoprene plug must be provided on the underside of the upper member of all arms approximately three inches from the point of attachment. The clear opening must not be less than 5/8 inch in diameter. Its design must be submitted for approval by the Commissioner or his authorized representative.
- (d) Mast Arm Members. All mast arm members must conform with the type of steel required for the arm specified. The members must be continuous lengths of pipe and bar cut to the proper size to fabricate the mast arm lengths requested. No butt welded, swaged and welded or other pieced together configurations of pipe and bar lengths will be accepted. The outer and inner surfaces of the pipes and bars must be smooth and even without protrusions, nicks, holes or other imperfections.

- (e) Interchangeability. Each member including the arm and all component equipment must be mutually interchangeable for assembly, so that no work will be required to make any member fit properly in the place of any other similar member of any other similar mast arm.

SCROLL DESIGN

- 5. (a) Scroll. The scroll must be fabricated out of 3/4 inch thick by 2-1/2 inch wide bar stock meeting the requirements of ASTM A36. The scroll must be formed as shown on Standard Drawing 930.
- (b) Clamps. The scroll must be attached to the mast arm and pole by clamps, as shown on Standard Drawing 930. The clamps must meet the requirements of ASTM A307 galvanized to ASTM A153. All connecting hardware must meet the requirements of the HARDWARE Section of this Specification.
- (c) Identification. The scroll and clamps must be permanently labeled for identification purposes. The identification must not affect the aesthetics of the scroll.

WELDING

- 6. (a) General. Where welds are required and approved, each welded joint must be thoroughly cleaned of flux and spatter, and must be made in conformity with the standards of the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, in conformity with the proper interpretation of the standard welding symbols of the American Welding Society. The bidder's proposal must state the type of electrode and must describe the welding methods proposed for use in fabricating the mast arm.
- (b) Certifications. Welders must have proper certification for the welding operations required. Welding by non-certified personnel will not be allowed. Certifications for welding personnel must be included with the submittal information package for review.
- (c) Testing. All welds of 5% of the mast arms and scrolls in every lot must be inspected for penetration and soundness of the welds by the magnetic particle inspection method or by radiography. Acceptance or rejection will be governed by the same conditions as in the TESTING Section. If the magnetic inspection process is used, the dry method with direct current must be employed. All transverse welds must be magnetized by the "prod" (Circular Magnetization) method. Proposed weld inspection method must be included with the submittal information package for review.

HARDWARE

7. Two (2) special 1/2" - 13 NC x 1-1/2" long stainless steel cap screws, and two (2) stainless steel flat washers, must be provided for each mast arm attachment. All other hardware necessary to complete the assembly of the mast arm and scroll must be furnished. All hardware must be stainless steel, or equal corrosion-resistant metal, subject to approval.

PAINTING

8. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove any oils or grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10.
- (c) Chemical Pretreatment. The cleaned metal surfaces must be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Exterior Coat. A Thermosetting, polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform eight (8) mil thickness in a one coat application. This powder coat must be cured in a convection oven at a minimum temperature of 400°F to form a high molecular weight fusion bonded finish.
- (e) Alternate Methods. Alternate powder coat methods may be reviewed and tested on a case by case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.
- (f) Interior Coat. The interior metal surfaces must be powder coated with a thermoplastic hydrocarbon resin containing corrosion inhibitors. The resin must be formulated for application over untreated metal surfaces. The resin must be applied at a temperature of approximately 200°F to a minimum thickness of three (3) mils. The interior thermoplastic coat must overlap the interior, thermosetting base coat by approximately one (1) inch. Alternate interior coatings may be used subject to prior approval of the Commissioner.
- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl solution at 95°F and 95% relative humidity without blistering.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-PA 2-73T, "Measurement of Dry Paint Thickness

with Magnetic Gauges", except that the lowest "Single spot measurement" in an area of two square inches must be not less than 7.0 mils.

- (i) Color. Color must be gloss black unless noted otherwise in the order. A 4" square color chip sample must be submitted for approval prior to fabrication. The chip sample must be of the same material as the mast arm, and must include the manufacturer's name and the manufacturer's color name as well. The sample must also include any other information required to purchase the same color for the pole mast and the cast aluminum finial and split pedestal base.
- (j) Field Touch-up. Any minor damage to the mast arm surfaces must be touched-up in a professional manner as recommended by the paint manufacturer, with protective coating solutions as provided by the mast arm manufacturer at no additional cost to the City. Any major damage to the mast arm shaft or component surfaces must be repaired at the manufacturer's place of business, or must be replaced as directed by the Commissioner. The Commissioner will be the sole judge of the extent of any such damage and the adequacy of repair. The Contractor must supply a field touch-up kit for every 20 mast arms or fraction thereof. Each kit must consist of a highly legible instruction sheet, one gallon of the recommended touch-up paint and all other materials required to touch-up 20 mast arms and scrolls.

STRUCTURAL REQUIREMENTS

- 9. The arm must be manufactured in accordance with AASHTO's 1994 "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." The mast arm and attachment plate assembly must be designed to meet AASHTO's 1994 criteria for 80 MPH wind loading with a 30% gust factor, for gateway luminaires of not less than 65 pounds each and having an effective projected area (EPA) of not less than 1.70 square feet each; and twin gateway luminaire fitters of not less than 50 pounds each and having an EPA of not less than 3.5 square feet each.

TESTING

- 10. (a) Testing. Structural testing must be conducted on 5% of the manufacturer's production mast arms and scrolls for each order in which the quantity is 20 or more. The testing must include coupon tests, load tests, and weld tests. All testing must be certified by the manufacturer, or an independent lab.

- (c) The selection of mast arms and scrolls must be a random selection from the entire completed lot required in the order.
- (d) Coupon tests for the arm and the scroll as outlined in ASTM A53, A 668, A27, or A36.
- (e) Load tests for mast arms. The scroll must not be considered as part of the load test. With mast arm rigidly anchored, a test load of 300 pounds must be applied at a point approximately one foot (1'-0") from the free end. The load must be applied at right angles to the center line of the mast arm and in the same vertical plane. The deflection must not be greater than 3". Within one (1) minute after the test load is released, measurement must be made of the set taken by the mast arm. This set must not be greater than 0.5". The deflection measurement device must be reset to zero and the test load must be reapplied. The deflection must not change from the deflection noted in the first test by more than $\pm 5\%$. No measurable set must be noted within one (1) minute after test load is released. The mast arm must then be checked to insure that it is still securely fastened, that it is plumb, and that no cracks have developed in either the mast arm or attachment plate.
- (f) Weld tests for both the arm and the scroll as described in the WELDING Section of this Specification.
- (g) Acceptance of Equipment. Tests must be made on 5% of all mast arms and scrolls in the order. If any of the mast arms or scrolls fail to meet these specifications, an additional three mast arms or scrolls must be tested for each failed unit. Should any of these additional units fail to meet these specifications, the entire lot will be subject to rejection. The Commissioner will then decide, based on the nature of the failure, whether the entire lot will be rejected outright or whether the manufacturer may subject each mast arm or scroll in the order to testing. If each mast arm or scroll in the order is tested, those mast arms or scrolls which fulfill the specified requirements may be accepted at the discretion of the Commissioner.

PACKAGING

- 11. (a) General. The mast arms and scrolls must be carefully inspected at the factory prior to shipment to assure that the mast arms and scrolls are complete and free of defects. When mast arms are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the mast arms. The same requirements apply to the scrolls. All hardware must be packaged in a clear container and labeled.

- (b) Packaging. The mast arms and scrolls must be shipped in bundles weighing a maximum of 1,000 pounds. Mast arms and scrolls must be in separate bundles. Each mast arm or scroll must be individually wrapped and protected so that it can be bundled and unbundled without damage to the unit or its finish. The wrapping must be clearly marked to identify the arms and scrolls. Specific instructions must be securely attached to each bundle indicating the proper methods of storage. In addition, each bundle must contain specific instructions on unbundling and erection of the mast arms or scrolls. Instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years.
- (c) Bundles. The bundles must consist of arms or scrolls laid to form an approximately rectangular cylinder. Arms and scrolls must be packaged in separate bundles. Materials such as lumber (2" x 4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting bundle capable of being handled, shipped and stored without shifting of contents or breaking. Bundling procedure will be subject to approval. Any bundles, in which either mast arms, scrolls or packaging is received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle to its original destination at no cost to the City of Chicago. The bundles should be capable of being stacked two high without breaking, or shifting of the contents. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped on a flat bed truck to facilitate unloading.
- (d) Appurtenant Devices and Hardware. Any appurtenant devices and hardware not attached to the mast arm or scroll must be carefully wrapped and securely attached to each bundle. All device and hardware containers must be clearly labeled as to the contents. Labels must identify the quantity of parts and their relationship to the arms or scrolls. Payment will be withheld for any units provided without the appropriate appurtenant devices and hardware. Cracked, broken, chipped or damaged units will be considered as incomplete quantities as regards payment. Improperly labeled units will also be considered as incomplete.
- (e) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for twenty 20 mast arms and 20 scrolls. These units will be securely attached to a sufficient number of bundles to fulfill the touch-up paint requirements stated herein.

**ELECTRICAL SPECIFICATION 1517
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 18, 2006**

PEDESTRIAN PUSH BUTTON

SUBJECT

1. This specification states the requirements for a pedestrian push button assembly which will include the switch and housing. This will be used to generate a signal to a traffic controller which will, in turn, actuate a walk signal.

GENERAL

2. (a) Specifications. The push button assembly must conform in detail to the requirements herein stated, and to the latest requirements of the Manual on Uniform Traffic Control Devices (MUTCD). The push button assembly must also meet the most recent requirements of the Americans with Disabilities Act (ADA).
- (b) Acceptance. Push button assemblies not conforming to this specification will not be accepted.
- (c) Drawings. The drawing mentioned herein is a drawing of the Department of Transportation. It is an integral part of this specification.
- (d) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the push button proposed to be used. The drawings must show every dimension necessary to indicate how parts will fit each other and be properly held in assembly.
- (e) Sample. One complete push button assembly of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (f) Warranty. The manufacturer must warrant the assembly against defects due to design, workmanship, and material, for a period of one year from the date of acceptance by the City. If any assembly fails to properly function within this period, the manufacturer will replace the assembly, free of charge to the city, including shipping. Failure will include, but not be limited to, loss of

button function and paint failure.

DETAIL REQUIREMENTS

3. (a) Assembly. Each pedestrian push button assembly must consist of a one piece aluminum casting incorporating a heavy duty push button switch, sign plaque with cast, raised, printed legend and integral banding brackets.
- (b) Design and Size. Each unit must appear as that shown on Standard Drawing 834. Each unit must be a permanent mold casting fabricated of aluminum alloy 356-TS6. The casting must be approximately 13 1/4" long with the extreme upper and lower segments molded to accept 3/4" banding. It must also be possible to bolt the assembly to a mounting surface using two holes that are in the center of the integral banding brackets. Directly below the upper integral banding bracket must be an integral sign plaque approximately 5" wide by 8" long. Cast into this plaque must be a raised printed legend taking up the full space of the plaque. This legend must read "PUSH BUTTON - WAIT FOR WALK SIGNAL" in letters at least one inch high. Directly below the plaque must be a cast switch housing. The housing must be of sufficient depth to accommodate the push button switch. In the center of the push button housing must be a threaded hole. The hole must be tapped for 5/8-11 UNC course thread. The push button switch must be screwed in from the rear of the housing. Directly below the push button housing must be the lower integral banding bracket. The rear of the casting must be open to facilitate wiring, inspection, and access to the switch. The extreme upper and lower segments in the rear must be curved to fit a round 10" to 12.5" pole at the appropriate height. The push button itself must be approximately two inches in diameter. The force to activate the switch must be no greater than 3.5 pounds. The entire push button assembly must operate between -35° Fahrenheit to +165° Fahrenheit. The push button unit must be equivalent to Alinco Model PBA-1000-2B.
- (c) Push Button Switch. The contacts must be normally open and must be closed when the push-button is pressed, restoring immediately to a normal open position when released. The switch must be rated at 35 amps at 12 volts d.c. or 20 amps at 24 volts d.c.. The switch contacts must be composed of 90% silver and 10% cadmium oxide to minimize arcing and pitting on the contact surfaces. The body of the switch must be of brass or other non-rusting material and must be approximately one inch in diameter. The upper body of the switch around the actuator must have a 5/8" threaded collar to allow mounting to the housing. The contacts must be entirely enclosed and insulated from the push-button housing.
- (d) Finish. The exterior finish of the housing must be powder coated with gloss black enamel. The background of the sign plaque must be painted a white enamel with black letters per MUTCD standards.

PACKAGING

4. (a) General. The push button housing and switch must be shipped fully assembled and ready for installation. Each assembly must be individually wrapped and boxed so that the assembly is not damaged in shipment.
- (b) Labeling. Each box must be labeled in 3/8 inch high letters A PEDESTRIAN PUSH BUTTON@. The City Commodity Code, contract number, manufacturer, and date of manufacture must be clearly labeled on the box.

**ELECTRICAL SPECIFICATION 1518
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 13, 2014**

INTERNALLY ILLUMINATED SIGN, LED

SUBJECT

1. This specification states the requirements for an internally illuminated sign using an LED (light emitting diode) light source. The sign will display a symbolic turn prohibition “NO LEFT TURN” or “NO RIGHT TURN”, or a symbolic ADO NOT ENTER@ message. The sign will be legible at all times it is energized. If the sign is not energized the display message will not be visible.

GENERAL

2. (a) Specifications. The illuminated sign must conform in detail to the requirements herein stated, to the specifications of the Federal Highway Administration’s Manual on Uniform Traffic Control Devices (MUTCD), and to the applicable paragraphs of Article 1084.01 of the Illinois Department of Transportation’s Standard Specifications for Road and bridge Construction (Standard Specifications).
- (b) Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards organizations:

Illinois Department of Transportation Standard Specifications for Road and Bridge Construction (Standard Specifications)
Institute of Transportation Engineers (ITE)
- (c) Acceptance. Illuminated signs not conforming to this specification will not be accepted.
- (d) Warranty. The manufacturer must warrant the signs against defective design, material, and workmanship for a period of 3 years from date of delivery [date of final acceptance for contract construction]. The LED modules must carry a 7 year warranty against failure or loss of color (chromaticity) and signal brightness (luminance) below minimum acceptable ITE standards from the date of delivery [from the date of final acceptance for contract construction]. In the event of defects or failure during this period, the manufacturer must

repair or replace such defects or failures at no expense to the City. This warranty must be evidenced by a letter or certificate of warranty submitted to the City at the time of final delivery.

- (e) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the illuminated sign proposed to be used. The drawings must show every dimension necessary to indicate how parts will fit each other and be properly held in assembly.
- (f) Sample. One complete illuminated sign assembly of the manufacture intended to be furnished must be submitted within 15 business days upon request of the Chief Procurement Officer.

DETAILED REQUIREMENTS

- 3. (a) Housing. The case must be formed from extruded aluminum alloy at least 0.125 inch thick. The case must be primed inside and out with one coat of zinc primer. The inside must be white enamel. The outside must be painted with two coats of baked on enamel of a matte black finish. The case will be furnished with 1.5 inch hubs, top and bottom. Doors must have a 6 inch aluminum sun hood. Door gaskets must be neoprene and must provide a weatherproof seal. All nuts and bolts are to be 18-8 stainless steel.
- (b) Sign Display. The sign display must be fabricated of material meeting the requirements of Article 1084 of the Standard Specifications. The face must be held in place by a formed aluminum channel. The display must contain the symbolic message for ANO LEFT TURN@, ANO RIGHT TURN@, or ADO NOT ENTER@. Colors and size of the message and background must conform to the MUTCD.
- (c) Illumination. The sign must consist of standard T-13/4 (5 mm) LED lamps and have an expected lamp life of 100,000 hours. Operating wavelengths and luminance must meet the requirements of Standard Specification 1084. Transformer must be rated for the line voltage with Class A rating insulation and weatherproofing. The sign must be designated for operation over a range of temperatures from -401 F. to +1651 F. (-401 C. to +741 C.).
- (d) Legibility. The sign must be legible 24 hours a day or only for specific time periods depending upon the requirements for the internally illuminated sign. Signs that are legible for specific time periods must be switched on and off from the traffic controller.

PACKAGING

4. (a) General. The signs must be shipped fully assembled and ready for installation. Each assembly must be individually wrapped and boxed so that the assembly is not damaged in shipment.
- (b) Labeling. Each box must be labeled in 3/8 inch high letters ALED ILLUMINATED SIGN@ ; the message also should be in 3/8 inch high letters. The City Commodity Code, contract number, manufacturer, and date of manufacture must be clearly labeled on the box.

**ELECTRICAL SPECIFICATION 1523
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 6, 2014**

SPLIT PEDESTAL BASE: FOR EXTENDED LOOP LIGHT POLE

SUBJECT

1. This specification states the requirements for a split pedestal base (Clamshell) for installation on an extended Loop light pole. This specification will address the requirements for a split fiberglass base without doors.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual split pedestal base dimensions and details. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted, and will be rejected as an incomplete submittal. If requested by the City, these drawings must also be submitted in electronic format in Microstation 95; failure to provide drawings in this format will be cause for rejecting the submittal.

Dimensions must include but will not be limited to: base height, width, pattern, and fluting. Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required.

- (b) Manufacturer's catalog cut sheets showing split pedestal base designation, and catalog number.
- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly, orientation, and installation.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled split pedestal base with hardware and all components, of the manufacture intended to be furnished, shall be submitted for review within fifteen (15) business days from receipt of notice. The sample base must be coordinated with an existing extended Loop light pole for accuracy of fit.

- (f) Warranty. The manufacturer must warrant the performance and construction of these split pedestal bases to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the bases have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, or failure or fading of the surface color. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to the City, of any split pedestal base, which, as determined by the Commissioner, would develop aforesaid failures. Any split pedestal base, or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified must be incidental to this contract.

GENERAL

3. (a) Products. Split pedestal bases must be the products of established manufacturers and must be suitable for the service required. Split pedestal bases which are proposed must be the products of a single manufacturer. Fiberglass bases must be manufactured by Shakespeare Company, W.J. Whatley, Incorporated, or an approved equal.
- (b) Specifications. The split pedestal bases must conform in detail to the requirements herein stated, and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The base must conform in design and dimensions to Standard Drawings 929 and 929A.
- (e) Approval. Whenever "approval" and "approved" are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of the split pedestal bases.
- (f) Commissioner's Review. The Commissioner will be the sole judge in determining the submitted split pedestal bases compliance with this specification. The Commissioner's decision will be final.

CONSTRUCTION OF FIBERGLASS BASE

4. (a) Each pedestal base must be formed of a fiberglass composite consisting of a polyester resin and containing a minimum of 65% fiberglass by weight. The resin must contain no clay fibers. The composite must be UV and weather resistant. Alternate materials may be considered. Each base half must be permanently marked on the inside identifying it as a base for an extended Loop light pole.
- (b) The split pedestal base must conform in detail and dimensions to Standard Drawings 929 and 929A.
- (c) The two halves of the clamshell must be identical to each other. They must be perfectly matched and when installed there shall be no more than a 0.125 inch gap between the inside top of the assembled base and the outside surface of the mast.
- (d) Once installed, the base should be designed to remain in place without the use of set screws. An installed base should not be able to be shifted or rotated.
- (e) The color of the base must be gloss black and must match the color of existing and proposed extended Loop light poles. The resin must contain color pigment throughout. The pigment must be even throughout the thickness of the base. A finish coat of urethane enamel must be applied to the surface of the base to a minimum dry thickness of 1.5 mils. The resin color must match the enamel color. A paint sample on fiberglass must be submitted for approval prior to production. The paint manufacturer's name and any information necessary to acquire the same color for the pole must be provided. The contractor must supply one quart of touch-up paint for every 50 bases ordered.
- (f) The texture of the fiberglass base exterior surface must be equal to that of a cast iron base. Acceptance of the aesthetic appearance of the base will be by the Commissioner.
- (g) The two halves of the shroud must be affixed by means of screws as shown on the Standard Drawings. The screws must fit so that the halves of the base are drawn together so that the edges of the base fit snug against each other. Threaded stainless steel inserts in the base must be used to affix the screws. The screws must not detract from the appearance of the base. Other methods of attachment may be considered. Any method of attachment must be approved by the Commissioner.

TESTING

5. (a) Testing. All completed fiberglass bases must be available for testing. Unless specifically authorized in writing, all tests must be at the manufacturer's plant. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the units are shipped. Tests shall be standardized according to ASTM requirements or other suitable organization's standards. The manufacturer must provide evidence that the bases are structurally sound and are able to take the normal abuse of salt spray, freeze-thaw cycles, and exposure to moisture. The bases must be impact resistant and must be resistant to UV damage.

PACKAGING

6. (a) General. The split pedestal bases must be carefully inspected at the factory prior to shipment to assure that the bases are complete and free of defects. When bases are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the bases. All hardware must be packaged in a clear container and labeled as to size, quantity, and part association.
- (b) Packaging. The split pedestal bases must be shipped on pallets with at least six units per pallet. Each base must be individually wrapped and protected so that it can be bundled and unbundled without damage to the base or its finish. The base wrapping must be labeled to identify the base. Specific instructions must be securely attached to each pallet indicating the proper methods of storage. In addition, each pallet must contain specific instructions on the installation of the split pedestal bases. Instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years. The pallets must be labeled in 3/8 inch high lettering indicating the type of base as "FIBERGLASS BASE FOR EXTENDED LOOP LIGHT POLE", the part number, the manufacturer, the date of manufacture, and the contract number.
- (c) Hardware. Any hardware not attached to the bases must be carefully wrapped and securely attached to each pallet. Hardware must be packaged in a clear bag with a label indicating the type of hardware and quantity. Payment will be withheld for any units provided without the appropriate hardware, or for any missing or improper packaging or labeling. Cracked, broken, chipped or damaged units will also be considered as incomplete quantities as regards payment.
- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for the number of bases on each pallet. These units will be securely attached to each pallet.

**ELECTRICAL SPECIFICATION 1526
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JUNE 12, 2014**

HELIX FOUNDATIONS

SUBJECT

1. This specification covers the requirements for steel helix foundations. These foundations may be used to support street light poles for both residential and arterial streets. They may also be used to support aluminum traffic signal posts. They may not be used for any combination poles that support both street lighting and traffic signals, or any traffic signal poles that support monotube arms.

GENERAL

2.
 - (a) Specifications. The foundations must conform in detail to the requirements herein stated and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number of which the most recently published revision will govern.
 - (b) Acceptance. Foundations not conforming to this specification will not be accepted.
 - (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation. They are integral parts of this specification cooperating to state necessary requirements.
 - (d) Bidders Drawings. The apparent low bidder must submit detailed scale drawings of the foundations showing actual dimensions, details, and welds, if so requested. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must give every dimension necessary to show how the foundation will function and how the pole or post will be mounted. These drawings must be submitted in electronic format, preferably MicroStation 95, if requested by the City.
 - (e) Sample. One complete foundation of each size and of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
 - (f) Warranty. The manufacturer must warrant the performance and construction

of the foundations to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of three years after the foundations have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the galvanizing system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

DESIGN

3. (a) Material. Steel must meet or exceed the requirements of ASTM A36. The shaft may be ASTM A53 Grade B, ASTM A252 Grade 2 or ASTM A36.
- (b) Dimensions. Each foundation must be dimensioned as shown on Standard Drawing 936. There are three types of foundations; a five foot foundation with a 13 inch bolt circle for three anchor bolts, a five foot foundation with a ten inch bolt circle for four anchor bolts, and a seven foot foundation with a ten to fifteen inch bolt circle for four anchor bolts.
- (c) Construction. Each foundation must have a shaft .250 inches thick with an outside diameter of 8-5/8 inches. The base plate must be 1 inch thick. The shaft must extend 1 inch into the base plate and be circumferentially welded top and bottom. The base plate must be even and flat on top with no sharp edges. The top of the base plate must be clearly and permanently marked to indicate the cableway orientation. The helix screw plate must be fabricated from a 3/8 inch thick 14 inch diameter circle of steel formed to a 3 inch pitch. The pilot point must extend 9 inches below the screw plate. The leading end of the pilot must be rounded, diamond shape, or chisel shaped. The pilot point must be welded concentric with the axis of the foundation. The cableways must be 3 inches wide by 18 inches long and be located as indicated on Standard Drawing 936. There must be no sharp edges on the cableway openings.

After fabrication, the complete foundation must be hot dipped galvanized in accordance with the provisions of ASTM A123, Grade B. This requires a zinc coating equal to 2 ounces per square foot. Touch up of small areas using a cold zinc rich coating or a cold galvanized coating is not permitted.

WELDING

4. (a) Standards. Every weld must be made in conformity with the American Welding Society. Each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and

must describe the welding methods he proposes to employ in fabricating the foundations.

- (b) Testing. The welds must be inspected for penetration and soundness by the magnetic particle inspection method or by radiography. If the magnetic inspection process is used, the dry method with direct current must be employed.

TESTING

- 5. (a) The foundations must be capable of withstanding 10,000 foot-pounds of torque applied about the main axis.
- (b) The manufacturer must certify the type of steel used to form the foundations.
- (c) The manufacturer must certify that the welds have been properly tested.

PACKAGING

- 6. (a) General. The foundations must be packaged so as not to incur any damage during shipping and unloading. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting or breaking of the contents. Each bundle must be capable of being lifted by a forklift truck and the bundles must be shipped in a flat bed truck to facilitate unloading.
- (b) All foundations will be delivered to the Division of Electrical Operations storage yard at 1539 South Ashland Avenue in Chicago, or to another location within the City as indicated on the order.

**ELECTRICAL SPECIFICATION 1527
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 30, 2007**

MAST ARMS: DAVIT, 8 AND 12 FOOT: STEEL

SUBJECT

1. This specification covers the requirements for 8 and 12 foot steel davit mast arms for supporting street light luminaires on steel tubular poles.

GENERAL

2. (a) Specifications. The mast arms must conform in detail to the requirements herein stated, and to the requirements of the following organizations cited herein:

American Association of State Highway and Transportation Officials (AASHTO)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Mast arms not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation. They are integral parts of this specification cooperating to state necessary requirements.
- (d) Bidders Drawings. Bidders must submit with their bids detailed scale drawings of the mast arms and attachments showing actual dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must give every dimension necessary to show how the parts will fit each other and be properly held in assembly. These drawings must be submitted in electronic format, preferably Microstation 95, if so requested by the City.
- (e) Sample. One complete mast arm of each size and of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.

- (f) Warranty. The manufacturer must warrant the performance and construction of the mast arms to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the mast arms have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.
- (g) Structural Requirements. The arms must be manufactured in accordance with AASTHO's 1994 version of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". The arms must be designed to meet ASSTHO's 1994 criteria for 80 MPH wind loading with a 30% gust factor. The arms must be designed for Chicago street lighting applications. The arm manufacturer must provide structural calculations and must certify that the arms are designed properly.

DESIGN

- 3. (a) 8-Foot Mast Arm. Each 8-foot mast arm must be fabricated from a continuous, single piece of steel sheet conforming to the requirements of ASTM A595, Grade A. It must conform in detail with the mast arm shown on Drawing Number 907.
- (b) 12-Foot Mast Arm. Each 12-foot mast arm must be fabricated from a continuous, single piece, of steel sheet conforming to the requirements of ASTM A595, Grade A. It must conform in detail with the mast arm shown on Drawing Number 907.
- (c) Mast Arm Attachment. The arm must be attached to the mast by slipping the bottom sleeve of the arm into the top of the mast as indicated on Standard Drawing 907. The arm sleeve must have two 0.72 inch diameter holes, factory drilled, centered one inch down from the top of the sleeve, in-line with the arm extension. These holes will accommodate a 0.63 inch through bolt. In addition, the mast must have two 0.72 inch holes, factory drilled, to align with the holes in the arm sleeve. The mast arm must also have three holes drilled approximately one inch from the bottom of where the sleeve will rest when inserted into the mast, separated at 120°, for 0.50 inch bolts to be used to level the arm. All hardware and details for attachment must be as shown on Standard Drawing 907.
- (d) Mast Arms. No butt welded, swaged and welded or other pieced together configurations will be accepted. The outer and inner surfaces of the arms

must be smooth and even without protrusions, nicks, holes or other imperfections.

PAINING

4. (a) Oil and Grease Removal. All metal surfaces must be washed with an alkaline detergent to remove any oils or grease.
- (b) Metal Cleaning. All exterior metal surfaces must be cleaned by blasting with a combination of shot and grit to remove all dirt, mill scale, rust, corrosion, oxides and foreign matter and provide a "near white" surface in accordance with SSPC-SP10. Included in this process must be one to two inches of the interior section of the mast arm.
- (c) Chemical Pretreatment. The cleaned metal surfaces must be treated with a hot, pressurized iron phosphate wash and must be dried by convection heat.
- (d) Primer Coat. All exterior surfaces are to be coated with Tnemec 90-97 corrosion-inhibiting zinc-rich aromatic urethane to a minimum dry film thickness of 2.5 mils (.0025"). The aromatic urethane is to consist of a zinc dust content not less than 83% by weight in dried film. The coating must be airless-spray applied and moisture cured.
- (e) Finish Coat. All exterior surfaces are to be subsequently coated with Tnemec Endura-Shield II 1074 aliphatic acrylic polyurethane to a minimum dry film thickness of 3.0 mils (.003"). The coating must be airless-spray applied and cured in an oven by heating the steel substrate to between 150° Fahrenheit and 220° Fahrenheit.
- (f) Interior Coat. The interior metal surfaces must be coated with red oxide rust inhibitive alkyd primer to a dry film thickness of 1.5 mils.
- (g) Durability. Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl solution at 95°F and 95% relative humidity without blistering. A panel of the same steel as the arms must be used for the test. Before the test, the panel must be scribed with an "X" down to bare metal.
- (h) Coating Measurement. Measurement of coating thickness must be done in accordance with SSPC-PA 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges," except that the lowest "Single spot measurement" in an area of two square inches must be not less than 5.5 mils.
- (i) Color. Color must be gloss black, unless otherwise specified in the order. A color chip sample must be submitted for approval prior to fabrication.

- (j) Alternate Methods. Alternate painting methods may be reviewed and tested on a case by case basis. However, no painting method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified.

WELDING

- 5. (a) Standards. Every weld must be made in conformity with the proper interpretation of the standard welding symbols of the American Welding Society as indicated on the drawings; however, each bidder must submit with his proposal a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods he proposes to employ in fabricating the mast arm.
- (b) Testing. The welds must be inspected for penetration and soundness by the magnetic particle inspection method or by radiography. If the magnetic inspection process is used, the dry method with direct current must be employed.

MAST ARM TESTS

- 6. (a) General. The first three (3) arms of the first fifty (50) arms of each size in every order must be tested for integrity of the welds. An additional one (1) arm for each additional fifty (50) arms in the lot must be tested.
- (b) Test. The 8-foot or 12-foot mast arm, when securely attached to a suitable and proper supporting structure, must withstand a side pull of not less than three hundred (300) pounds applied at a point seven feet (7') from the center of the vertical section of the arm without failure of welds or permanent set.
- (c) Rejection. If any of the mast arms in any lot fail to meet the test, an additional three (3) mast arms in the same lot must be tested. If any of these mast arms fail to meet the test requirements the entire lot will be subject to rejection, except that the manufacturer may subject each mast arm in the lot to the test, and those which meet the requirements will be accepted.

PACKAGING

- 7. (a) General. The arms must be shipped in bundles. Each arm must be individually wrapped so that the arm can be bundled for shipping and unbundled for delivery without damage to the arm or its finish. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled, shipped and stored without shifting or breaking of the contents. Any bundles, in which either the mast arms or packaging is

received broken, damaged or with contents shifted, will not be accepted and it will be the responsibility of the supplier to return the bundle at no cost to the City. Each bundle must be capable of being lifted by a fork lift truck or crane and the bundles must be shipped in a flat bed truck to facilitate unloading. Each arm wrapping must be clearly labeled indicating the arm size, i.e. " 8' STEEL DAVIT MAST ARM".

- (b) The hardware must be shipped with each bundle. The package must be labeled and placed in a prominent position to facilitate accessibility, and must be attached to, or within, the bundle in such a manner as to assure safe delivery.

**ELECTRICAL SPECIFICATION 1528
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JUNE 6, 2014**

PRECAST CONCRETE STRUCTURES

SUBJECT

1. This specification covers the requirements for precast concrete structures to be used for City of Chicago electrical facilities. The structures will include manholes, handholes, and street light pole foundations.

GENERAL

2. (a) Specifications. The precast structures must conform in detail to the requirements herein stated and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number of which the most recently published revision will govern.
- (b) Acceptance. Precast structures not conforming to this specification will not be accepted. The Commissioner of Transportation or his representative will be the sole judge in determining if the precast structures meet this specification. The Commissioner's decision will be final.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation. They are integral parts of this specification cooperating to state necessary requirements.
- (d) Bidders Drawings. The apparent low bidder must submit detailed scale drawings of the precast structures showing actual dimensions and details, if so requested. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must give every dimension necessary and show how the structure is assembled.
- (e) Sample. One complete precast structure of each item must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (f) Warranty. The manufacturer must warrant the performance and construction of the precast structures to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to

design, workmanship, or material developing within a period of one (1) year after the precast structures have been delivered. This will be interpreted particularly to mean structural failure of any element. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made. The Commissioner's decision will be final.

DESIGN

3. (a) Material. Concrete must be Portland cement concrete, Class SI or PC, meeting current IDOT specifications. Pulling irons in manholes must meet or exceed the requirements of ASTM A36 steel. Pulling irons must be hot dipped galvanized. Steel reinforcing bars must meet or exceed the requirements of ASTM A615, Grade 60. Cable supports in manholes, including stanchions and racks, must be manufactured for that specific purpose. Stanchions must be non-metallic and must be capable of accommodating several different sizes of cable hooks at various elevations. A minimum of eight cable hooks, 4 inches in length, must be provided with each manhole, and should include any hardware necessary to affix the hooks to the racks. Cable hooks for handholes must be manufactured for that specific purpose. Cable hooks for handholes must be a minimum of 3 inches in length and 3 inches in depth. Anchor rods in foundations must meet the latest Electrical Material Specification 1467. Conduit elbows in foundations must meet the latest Electrical Material Specification 1462.
- (b) Foundations must include conduit elbows, anchor rods, washers, and nuts. The 7 foot foundation must include a 6 foot re-bar cage. Handholes must include cable hooks. Manholes must include cable racks, pulling irons, and cable hooks. Each manhole and each handhole must have lifting anchors cast in the concrete to facilitate shipment and installation. If the manhole or handhole is in more than one piece, instructions for assembly must be provided. Also, a sufficient amount of bonding agent must be provided. The bonding agent must be approved material. Frames and covers, sump grates, clay tile, and ground rods are not included under this specification.
- (c) Dimensions of Manholes and Handholes. Each manhole or handhole must be dimensioned as shown on the appropriate standard drawing. The 30 inch diameter handhole is Standard Drawing 867. The 36 inch diameter handhole for 24 inch frame and cover is Standard Drawing 866. The 36 inch diameter for 30 inch for frame and cover is Standard Drawing 871. The 3 foot by 4 foot by 4 foot manhole for a 24 inch diameter frame and cover is Standard Drawing 730. The 3 foot by 4 foot by 4 foot manhole for 30 inch frame and cover is Standard Drawing 729. The 4 foot by 6 foot by 6 foot manhole for 24 inch frame and cover is Standard Drawing 732. The four foot by 6 foot by 6 foot manhole for 30 inch frame and cover is Standard Drawing 733. The 5

foot 4 inch by 7 foot 4 inch manhole roof is Standard Drawing 733.

- (c) Dimensions of Grade Rings. Grade rings shall be in four different dimensions. The 39 inch outside diameter ring shall have a 24 inch diameter opening and shall come in both 2 inch and 4 inch thicknesses. The 45 inch outside diameter ring shall have a 30 inch diameter opening and shall also come in both 2 inch and 4 inch thicknesses.
- (d) Dimensions of foundations. The residential street light foundation shall be dimensioned as shown on standard drawing 565. The 7 foot arterial street light foundation shall be as shown on standard drawing 818.

DELIVERY

- 4. All manholes, handholes, and foundations will be delivered to the Division of Electrical Operations storage yard at 1539 South Ashland Avenue in Chicago, or to another location within the City as indicated on the order. Any manhole, handhole, or foundation deemed to be defective by the Commissioner or his representative must be removed and replaced at no cost to the City. The Commissioner's decision will be final.

**ELECTRICAL SPECIFICATION 1532
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
SEPTEMBER 15, 2003**

UNINTERRUPTIBLE POWER SUPPLY FOR TRAFFIC SIGNALS

SUBJECT

1. This specification states the requirements for an uninterruptible power supply (UPS) for the operation of traffic signals in the event of a power failure or power interruption. The back-up power supply will be batteries; the batteries will recharge through the 120 volt electric service line. The unit must automatically activate when a power outage, a power drop, or a power surge, is sensed. The transfer from utility power to battery power must not interfere with the normal operations of the traffic controller, conflict monitor, or any other part of the traffic system. A generator port must be provided to accept input from an external generator which can operate the traffic signals. The unit must be self contained in a cabinet which can be mounted to the side of a traffic signal control cabinet.

SUBMITTAL INFORMATION REQUIRED

2. (a) Information Required. Each bidder must submit a proposal, including information relative to the proposed power supply as further detailed in this Section, for review and approval. Failure to submit any of the information as listed and described below will constitute an incomplete submittal. Incomplete submittals will not be reviewed and will be considered rejected:
 1. Manufacturer shop drawings and product data.
 2. Proposed test procedures and statements.
 3. Material delivery schedule.
 4. Sample unit
- (b) Manufacturer=s Shop Drawings and Product Data. Submittal must be complete, coordinated, approvable, and must demonstrate compliance with all Contract requirements specified herein.
 1. Scaled manufacturer=s shop drawings showing actual dimensions and details. Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required.

2. Manufacturer=s catalog cut sheets.
 3. Manufacturer=s specifications.
 4. Manufacturer=s written warranty.
 5. Manufacturer=s written installation instructions and maintenance manuals including recommendations and/or procedures for assembly, and installation.
- (c) Proposed Test Procedures and Statements. Submittal must include a statement indicating the types of tests proposed.
- (d) Material Delivery Schedule. Submittal must include a schedule listing the time frame from placement of an order, to testing, to time of delivery for various quantities of units. The schedule must be coordinated with all required inspection and testing. Once approved, the Material Delivery Schedule will become binding under the Contract terms. The City requires, from placement of an order to delivery, that the time will not exceed six weeks.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled unit with mounting hardware and all components, of the manufacture intended to be furnished, must be submitted for review within forty-five (45) business days of receipt of such notice. The sample must be submitted to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. If after testing, it is determined that the sample does not meet the specification, the manufacturer may be allowed an additional period of fifteen (15) business days, after notification, to deliver another sample for testing. If the second sample does not meet the specifications, the manufacturer will be disqualified.
- (f) Warranty. The manufacturer must warrant the performance and construction of the UPS to meet the requirements of this Specification and must warrant all parts, components, batteries, and appurtenances against defects due to design, workmanship, or material developing within a period of five (5) years after the UPS has been delivered. The warranty must be furnished in writing guaranteeing replacement, including cost of shipment, free of charge to the City, of any UPS, or any component parts thereof, which, as determined by the Commissioner, would develop aforesaid failures. The warranty must accompany submittal information. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner=s decision will be final. Any cost for the warranty as specified must be incidental to this contract. The manufacturer must supply 24 hour trouble-shooting assistance via an 800 number, for the duration of the supply contract.

GENERAL

3. (a) The UPS system, including batteries, must be contained in an external cabinet as specified herein and is intended to be mounted to the side of an existing traffic control cabinet.
- (b) Products. The UPS must be the product of an established manufacturer, and must be suitable for the service required. The UPS must be manufactured by U.S. Traffic Corporation, On-Line Power, Inc., or an approved equal.
- (c) Compatibility. The UPS must be compatible with City of Chicago traffic controllers and associated equipment.
- (d) Review. The Chief Procurement Officer will be the sole judge in determining the UPS compliance with this Specification. The Chief Procurement Officer's decision will be final.

GENERAL OPERATION

4. (a) The line power provided by ComEd is nominally 120 volt, single phase, 60 Hertz. The UPS system will take the line power, regulate it, and provide continuous 120 volt, single phase, 60 hertz power to the traffic system. The UPS must regulate the input line voltage within the limits specified herein. The input line voltage will also be transformed and rectified to charge the batteries. Under battery operation, the output from the batteries must go through an inverter to provide the proper A.C. current to provide continuous 120 volt, single cycle, 60 Hertz power to the traffic system. In the event of a power loss, the system must automatically switch to battery operation, without adversely affecting the traffic system. When power is restored, the system must automatically switch back without adversely affecting the traffic system. In the event the UPS system fails, an automatic switch must bypass the UPS and connect unconditioned power from ComEd directly to the traffic system. A manual bypass switch must also be provided. The system must be capable of running off a generator. The UPS must allow the generator to be put in or out of the system without adversely affecting the traffic system.
- (b) The system must be capable of providing power for normal full timing mode, flash mode, or a combination of both. The operation must be field programmable to activate at various times, to change operation due to changing battery capacities, and to track alarm conditions, using the touch pad or remotely using the RS-232 interface. Programmability must be in ASCII formats and must not require any external or proprietary software. The DB-9 connector for the RS-232 interface must be located on the front panel of the UPS. The UPS must provide a minimum of 4 hours of full normal timing for a full LED controlled intersection.
- (c) In the event ComEd line voltage falls outside the high and low limits (95VAC and 130VAC should be the default values) the UPS must transfer

the load to battery power. The high and low limits must be programmable.

- (d) The UPS must return to line mode when the ComEd power is restored within the proper limits for a specified period of time. The limits must be programmable. The default values should be 105VAC and 125VAC. This time must be programmable and should range from 3 to 30 seconds.
- (e) The transfer time allowed, from disruption of normal utility line voltage to batteries or from batteries back to line voltage, must be such that the traffic signal system is not disrupted. The maximum transfer time allowed will be 60 milliseconds.

SPECIFICATIONS

- 5. (a) The UPS capacity will be a minimum of 2000VoltAmps/ 1500 watts.
- (b) The inverter must have a minimum efficiency of 80%.
- (c) The UPS will have an operating range of between !37EC. to +74EC.
- (d) The manual bypass switch must be rated at 240 volts, 40 amps.
- (e) The UPS must have a temperature compensated battery charging system. The charging system must compensate over a range of 2.5mV to 4 mV per degree centigrade per cell. Batteries must not be charged when temperatures exceed 50E C. The temperature sensor must be located in the cabinet near the batteries.
- (f) The charger must be rated at 10 amps at 48 VDC.
- (g) When under battery operation the UPS output voltage must be between 110 VAC and 125VAC, with a sine wave with THD less than 3% at 60 Hertz(∇ 3 Hz).
- (h) The UPS must be equipped to prevent a malfunction feedback to the utility service or to the cabinet per UL 1778, Section 48 ABack-Feed Protection Test@. The upstream back-feed voltage from the UPS must be less than 1 volt AC.
- (i) The UPS must have a lightning surge protection in compliance with IEEE/ ANSI C.62.41 for 2000 volts AC.
- (j) The UPS must not weigh more than 50 pounds.
- (k) The UPS must have a minimum efficiency of 95%.

- (l) The generator bypass switch must be supplied with a 30 amp, weather-proof locking receptacle and cover plate.

COMPUTER CONTROL AND DISPLAY

6.
 - (a) The UPS must include a LCD display with programmable keypad, a red LED and a green LED, and an RS-232 interface.
 - (b) The UPS processor must be capable of indicating, through the LCD display or the RS-232 interface, the current battery charge status, various input/output voltages, power output, battery temperature, date, time, settings of programmable relays, events, and various other functions.
 - (c) The UPS must provide a temperature control for the cabinet fan.
 - (d) The UPS must be provided with a resettable inverter event counter and a cumulative inverter timer.
 - (e) The UPS must be equipped with an event log for a minimum of 100 events. Each event must have a date and time.
 - (f) The UPS must be capable of performing a self-test.
 - (g) Password protection must be provided.
 - (h) The following LED conditions must be used to indicate current status:

RED FLASHING - Alarm
RED STEADY - Fault
GREEN FLASHING - Battery Mode
GREEN STEADY - Line Mode
 - (i) The manual UPS bypass switch will allow the UPS to be maintained or replaced.

BATTERY SYSTEM

7.
 - (a) Individual batteries must be 12 volt, and must be commercially available and easily replaced.
 - (b) Four 79ah batteries must be supplied
 - (c) The batteries will be connected in series. The wiring harness must be color

coded with quick disconnects.

- (d) Batteries must be certified to operate over a temperature range of -25E C. to +74E C.
- (e) The batteries must be extreme temperature, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (absorbed glass mat/valve regulated lead acid) .
- (f) Maximum recharge time from protective low cut-off to 80% of full capacity must not exceed 20 hours.
- (g) Thermostat controlled heater strips or pads must be supplied to keep battery operation efficient.

RELAY CONTACTS

- 8. (a) The UPS must provide 6 sets of panel-mounted, potential free, fully programmable relay contacts rated at 1 amp, 120 volt. The relays must be numbered from C1 to C6.
- (b) Each relay must be programmable to activate under any number of the following conditions:

ON BATTERY, relay activates when UPS switches to battery power.

LOW BATTERY, relay activates when batteries have reached a certain level of remaining capacity. This is adjustable from 0 to 100%.

TIMER, relay activates after battery power is on for a certain amount of time. This is adjustable from 0 to 8 hours.

ALARM, relay activates after a specific alarm is detected. Alarm conditions include line frequency, low output voltage, no temperature reading, overload, batteries not connected, high temperature, and low temperature.

FAULT, relay activates after a specific fault is detected. Fault conditions include short circuitry, low battery voltage, high battery voltage, high internal temperature, and excessive overload.

OFF, relay is not active.

CABINET

- 9. (a) Housing. The cabinet will house the entire UPS, including batteries, switches, charger, inverter, and interconnect. The cabinet will meet the requirements for NEMA 3R enclosures. The housing must have dimensions so that it may easily be attached to the side of a City of Chicago M or P cabinet. The housing must not interfere with the opening of the traffic cabinet door. The

UPS cabinet door, when opened, must not interfere with the traffic cabinet housing or traffic cabinet door when the traffic cabinet door is also in the open position. The complete enclosure and door will be made from .125 inch thick aluminum type 5052-H32. All external seams will be continuously welded. The door opening will have a double flange for weather sealing purposes. The housing must have a port for connecting an external generator.

- (b) Door. The cabinet will have a door to provide access to the complete cabinet interior. The door will have a continuous piano hinge of 14 gauge stainless steel with a .120 inch diameter stainless steel hinge pin. The hinge will be attached to the enclosure and the door with close end pop rivets. The door will have a three point locking mechanism with rollers at the ends of the latch rods. The door must have stops at 90, 150, and at 180 degrees. The latch handle must be capable of being padlocked. The key lock must be a Corbin cylinder lock with a #2 key. A continuous neoprene gasket will be used to weatherproof the enclosure when the door is closed.
- (c) Ventilation. A fan must be mounted in the air baffle at the top of the cabinet with an air outlet built into the overhang. The fan must have a capacity of 100CFM. The fan must be thermostatically controlled. The bottom of the door will be louvered to allow air flow. A removable dust filter will be located behind this vent.
- (d) Finish. The entire enclosure must be degreased in a wash process and dried in a heated chamber. A thermosetting, ultra-violet resistant, polyester powder coat must be electrostatically applied and cured in a heated chamber as recommended by the powder coat paint manufacturer. The exterior coat will be gloss black unless otherwise noted in the order. The interior may be left unpainted.
- (e) Mounting. The cabinet will be mounted to the traffic control cabinet with 6 hex head bolts, 1/4 x 20. All holes will be field drilled, by the City, to accommodate the specific situation. The bolts, washers, and nuts will be supplied as part of this contract. A grommet will be supplied to protect the cable in a field drilled 1.5" hole for cable connection to the existing traffic controller.
- (f) Hardware. The cabinet must be supplied with all mounting hardware, gaskets, bushings, grommets, caulking, etc. necessary to install the cabinet in a safe and, secure, weatherproof way.

TESTING

- 10. (a) General. Testing must be conducted on each unit the manufacturer intends to

deliver to the City. A testing procedure must be submitted to and approved by the City before testing commences. All testing must be certified by the manufacturer or an independent lab.

- (b) Testing of the equipment must verify that the operation meets the requirements of this specification. All equipment must be shown to operate correctly, including the rectifier, charger, inverter, batteries, and control unit. The UPS must be connected to a dummy load at the factory and tested for performance under various conditions of line voltage and frequency, varying loads, temperature range, and humidity range. The automatic switching must be successfully demonstrated; losing line power and restoration of line power must not adversely affect the operation of the traffic signals. Use of the manual bypass switch must be successfully demonstrated. A generator must be connected to the unit and successfully operate the system without interruption.
- (c) Batteries. The batteries must be shown to be able to operate the traffic signals for the specified time. The batteries must be shown to be able to be recharged in the specified time between failures.
- (d) Controls. The control unit, including the LCD display and the RS-232 interface, must be shown to function according to this specification. All reports and event monitoring must be successfully demonstrated. Programming functions must also be shown to work properly.
- (e) It must be demonstrated that the cabinet will fit properly to the side of an M cabinet and to the side of a P cabinet, be properly dimensioned, and will not interfere with any maintenance operations.
- (f) The UPS unit must be fully tested after installation. A manufacturer's representative must be available on site to oversee the installation.

SHIPMENT AND DELIVERY

- 11. (a) General. The UPS must be fully assembled in the cabinet and be carefully inspected at the factory prior to shipment. All hardware must be packaged in a clear container and labeled as to size and quantity.
- (b) Packaging. The cabinets must be shipped on individual pallets. Each cabinet must be individually wrapped and protected so that it can be handled without damage to the cabinet or its finish. The UPS and cabinet must be wrapped to give protection from the elements, as well as from shipping

- (c) Delivery. UPS units must be delivered to the Division of Electrical Operations at 2451 S. Ashland Avenue. Units must be available for testing and shipping within six weeks of the placement of an order.

**ELECTRICAL SPECIFICATION 1533
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED NOVEMBER 21, 2014**

NON-METALLIC CONDUIT

SCOPE

1. This specification states the requirements for both rigid and coilable non-metallic conduit. The conduit will be used for low voltage (600 volt rated cables) electrical street lighting and traffic control systems. It may also be used for fiber-optic communications cables. This conduit will be installed underground. Rigid non-metallic conduit may be installed on structure.

GENERAL

2. (a) Standards. The following standards are referenced herein.

ASTM – American Society for Testing and Materials
NEC – National Electrical Code
NEMA – National Electrical Manufacturer’s Association
UL – Underwriter’s Laboratories
- (b) Warranty. The manufacturer must warrant the conduit against defective workmanship and material for a period of one year from date of installation or date of delivery. Any conduit that is found to be defective must be replaced without cost to the City.
- (c) Sample. If requested by the Chief Procurement Officer, a sample of the conduit intended to be furnished under this specification, must be submitted to the Engineer of Electricity within fifteen (15) business days upon receipt of such request.

MATERIAL

2. (a) Rigid non-metallic conduit will be made of polyvinyl chloride (PVC). All conduit and fittings must comply with ASTM D 1784 and with the applicable sections of NEMA TC2, UL standard 651, and NEC Article 352. Fittings must meet the standards of NEMA TC3 and TC6, as well as UL 514.

- (b) Coilable non-metallic conduit will be made of high-density polyethylene (HDPE). All conduit must comply with ASTM D3485, ASTM D 1248, and NEMA TC7.
- (c) A tape must be installed in the HDPE conduit at the factory. The tape is for pulling cable through the conduit. The tape must be specifically manufactured for this purpose. The tape must have a tensile strength of at least 1000 pounds.

SIZES

- 3. (a) PVC and HDPE will come in two wall thicknesses: schedule 40 and schedule 80.
- (b) PVC will come in ten-foot sections. HDPE will come on reels.
- (c) Nominal inside diameters (in inches) for non-metallic conduits will include the following: $\frac{1}{2}$, $\frac{3}{4}$, 1, 1 $\frac{1}{4}$, 1 $\frac{1}{2}$, 2, 2 $\frac{1}{2}$, 3, 3 $\frac{1}{2}$, 4.

PACKING

- 4. Rigid conduit must be shipped in bundles. Coilable conduit must come on wooden reels. Both bundles and reels must be tagged to indicate the size and diameter of the conduit, the quantity in feet, the weight, and the manufacturer's name. The conduit itself must be marked to indicate the type and size, as well as the manufacturer.

**ELECTRICAL SPECIFICATION 1534
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 5, 2013**

CABLE: SINGLE-CONDUCTOR, COPPER 600 VOLT

SUBJECT

1. This specification states the requirements for single conductor cables intended to be used in 240 VAC street lighting circuits. The cable will also be used as service cable for both street light controllers and traffic signal controllers. The cables will be installed in underground conduit and rated as 600 volt.

GENERAL

2. (a) Specifications. The cable must conform in detail to the requirements herein stated, and to the applicable portions of the latest revisions of the specifications and methods of test of the following agencies:
 - (1) ASTM – American Society for Testing and Materials
 - (2) ICEA – Insulated Cable Engineers Association
 - (3) IEEE – Institute of Electrical and Electronics Engineers
 - (4) UL – Underwriters Laboratories
- (b) Acceptance. Cable not in accordance with this specification will not be accepted.
- (c) Sample. If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be provided under this specification must be sent to the attention of the Engineer of Electricity within fifteen (15) days of receipt of such request.
- (d) Warranty. The manufacturer must warrant the cable to be first class material throughout. In lieu of other claims against them, if the cables are installed within twelve (12) months of date of shipment, the manufacturer must replace any cable failing during normal and proper use within two years of date of installation. All replacements under this warranty must be made free of charge F.O.B. delivery point of the original contract.

CABLES

3. (a) Construction. The cable must consist of an uncoated multiple strand copper conductor with a tight fitting thermoset, free stripping, concentric layer of ethylene propylene (EPR) insulation.
- (b) The number of strands and the outer diameter of the cable shall be as noted in TABLE A.
- (c) Cable shall be UL approved for sunlight resistance and for direct burial applications.
- (d) Cable must meet IEEE 383 and UL 1581 70,000 BTUs per hour flame test requirements.

COLOR CODE

4. (a) Triplexed cable shall consist of a black cable, a red cable, and a green ground cable. Triplexed cable will have a 16" to 18" lay.
- (b) Individual cables will be black, red, or white, depending upon the order.

CONDUCTOR

5. (a) Material. The conductors must be soft round copper strands.
- (b) Specifications. The conductor must meet the requirements of ASTM B3 and ASTM B8.
- (c) Sizes. The conductor sizes must be in accordance with all requirements in Table A of this specification.
- (d) Stranding. The number of strands must be as indicted in Table A. Stranding must meet the requirements of ASTM B8, Class B.

INSULATION

6. (a) Type. The insulation must be ethylene propylene rubber compound (EPR) meeting the requirements of ICEA S-95-658 and UL 44 for RHW-2 cable and UL 854 for USE-2 cable.
- (b) Thickness. The insulation must be circular in cross-section, concentric to the conductor, and must have an average thickness not less than that set forth in Table A of this specification, and a spot thickness not less than ninety percent (90%) of the average thickness.

- (c) Cable Marking. The cable must be identified by a permanently inscribed legend in white lettering as follows:

1/C No. (conductor size) AWG-600V-90°C-EPR-RHW-2

The legend must be repeated at approximately eighteen (18) inch intervals on the outside surface of the cable parallel to the longitudinal axis of the conductor. A sequential footage marking must be located on the opposite side from the legend.

TESTING

7. (a) Initial Physical Requirements.
- | | |
|--------------------------------------|------|
| 1. Tensile strength, minimum, p.s.i. | 1200 |
| 2. Elongation at rupture, minimum % | 250 |
- (b) Oven Exposure Test. After conditioning in an air oven at $121\pm 1^\circ\text{C}$ for 168 hours using methods of test described in ASTM D 573:
- | | |
|--|----|
| 1. Tensile strength, minimum % of initial value | 75 |
| 2. Elongation at rupture, minimum percent of initial value | 75 |
- (c) Water Absorption Test. Gravimetric method: After 168 hours in water at $70\pm 1^\circ\text{C}$ water absorption, at a maximum – 5 milligrams per square inch
- (d) Cold Bend Test. The completed cable must pass the test requirements of ASTM D 470, except that the test temperature must be -25°C .
- (e) Electrical Tests.
1. Voltage. The completed cable must meet an A.C. and D.C. voltage test in accordance with ASTM D 470 and D 2655.
 2. Insulation Resistance. The completed cable must have an insulation resistance constant of not less than 20,000 ohms when tested in accordance with ASTM D 470.
- (f) Flame Tests. Cable must pass a 70,000 BTU flame test in accordance with IEEE 383.
- (g) All of the above tests must be on cable produced for the order. Tests must be taken on samples taken every 25,000 feet, or fraction thereof, of each conductor size.

- (h) Test Reports. No cable shall be shipped until certified copies of all factory tests have been reviewed and approved by the City. Cable that does not pass any one of the above tests will be rejected.

PACKAGING

- 8. (a) Reels. The completed cable must be delivered on sound substantial, non-returnable reels. Both ends of each length of cable must be properly sealed against the entrance of moisture and other foreign matter by the use of clamp-on cable caps. The ends must be securely fastened so as not to become loose in transit. Before shipment, complete 2 X 4 lagging must be applied to all reels.
- (b) Footage. Each reel must contain the length of cable as set forth in Table A of this specification. Alternate lengths may be considered.
- (c) Reel Marking. A metal tag must be securely attached to each reel indicating the reel number, contract number, date of shipment, gross and tare weights, the appropriate City commodity code if applicable, and a description of the cable. Also, each reel must have permanent marking on it indicating the total footage, and the beginning and ending sequential footage numbers. Directions for unrolling the cable must be placed on the reel with an approved permanent marking material such as oil-based paint or a securely attached metal tag.

TABLE A

CONDUCTOR		INSULATION THICKNESS	A-C TEST	REEL LENGTH	OVERALL DIAMETER
<u>AWG</u>	<u>STRANDS</u>	<u>MILS</u>	<u>VOLTS</u>	<u>FEET</u>	<u>INCH</u>
14	7	45	5500	2000	.133
12	7	45	5500	2000	.152
10	7	45	5500	2000	.176
8	7	60	5500	2000	.236
6	7	60	5500	2000	.274
4	7	60	5500	2000	.322
2	7	60	5500	1000	.382
1/0	19	80	7000	1000	.470
2/0	19	80	7000	1000	.514
3/0	19	80	7000	1000	.564
4/0	19	80	7000	1000	.620
250 MCM	37	95	8000	1000	.705

**ELECTRICAL SPECIFICATION 1535
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 12, 2015**

RESIDENTIAL STREET LIGHTING CONTROLLER

SUBJECT

1. This specification states the requirements for a residential street lighting controller and cabinet for controlling residential street lighting circuits. The controller is intended to be mounted to a Commonwealth Edison wood pole.

GENERAL

2. (a) Specifications. The controller and cabinet must conform in detail to the requirements herein stated, to the Specifications and Methods of Test of the American Society for Testing and Materials, cited by ASTM Designation Number, in which the most recently published revision will govern. Cabinets must meet or exceed the requirements of a NEMA 4X enclosure type and must be U.L. listed.
- (b) Acceptance. Controllers not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, and must be interpreted as part of these specifications cooperating to state necessary requirements.
- (d) Sample. One complete controller of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such a request. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (e) Warranty. The manufacturer must warranty the controller and cabinet against flaws in material or workmanship for a period of two (2) years from the date of delivery. Any controller, cabinet, or components developing flaws within this period must be replaced by the manufacturer, including shipment, at no cost to the City.

DESIGN

3. (a) Drawings. The controller and cabinet must conform in detail to requirements shown on Electrical Standard Drawing 955.
- (b) Dimensions. The overall outside dimensions of the control cabinet must be 19.5 inches in height by 17.5 inches in width by 9.6 inches in depth. Cabinets must have sloped tops to shed water.

CABINET REQUIREMENTS

4. (a) Cabinet. The cabinet must be classified as NEMA 4X. The cabinet and the door must be constructed of gray, hot molded, fiberglass reinforced polyester resin compound with a minimum of 20% glass fibers by weight. Fiberglass material must meet UL 746C requirements with halogen-free and self-extinguishing characteristics. The enclosure should be listed under UL standard 508. The cabinet door opening must be double flanged on all four (4) sides. The cabinet will be made of one piece of molded fiberglass.
- (b) Door. The door will be fabricated of one-piece of fiberglass. The door size must be as shown on Electrical Standard Drawing 955. The door must be hinged on the left side when facing the cabinet. The door must have a gasket that meets the requirements found in U.L.508 Table 21.1. The gasket must form a weather-tight seal between the cabinet and the door.
- (c) Hinge. Hinge must be a continuous stainless steel piano hinge bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts and nylock nuts. The hinge leaves must not be exposed externally when the door is closed. Only the hinge knuckles must be visible upon closing the door. The hinge pin must be 0.250 inch diameter stainless steel and must be capped top and bottom by weld to render it tamper-proof.
- (d) Latching. Two (2) quick release, padlockable, stainless steel latches must be provided.
- (e) Cable Openings. The bottom of the cabinet must have an opening to accommodate a cord grip for a cable up to 1.375 inches in diameter. The bottom of the cabinet must also have an opening to accommodate a 2.0 inch schedule 40 rigid galvanized steel conduit. The cord grip and conduit hub must be included as part of the cabinet assembly.
- (f) Cabinet Mounts. The cabinet must be equipped with two (2) galvanized steel brackets, a minimum of 1/16" in thickness, which will allow mounting to a wood pole. Each bracket will be mounted to the back of the cabinet with two (2) 1/4-20 stainless steel hex head bolts with washers, and nuts. Each bracket will be formed of a single piece of galvanized steel, 16" by 6". The top of the

bracket will be straight and have two holes drilled to accept the mounting bolts of the cabinet. The lower part of the bracket must be bent to form two “wings” to fit around the ComEd pole. Each wing will be drilled to accept 1/2-13 X 4” stainless steel lag bolts. All bolts will be included.

PANEL

5. The panel must be composed of phenolic plastic 1/2 “ in thickness, or an approved equal. It must be securely bolted to the cabinet using stainless steel hardware. The panel must have holes cut into it, and holes drilled into it, to accept mounting of all the electrical components. The location of the components must be as indicated on Electrical Standard Drawing 955.

ELECTRICAL COMPONENTS

6.
 - (a) The contactor must be rated for 50 amps and fit a Milbank AP2300 socket.
 - (b) Circuit breakers must have thermal magnetic trips. Each breaker must be enclosed in a hard case insulated housing. The frame must be rated for 100 amp service at 240 volts. The minimum interrupting capacity will be 18,000 r.m.s. amperes at 240 volts. All breakers must be UL listed.
 - (c) Wiring will be as indicated on Electrical Standard Drawing 955. All wire will have stranded copper conductors. All wires must be insulated with an approved 125° Centigrade insulation.
 - (d) All components will be as indicated on Drawing 955, or approved equals.

**ELECTRICAL SPECIFICATION 1537
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED AUGUST 5, 2013**

**CABLE: TRAFFIC SIGNAL, MULTIPLE CONDUCTOR,
COPPER WIRE, 600 VOLT**

SUBJECT

1. This specification states the requirements for a multiple conductor cable to be installed in underground conduits and used to distribute electrical energy to operate automatic traffic control signals for both vehicular and pedestrian traffic at street intersections within the City of Chicago. The cable will be used between the traffic controller cabinet and the junction boxes on the traffic signal poles. The cable will be rated as 600 volt.

GENERAL

2. (a) Specification. The cable must conform in detail to the requirements herein stated, and to the specifications and methods of test of the following:

ASTM - American Society for Testing and Materials
ICEA - Insulated Cable Engineers Association
IEEE - Institute of Electrical and Electronic Engineers
UL - Underwriters Laboratories
- (b) Acceptance. Cable not conforming to this specification will not be accepted.
- (c) Sample. If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be furnished under this specification must be submitted to the attention of the Engineer of Electricity within fifteen (15) business days of receipt of such request.
- (d) Warranty. The manufacturer must warrant the cable to be first class material throughout. In lieu of other claims against them, if the cable is installed within twelve (12) months of date of shipment, the manufacturer must replace any cable failing during normal and proper use within two years of date of installation. All replacements under this warranty must be made free of charge F.O.B. delivery point of the original contract.

CABLES

3. (a) Construction. The cable must consist of coated conductors each concentrically encased with a free- stripping, thermoset cross-linked polyethylene insulation. Suitable fillers must be used to produce an essentially round cross-section. A Mylar tape must be wrapped over the conductor assembly, and a thermoset low smoke zero halogen polyolefin (LSZH) jacket applied overall.
- (b) Outer Diameter. The maximum allowable outer diameter for round cables must be as follows:

<u>No. Of Conductors</u>	<u>Outer Diameter</u> (inches)
Ten	0.69
Nineteen	0.90

- (c) Cable shall be UL approved for sunlight resistance and for direct burial applications.
- (d) Cable must meet IEEE 383 and UL 1581 and UL1202 70,000 BTUs per hour flame test requirements.

COLOR CODE

4. Conductor identification must be provided by color synthetic-resin coverings, or an approved equal. Table A sets forth the color code for the various conductor arrangements.

CONDUCTOR

5. (a) Material. Solid, soft, or annealed, tinned copper wire, meeting the requirements of ASTM B-33 and B-258.
- (b) Size. Cables must be made up of conductor sizes as set forth in this specification. The Number 14 AWG will be solid.

INSULATION

6. (a) Type. The insulation must be a thermoset cross-linked polyethylene compound meeting the requirements of ICEA S-73-532 and UL 44 for XHHW-2 cable.
- (b) Thickness. The insulation must be circular in cross-section and have the following minimum thicknesses.

<u>Conductor Size. AWG</u>	<u>stranding (No. Of Wires)</u>	<u>No. of Conductors</u>	<u>Insulation Thickness (mils)</u>
#14	1	10	30
#14	1	19	30

CABLE TAPE

7. The assembled and cabled conductor core must be wrapped with a one mil (0.001 inch) thick Mylar tape allowing a minimum of ten percent (10%) overlap.

JACKET

8. (a) Material. The jacket must be a thermoset low smoke zero halogen (LSZH) polyolefin.
- (b) Workmanship. The jacket must have a smooth exterior surface free from holes, cracks, and splits, and must be tough, elastic, homogeneous in composition, and properly vulcanized.
- (c) Thickness. Thickness of the jacket must be 4/64 inches. Minimum thickness must be not less than ninety percent (90%) of the average thickness.
- (d) Cable Marking. Outer Jacket must be embossed or printed with the manufacturer's name, year of manufacture, insulation and jacket materials, conductor number, conductor size, at approximately 18" intervals. On the side opposite, the cable must be sequentially marked in one (1) foot increments. The jacket must be black.

TESTING

9. (a) Initial Physical Properties of Insulation.
1. Tensile Strength, minimum 1200psi
 2. Elongation at Rupture, minimum 250%
- (b) Physical Properties of Insulation After Aging. After 168 hours in air oven at 121° C.
1. Tensile Strength 75% of initial value
 2. Elongation 75% of initial value
- (c) Initial Physical Properties of Jacket.

1. Tensile Strength, minimum 1800psi
 2. Elongation at Rupture, minimum 300%
- (d) Physical Properties of Jacket After Aging. After 168 hours in air oven at 121° C.
1. Tensile Strength 75% of initial value
 2. Elongation 65% of initial value
- (e) Water Absorption. Tests must be made in accordance with ASTM D 470. After 168 hours in distilled water at 70° C., water absorption of the insulation material must not exceed 5 milligrams of water per square inch. For the jacket material the water absorption must not exceed 1 milligram per square inch under the same conditions.
- (f) Cold-Bend Test. The completed cable must pass cold bend test of ASTM D 470, except that the test temperature must be minus(-)25°C.
- (g) Electrical Requirements.
1. Voltage. The completed cable must meet an A.C. and D.C. voltage test in accordance with ASTM D 470 and D 2655.
 2. Insulation Resistance. The completed cable must have an insulation resistance of not less than 20,000 ohms when tested in accordance with methods in ASTM D 470.
- (h) Flame Tests. Cable must pass a 70,000 BTU flame test in accordance with IEEE 383.
- (i) Tests. The above tests must be performed on the insulation, the jacket, and the completed cable as required above. Tests must be performed on samples taken every 25,000 feet or fraction thereof of each cable size.
- (j) Reports. No cable will be accepted until certified copies of the test reports have been reviewed and approved by the City. Cable that does not pass any of the above tests will be rejected.

PACKAGING

10. (a) Reels. The completed cable must be delivered on sound substantial, non-returnable reels. Both ends of each length of cable must be properly sealed against the entrance of moisture and other foreign matter by the use of clamp-on cable caps. The ends must be securely fastened so as not to become loose in transit. Before shipment, complete 2 x 4 lagging must be applied to all reels.

- (b) Footage. Each reel must contain the length of cable as set forth below.
- | | |
|------------------------|-----------|
| (1) Ten-Conductor | 2000 feet |
| (2) Nineteen-Conductor | 1000 feet |
- (c) Marking. A metal tag must be securely attached to each reel indicating the reel number, contract number, date of shipment, gross and tare weights, the appropriate City commodity Code Number if applicable, and a description of the cable. Also, each reel must have permanent marking on it indicating directions for unrolling the cable and the footage of cable contained in the reel. Indelible ink or other such material susceptible to washing off or fading will not be permitted; and approved permanent marking material such as paint or a securely attached metal tag is required.

TABLE A COLOR CODE CONDUCTOR IDENTIFICATION

Base Color	First Tracer	Second Tracer	10	19
White	Black	Red	--	14
White	Red	Green	--	14
Black	--	--	14	14
White	--	--	14	14
Red	--	--	14	14
Green	--	--	14	14
Orange	--	--	14	14
Blue	--	--	14	14
White	Black	--	--	--
Red	Black	--	14	14
Green	Black	--	14	14
Orange	Black	--	14	14
Blue	Black	--	14	--
Black	White	--	--	--
Red	White	--	--	14
Green	White	--	--	14
Blue	White	--	--	14
Orange	White	--	--	14
White	Red	--	--	--
Blue	Orange	--	--	14
Red	Blue	--	--	14
Green	Blue	--	--	14
Orange	Blue	--	--	14

**ELECTRICAL SPECIFICATION 1540
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 30, 2006**

VIDEO DETECTION CAMERA AND MOUNT

SUBJECT

1. This specification states the requirements for a video camera to be used to detect vehicular traffic at a signalized intersection. The camera will be mounted to a traffic signal arm or a luminaire arm with a mounting bracket specifically manufactured for that purpose.

GENERAL

2. (a) Standards. The camera and enclosure must meet NEMA, MIL-STD-810E, and FCC Class B, Part 15 standards.
- (b) Sample. One camera and mount of the manufacture proposed to be furnished must be submitted along with specification sheets within fifteen (15) business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (c) Warranty. The manufacturer must warrant the camera and mount to meet the requirements of this specification, and must warrant all components against defective design, material and workmanship for a period of five (5) years from date of acceptance. In the event that defects or failures occur during the warranty period, the manufacturer must repair and/or replace all defective materials at no expense to the City. This warranty must be evidenced by a letter or certificate of warranty submitted to the City at the time final delivery is made. The warranty must cover all units delivered in an order. The warranty must be signed by an official of the manufacturer who is empowered by the manufacturer to enter into such an agreement.
- (d) Compatibility. The camera must be compatible with the associated digital video detector processing equipment and traffic signal controller equipment used by the City of Chicago.

CAMERA REQUIREMENTS

3. (a) Power Lens.
 1. 1/3-inch format.
 2. Focal Length: 6-60mm.
 3. Iris range: f1.4-360
 4. Focus range: 1.3m.
 5. Angle of view (wide angle): (h_{xv}) 43.4° x 32.7°
 6. Angle of view (telephoto): (h_{xv}) 4.5° x 3.5°
 7. Focus control: motor, 12VDC, < 70mA
 8. Zoom Control: motor, 12VDC, < 70 mA
- (b) Must be fully automatic to adjust for lighting conditions.
- (c) Imager: interline transfer CCD, 1/3-inch image format.
- (d) Active picture elements: 582 horizontal by 494 vertical.
- (e) Horizontal resolution: 570 TVL
- (f) Digital signal processing.
- (g) Illumination at Imager: minimum of .018 lux.
- (h) Electromagnetic interference: must meet FCC Class B, Part 15 requirements.
- (i) Power: the camera will consume no more than 4 watts. The heater must consume no more than 11 watts.
- (j) The camera will operate within the temperature range of -20° C. to +50° C.

ENCLOSURE

4. (a) The camera must be housed in an extruded aluminum housing with a white epoxy powder coat.
- (b) The window will be 3mm thick glass.
- (c) Heater: a built-in thermostatically controlled heater will keep the window from fogging or from icing up.
- (d) The enclosure must provide protection from the environment. The enclosure must meet military specification MIL-STD-810-E for salt air, and NEMA-6P, IP68 for dust.

- (e) Sunshield: a sunshield will protect and shield the window, as well as provide a heat sink for the camera.
- (f) The rear of the housing will have a cable connector. The plug will be a MIL-3102 for a 16 pin arrangement.
- (g) Camera cradle: the camera housing will be attached to an extruded aluminum cradle. The cradle can be rotated 360°. The cradle will be tapped in the base for at least two (2) 1/4-20 mounting screws.

ENCLOSURE MOUNTS

- 5. (a) The mount will have a swivel head and tilt mechanism. The swivel will allow for full 360° rotation and the tilt will allow for 75° tilt both above and below the horizontal. Both the swivel and tilt will be locked in position with stainless steel bolts. The camera enclosure will be attached to the mount with a minimum of two (2) 1/4-20 stainless steel bolts. The mount will be attached to the arm or pole with two (2) lengths of stainless steel banding, or similar. The mounts will be constructed of aluminum, with a white epoxy powder coat. The mount must provide for cable. The construction must be structurally sound and be able to withstand the loads as indicated in ASSTHO's Structural Supports – 1994 edition.
- (b) The mast arm mount will have a two (2) inch diameter pipe welded to a contoured plate. The plate will be sized to accept banding. The swivel head will be welded to the top of the pipe. The length of the entire assembly will be approximately 10 inches.
- (c) The pole mount will have a two (2) inch pipe welded to a contoured plate. The plate will be sized to accommodate 2 lengths of steel banding. The other end of the pipe will have a 90° bend to which the swivel head will be welded. The entire length of the assembly will be approximately 15 inches.

PACKING

- 5. (a) Each camera and enclosure must be packed in a cardboard container so that the contents will not be damaged in shipping or handling. Instructions must be included in each container.
- (b) Each package must be clearly labeled as to the contents.

**ELECTRICAL SPECIFICATION 1541
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
SEPTEMBER 16, 2004**

REINFORCING ROD FORMED STEEL CAGES

SUBJECT

1. This specification is for steel cages. The cages are to be used in street light pole foundations to provide the necessary strength to support street light poles.

DESCRIPTION

2.
 - (a) The steel must conform to the requirements of the American Society for Testing and Materials cited by ASTM designation number, of which the latest revision will govern.
 - (b) The steel cages must conform to all the requirements shown on Electrical Standard Drawing 793A.
 - (c) The steel cages must be constructed of number 3 and number 6 reinforcing bars, as shown on Electrical Standard Drawing 793A. Reinforcing steel must conform to ASTM A615, Grade 60, with a yield strength of 60,000 psi. All joints must be welded according to the latest recommendations of the American Welding Society's (AWS) Document 1.4.

ACCEPTANCE

3. If so requested, a sample cage must be delivered to the City within fifteen (15) business days of such request by the Chief Procurement Officer. The contractor must present certification that the steel used meets this specification. The City reserves the right to reject any cages which do not completely meet this specification.

DELIVERY

4. The Contractor must furnish and deliver the steel cages to the City of Chicago, Department of Transportation, Division of Electrical Operations, 4101 South Cicero Avenue, Chicago, Illinois 60650, or to a location as directed in the contract. Any cages that do not meet the specification or are delivered damaged will be rejected.

**ELECTRICAL SPECIFICATION 1543
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 7, 2014**

**TRAFFIC SIGNAL: OPTICALLY PROGRAMMED, TWELVE-INCH SINGLE
FACE, SINGLE OR MULTIPLE-SECTION, LED**

SUBJECT

1. This specification states the requirements for optically programmed, twelve-inch, single face, single and multiple-section, electric traffic signals with aluminum housings for use in the traffic control system of the City of Chicago. Indications shall include red, yellow, green, yellow arrow, and red arrow.

GENERAL REQUIREMENTS

2. (a) Sample and Certified Test Reports. One complete signal, fully assembled and wired, of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (b) Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:

American Association of State Highway and Transportation Officials (AASHTO)
American Iron and Steel Institute (AISI)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)
- (c) The traffic signal heads shall conform to ITE Standard "Vehicle Traffic Control Signal Heads" (VTCSH), in which the most recently published revisions will govern.
- (d) Approval. Approval will mean approval in writing by the Commissioner or

his duly authorized representative.

HOUSING REQUIREMENTS

3. (a) **Housing.** The housing of each section shall be one piece, cast aluminum, complete with integral top, bottom, and sides. The aluminum die casting material shall meet or exceed the ITE alloy composition and tensile strength requirements. The housing shall be prepared with chromate treatment primer and painted with two coats of enamel in color as specified in the line item or contract plans.
- (b) **Assembly.** A traffic signal section shall be comprised of, but not limited to, the housing, hinged front and rear doors, visor, optical unit and all necessary gaskets and hardware. The multi-section, single face, traffic signal shall be comprised of single face single sections assembled together, containing an internally mounted terminal block. Arrow indications must be shipped as single sections. The traffic signals shall be designed and constructed to permit sections to be assembled together, one above the other, forming a weatherproof and dust-tight unit. Each housing must be equipped with holes to be used for mounting back-plates.
- (c) Individual sections shall be fastened together with adjustable coupling assemblies which lock the individual sections together. The assembly must allow the incremental tilting of the signal faces $\pm 10\%$ from horizontal while maintaining a common vertical axis for the sections.
- (d) **Height.** The overall height of an assembled traffic signal must be 14 inches ± 1 inch for a single-section signal, 42 inches ± 3 inches for a three-section signal, and 70 inches ± 5 inches for a five-section signal.
- (e) **Mounting.** The traffic signal shall be designed for mounting with standard traffic signal brackets using 1.5 inch pipe size fittings.
- (f) **Positioning Device.** The top and bottom opening of each housing must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments. A total of 72 teeth must be provided in the serrated bosses to allow the signal face to be rotated 360° about its axis. The teeth shall be clean and well defined to provide positive positioning.
- (g) **Hinges.** The signal housing shall be sectional; one section for each optical unit. Each housing must have 4 integral hinge lugs, with stainless steel hinge pins (AISI 304 or equivalent), located on the left side for mounting the front door and on the right side for the rear door. The hinge pins must be straight and not protrude past the outside of the housing lugs. The housing must have 2 integral latching bolt lugs on the right side of the front door and 1 bolt lug on the left side of the rear door. Each closure must consist of a stainless steel

hinge pin to which a latching bolt (AISI 304 or equivalent), washer, and wing nut will be attached. The wing nuts must be captive and must provide for opening and closing the door without the use of tools.

- (h) Front and Rear Doors. The doors shall be one piece die cast aluminum construction. The front door shall house the objective lens and allow access to the optical-limiter diffuser. Two hinge lugs on the left side and 2 sets of latch screw jaws centered on the right side, as viewed from the front of the signal, must be integrally cast with the housing front door. The front door shall be prepared with chromate treatment primer and painted with 2 coats of flat black enamel. The rear door shall allow access to the lamp. Two hinge lugs on the right side and 1 set of latch screw jaws centered on the left side, as viewed from the rear of the signal, must be integrally cast with the housing rear door. The rear door shall be prepared with chromate treatment primer and painted with 2 coats of enamel in color matching the signal housing. The doors must be hinged to the housing with 2 stainless steel hinge pins, drive fitted. The inside of the doors must be grooved to accommodate a one piece, air-cored ethylene propylene diene monomer (EPDM) gasket to provide a weatherproof and dust proof seal when the door is closed.
- (i) Gaskets. Wherever necessary to make a completely dust-proof, moisture-proof and weatherproof assembly of the housing and optical system, approved type gaskets of neoprene or silicone rubber shall be provided.
- (j) Visor. Each traffic signal shall have a visor for each signal indication (section). The visor must be the cutaway type, a minimum 9 inches long, fabricated of sheet aluminum, prepared with chromate treatment primer and painted with 2 coats of flat black enamel. The visor shall fit tightly against the front door and not permit any light leakage between the door and visor. All hardware necessary for attachment of the visor must be of stainless steel. The visor must have four mounting lugs for attaching the visor to the door. Screws must go through the visor lugs into the metal door to secure the visor.

OPTICAL UNITS

- 4. (a) The traffic signal heads shall be provided with 12 inch acrylic Fresnel lenses colored to ITE specifications. A smaller clear objective lens shall be mounted behind the Fresnel lens. Masked off portions of the clear lens will control the direction of light. A masking kit shall be provided with each individual head section. Masking shall provide a selectively visible or veiled projected indication anywhere within 15° of the signal optical axis.
- (b) An LED lamp shall be held in a 3-prong base by a wire ring and a spring load clip.

- (c) Lamp Collar. The lamp housing must consist of an integral lamp support, indexed ceramic socket, and quick release self-aligning lamp retainer. The electrical connection between the lamp housing and signal case must be accomplished with an interlock assembly which disconnects the lamp housing when opened.
- (d) Optical Limiter - Diffuser. The optical limiter-diffuser must provide an imaging surface at focus on the optical axis for objects 900 to 1,200 feet distance and permit an optical masking tape to be variously applied as determined by the desired visibility zone. The optical limiter-diffuser must be provided with positive indexing means and composed of heat-resistant glass.
- (e) Objective Lens. The objective lens must be a high resolution planar incremental lens hermetically sealed with a flat laminate of weather-resistant acrylic. The lens must be symmetrical in outline and capable of being rotated to any 90° orientation about the optical axis. The projected signal indication must be capable of being veiled anywhere within 15° of the optical axis. The indication must not result from external illumination and must conform to ITE standards.
- (f) The optical unit with lamp shall meet the applicable requirements of the ITE standards for Vehicle Traffic Control Signal Heads (VTCSH) Part 2: LED Vehicle Signal Modules, for signal brightness (luminance), and beam spread (luminance at various vertical and horizontal angles).

LED LAMPS

- 5. (a) LED lamp shall consist of an integral sealed unit containing the following components: housing, integral lens, matrix of light emitting diodes (LEDs) emitting white monochromatic light, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 Hertz power.
- (b) LED lamp shall be of such dimensions as to permit mounting in the signal head and be interchangeable with incandescent lamps manufactured for the same purpose.
- (c) Minimum brightness of LED lamps shall be in accordance with the luminous requirements of ITE. During the required operating life of LED lamps, the luminance output of the lamps must not be less than 60% of the values specified in the standard.
- (d) LED lamps shall be equivalent to an incandescent 150 watt PAR-46 lamp. The lamp shall have the same shape as a PAR-46 lamp and shall have a 3-prong base.

- (e) LED lamp power supply shall be current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker. Units must be fully operable over a range of 90 volts to 130 volts at 60 Hertz \pm 3 Hertz.
- (f) Lamps must be fully operable at temperature ranges of -40° F. (-40° C.) to +165° F. (+74° C.) at up to 100% relative humidity.
- (g) Lamps shall be clearly marked in a permanent manner showing information required for warranty and long term performance. Information to be shown must include manufacturer name, date of manufacture, and electric power requirements.
- (h) The LED lamp shall be compatible with the traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal load switches and conflict monitors.
- (i) LED lamps shall meet applicable sections of Title 47, Sub-Part B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.

WIRING

6. (a) Wire Leads. Each lamp connector must be furnished with 2 wire leads color coded as follows:

First Wire:

White

Common

Second Wire:

Red

Red Section

Yellow

Yellow Section

Green

Green Section

Yellow with Black Tracer

Yellow Arrow Section

Green with Black Tracer

Green Arrow Section

The wires must be No. 18 AWG stranded copper wire rated at 600 volt, 105°C., with thermo-plastic insulation. The leads must connect to the terminal strip without being spliced. The ends of the lamp leads must be stripped of 0.5 inches of insulation and tinned.

- (b) Terminal Strip. A dual-point, barrier type, terminal strip with a solid base and pressure plate type connectors shall be securely attached at both ends to the housing body inside the "Green" section of the signal head. The number of terminal points shall be predicated upon the number of sections in the signal head. Single section, 2 section, 3 section and 4 section heads must have 5 point blocks, while 5 section heads must have 6 point blocks.
- (c) Cable. One 11 foot length of flexible SO electric cord must be furnished with each signal head. The conductors must be No. 16 copper with color coded insulation. and an overall jacket. The number of conductors must include a neutral, a ground, and one leg for each section. Both ends of each cable length must be carefully stripped of 6 inches of jacket and 1 inch of insulation, with each conductor properly tinned.

TESTING AND DOCUMENTATION REQUIREMENTS

- 7. (a) Documentation. The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic signals being supplied meet or exceed the specification requirements. All optical units shall be tested by a nationally recognized testing laboratory (NRTL), such as Intertek (ETL division), to demonstrate compliance with the latest ITE VTCSH specification. All LED units shall have the testing laboratory's label attached.
- (b) Inspection. The signals will be subject to inspection at the request of the Commissioner. Final inspection shall be made at point of delivery. Any signal rejected must be removed, disposed of, and replaced by the contractor at his sole cost.
- (c) Warranty. The manufacturer shall warrant the signals to meet the requirements of this specification, and must warrant all equipment, components, parts and appurtenances against defective design, material and workmanship for a period of 3 years from date of delivery [date of acceptance for contract construction]. In the event defects and failures occur during the warranty period, the manufacturer must replace such units at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The warranty must be signed and dated by an official of the manufacturer who is empowered by the manufacturer to enter into such a warranty.

PACKAGING

- 8. (a) Packing. Each traffic signal assembly shall be packed in a suitable carton so secured that the signal will not be damaged during shipment, handling or storage. Each section will include a lamp.
- (b) Marking. Each carton containing a traffic signal shall be clearly marked on

the outside in letters not less than 3/8 inch tall with the legend: "TRAFFIC SIGNAL, OPTICALLY PROGRAMMED@, the number of Sections as required, the colors, the name of the manufacturer, the date of manufacture, the pertinent Contract Number, and the appropriate City Commodity Code Number.

**ELECTRICAL SPECIFICATION 1544
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 7, 2014**

**LIGHT EMITTING DIODE LAMP (PAR-46) FOR OPTICALLY
PROGRAMMABLE VEHICULAR TRAFFIC SIGNAL**

SUBJECT

1. This specification states the requirements for a light emitting diode (LED) lamp (Par-46) for optically programmable vehicular traffic signals intended for installation within traffic signal head housings meeting the standard requirements of the Institute of Transportation Engineers.

GENERAL

2. (a) Standards. The LED lamp shall meet the appropriate requirements of the following standards, as required within the body of this specification:

American Association of State Highway and Transportation Officials (AASHTO)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
National Electrical Manufacturer's Association (NEMA)
Underwriters Laboratories (UL)
- (b) Sample and Certified Test Reports. One LED lamp intended to be furnished shall be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (c) Approval. Approval will mean approval in writing by the Commissioner or his duly authorized representative.
- (d) Warranty The manufacturer shall warrant the performance and construction of the LED lamp to meet the requirements of this specification and must warrant the lamp against defects in design, material and workmanship for a period of 7 years from the date of delivery [date of acceptance for contract construction]. Warranty must include coverage against failure or loss of signal brightness (luminance) below minimum acceptable ITE standard

levels. In the event defects or failures occur during the warranty period, the manufacturer must replace all defective lamps at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The warranty must cover all units delivered in an order or installed by contract, and must include unit serial numbers. The warranty must be signed and dated by an official of the manufacturer empowered by the manufacturer to enter into such a warranty.

FUNCTIONAL REQUIREMENTS

3. (a) LED lamps shall consist of an integral sealed unit containing the following components: housing, integral lens, matrix of light emitting diodes (LEDs) emitting monochromatic white light, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 Hertz power.
- (b) LED lamps shall be of such dimensions as to permit mounting in a programmable traffic signal housing, and be interchangeable with incandescent optical units manufactured for the same purpose.
- (c) Minimum brightness of the LED lamp shall be in accordance with the luminous requirements of ITE. During the required operating life of the lamps, the luminance output must not be less than 60% of the values specified in the standard.
- (d) LED lamps shall be equivalent to an incandescent 150 watt PAR-46 lamp. The module shall have the same shape as a PAR-46 lamp and shall have a 3-prong base.
- (e) LED lamp power supply shall be constant current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker. Units must be fully operable over a range of 90 volts to 130 volts at 60 Hertz \pm 3 Hertz.
- (f) Lamps must be fully operable at temperature ranges of -40° F. (-40° C.) to +165° F. (+74° C.) at up to 100% relative humidity.
- (g) Lamps shall be clearly marked in a permanent manner showing information required for warranty and long term performance. Information to be shown shall include manufacturer name, date of manufacture, and electric power requirements.
- (h) The LED lamp shall be compatible with the traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal

load switches and conflict monitors.

- (i) Units shall meet applicable sections of Title 47, SubPart B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.

TESTING

4. (a) Documentation. The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic lamps being supplied meet or exceed the requirements.

PACKAGING

5. (a) Each LED lamp shall be packed in a suitable carton, so secured that the unit must not be damaged during shipment, handling, or storage.
- (b) Each carton shall be clearly marked on the outside in letters not less than 3/8 inch tall with the legend "LED PAR-46 LAMP FOR OPTICALLY PROGRAMMABLE TRAFFIC SIGNAL", the name of the manufacturer, the contract number, date of manufacture, and the City commodity code.

**ELECTRICAL SPECIFICATION 1545
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 7, 2014**

**PEDESTRIAN COUNTDOWN TRAFFIC SIGNAL
LED, 16 INCH WITH SYMBOLIC WALK/DON'T WALK,
POLYCARBONATE HOUSING**

SUBJECT

1. This specification states the requirements for a single section pedestrian countdown signal with light emitting diode (LED) symbolic messages on a nominal sixteen inch by eighteen inch message surface and enclosed in a polycarbonate housing.

GENERAL REQUIREMENTS

2. (a) Sample and Certified Test Reports. One complete pedestrian countdown signal, fully assembled and wired, of the manufacture proposed to be furnished, must be submitted along with the required certified test reports, within 15 business days upon request of the Chief Procurement Officer. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (b) Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:

American Association of State Highway and Transportation Officials (AASHTO)
American Iron and Steel Institute (AISI)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)
- (c) Approval. Approval will mean approval in writing by the Commissioner or his duly authorized representative.

MATERIAL AND EQUIPMENT REQUIREMENTS

3. (a) The pedestrian signal heads must conform to ITE Standard "Pedestrian Traffic Control Signal Indications" (PTCSI), in which the most recently published revision will govern.
- (b) Housing Design. The housing must be one piece, ultra violet stabilized polycarbonate resin of the specified color, injection molded complete with integral top, bottom, and sides, having a minimum thickness of 0.1 inches.

The polycarbonate formulation used must provide these physical properties in the housing (Tests may be performed on separately molded specimens).

<u>TEST</u>	<u>REQUIRED</u>	<u>METHOD</u>
Specific gravity	1.17 minimum	ASTM D 792
Vicat Softening temp	310-320° F	ASTM D 1525
Brittleness temp.	-200° F	ASTM D 746
FlammabilitySelf-extinguishing		ASTM D 635
Tensile strength, yield	8,500 PSI	ASTM D 638
Elongation at yield	5.5-8.5%	ASTM D 638
Shear strength, yield	5,500 PSI min.	ASTM D 732
Izod impact strength (notched, .125" thick)	12-16 ft. lbs./in.	ASTM D 256
Fatigue strength (at 2.5 mm cycles)	950 PSI min.	ASTM D 671

- (c) Positioning Device. The top and bottom opening of each housing must have integral serrated bosses that will provide positive positioning of the signal head in 5° increments to eliminate undesirable rotation or misalignment of the signal head between sections. A total of 72 teeth must be provided in the serrated bosses to allow the signal face to be rotated 360° about its axis. The teeth shall be clean and sharp to provide positive positioning with the grooves of the mating section or framework. Each opening must accommodate standard 1.5 inch pipe fittings and brackets.
- (d) Hinges. The housing must have 4 integral hinge lugs, with stainless steel hinge pins (AISI 304 or equivalent), located on the left side for mounting the door. The hinge pins must be straight and not protrude past the outside of the housing lugs. The housing must have 2 integral latching bolt lugs on the right side each with a stainless steel hinge pin to which a latching bolt (AISI 304 or equivalent), washer, and wing nut will be attached. The wing nuts must be captive.
- (e) Door. The door must be a one piece ultraviolet stabilized polycarbonate resin of the specified color, injection molded complete with a minimum thickness of 0.1 inch. Two hinge lugs on the left side and 2 sets of latch screw jaws

centered on the right side, as viewed from the front of the signal, must be integrally cast with the housing door. The door must be hinged to the housing with 2 stainless steel hinge pins, drive fitted. Two stainless steel latch screws and wing nuts and washer assemblies on the latch side of the housing body must provide for opening and closing the door without the use of tools.

The inside of the door must be grooved to accommodate a one piece, air-cored ethylene propylene diene monomer (EPDM) gasket to provide a weatherproof and dust proof seal when the door is closed. The outside of the door must have an integral rim completely encircling the opening to prevent leakage between the door and the LED module. The rim must have equally spaced tabs around the circumference with threaded metal inserts for the visor attachment.

- (f) Gaskets. Wherever necessary to make a completely dust-proof, moisture-proof and weatherproof assembly of the housing and optical system, approved type gaskets of neoprene or silicone rubber shall be provided.

LED OPTICAL MODULES

- 4. (a) Light emitting diode (LED) optical modules must consist of an integral unit containing the following components: power leads, housing, integral lens, matrix of light emitting diodes (LEDs) emitting monochromatic light of desired colors, and electronic and electrical components necessary to permit operation at nominal 120 volt, 60 hertz power. All units shall form a neat compact unit within the housing body with no light leakage between the door and the housing body.
- (b) The LED unit shall meet the applicable requirements of ITE's LED Pedestrian Traffic Control Modules. During the required operating life of LED signal units, the luminance output of the units must not be less than 60% of the values specified in the standard.
- (c) LED module power supply must be constant current regulated and filtered to provide instant on indications, and to prevent momentary signal outages or flicker.
- (d) Modules shall consist of LEDs uniformly distributed to present a homogeneous appearance on the face of the lens from a wide viewing angle.
- (e) LEDs shall be wired so that the loss of a single LED or a string of LEDs will not reduce the luminescence below the minimum requirement.
- (f) For purposes of this specification, failure of a single unit is defined as an occurrence where the luminescence of the signal measured in candela in

standard test procedures is less than the required initial luminance or luminance at time points and conditions specified; or where minimum required brightness is achieved, but 2 or more series strings of LEDs or in excess of 20% of LEDs are not operable.

- (g) LED modules must be fully operable over a range of 90 volts to 130 volts at 60 hertz \pm 3 hertz.
- (h) Surge protection. Each unit must be provided with integral surge protection to withstand a transient of 600 volt, 100 microsecond rise and 1 millisecond pulse width. The surge protector shall provide full electrical and physical protection to all unit components.
- (i) Maximum permissible power consumption at ambient conditions (nominal 120 volts, 60 hertz, 70°F.) must be 18 watts at a minimum 90% power factor. Power consumed must not vary by more than 10% from nominal power consumption over a voltage range of 105 volts to 125 volts, and over permissible environmental ranges.
- (j) Modules must be fully operable at temperature ranges of -40°F. (-40°C.) to +165°F. (+74°C.) at up to 100% relative humidity.
- (k) Modules shall be clearly marked on the back surface of the unit in a permanent manner showing information required for warranty and long term performance. Information to be shown must include manufacturer name, date of manufacture, electric power requirements, signal model type, and signal serial number.
- (l) The LED module shall be compatible with all traffic signal controller equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment. In particular the LED unit shall be compatible with the NEMA TS-1 and later traffic signal load switches and conflict monitors.
- (m) Modules shall meet applicable sections of Title 47, Sub-Part B, Section 15 of the Federal Communications Commission (FCC) rules as applies to electronic noise limitation and electromagnetic interference.
- (n) Total harmonic distortion (THD) induced into the voltage and current AC power line sine waves must not exceed 20%.
- (o) Burn-in. LED Optical modules must be energized for a minimum 24 hour burn-in at 100% on-time duty cycle.

DISPLAY

5. (a) The message area shall be approximately 16 inches square and display the double overlay "Don't Walk" and "Walk" symbols immediately adjacent to the countdown digits. The symbols shall be applied in such a manner as to provide an opaque polycarbonate background and illuminated legends.
- (b) Symbolic Messages. Symbols for "Walk" (Man) and "Don't Walk" (Hand) must conform in style and color to those of ITE. The symbols must not be less than 9.5 inches high with proportional width. The "Don't Walk" symbol must be Portland orange, and the "Walk" symbol must be of lunar white, conforming to the specifications of the ITE/PTCSI.
- (c) Countdown Digits. Countdown digits must be Portland orange and not less than 9 inches high with proportional width and shall be compliant with latest ITE standards.
- (d) The module message surface shall be constructed of ultraviolet (UV) stabilized, impact resistant polycarbonate, acrylic or other approved material. The surface must be anti-glare, smooth texture, and clear.

WIRING

6. (a) Wire Leads. Each module connector must be furnished with 3 wire leads color coded as follows:

White	-	Common
Red	-	"Don't Walk" Indication
Green	-	"Walk" Indication

The leads must be No.18 AWG, stranded copper wire rated at 600 volt and 105°C., with thermoplastic insulation. The ends of the leads must be stripped of 0.5 inches of insulation and tinned. The leads must be splice-free and connected to one side of the terminal strip.

- (b) Terminal Strip. A four terminal, eight point, barrier type terminal strip with solid base and pressure plate type connectors must be securely attached at each end to the housing body inside the walk section.
- (c) Cable. One 11 foot length of flexible electric cord, medium duty, type SO, 3-conductor No. 16 AWG stranded copper, with color coded insulation, and an overall jacket, must be furnished with each pedestrian signal. Both ends of each cable length must be carefully stripped of 6 inches of jacket and 1 inch of insulation, and each conductor properly tinned.

COUNTDOWN FUNCTIONALITY

7. (a) The countdown unit shall be compatible with all traffic signal controller

equipment currently in use by the City of Chicago, and meeting the City's latest specifications for traffic signal control equipment.

- (b) The countdown timer must have a micro-processor capable of recording its own time when connected to a traffic controller.
- (c) The countdown timer unit must continuously monitor the traffic controller for any changes to the pedestrian phase time and re-program itself automatically as needed.
- (d) The countdown unit must register the time for the walk and clearance intervals individually and must begin counting down at the beginning of the pedestrian change interval (flashing hand).
- (e) At the end of the pedestrian change interval, the unit must display "A0" and the blank out. The display must remain dark until the beginning of the next countdown.
- (f) In the event of a preemption sequence, the countdown unit must skip the preempted clearance time and reach "0" at the end of the pedestrian change interval.
- (g) The countdown must remain synchronized with signal indications and always reach "A0" at the end of the pedestrian change interval.
- (h) The countdown must not display an erroneous or conflicting time when subjected to defective load switches.

TESTING AND DOCUMENTATION REQUIREMENTS

- 8. (a) Documentation. The contractor shall provide certified manufacturing and testing documentation to demonstrate that the traffic signals being supplied meet or exceed the specification requirements. All LED Optical modules shall be tested by a nationally recognized testing laboratory (NRTL), such as Intertek (ETL division), to demonstrate compliance with the latest ITE VTCSH specification. All LED modules shall have the testing laboratory's label attached.
- (b) Inspection. The signals will be subject to inspection at the discretion of the Commissioner. Final inspection shall be made at point of delivery. Any signal rejected must be removed, disposed of, and replaced by the contractor at his sole cost.
- (c) Warranty. The manufacturer shall warrant the signals to meet the requirements of this specification, and must warrant all equipment, components, parts and appurtenances against defective design, material and

workmanship for a period of 3 years from date of delivery [date of acceptance for contract construction]. In addition, LED optical modules must carry a 7 year warranty against failure or loss of color (chromaticity) and signal brightness (luminance) below minimum acceptable PTCSI standard levels from date of delivery [date of acceptance for contract construction]. In the event defects and failures occur in the LED units during the warranty period, the manufacturer must replace such units at no expense to the City. This warranty shall be evidenced by a letter or certificate of warranty submitted to the City at the time delivery is made. The LED warranty must cover all units delivered in an order or installed by contract, and must include unit serial numbers. The warranty must be signed and dated by an official of the manufacturer who is empowered by the manufacturer to enter into such a warranty.

PACKAGING

9. (a) Packing. Each pedestrian signal assembly shall be packed in a suitable carton so secured that the signal will not be damaged during shipment, handling or storage.
- (b) Marking. Each carton containing a pedestrian signal shall be clearly marked on the outside in letters not less than 3/8 inch tall with the legend: "PEDESTRIAN SIGNAL, COUNTDOWN, SIXTEEN-INCH, SYMBOLIC LED WALK-DON'T WALK@, the name of the manufacturer, the date of manufacture, the pertinent Contract Number and the appropriate City Commodity Code Number.

**ELECTRICAL SPECIFICATION 1546
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED MARCH 7, 2014**

**ORNAMENTAL BRACKET ARMS
FOR MID-MOUNT RESIDENTIAL AND ARTERIAL
LUMINAIRES**

SUBJECT

1. This specification states the requirements for a street lighting bracket arm for a mid-mount residential luminaire, and a street light bracket arm for a mid-mount arterial luminaire. The bracket for the mid-mount residential luminaire will be mounted to a light pole approximately ten feet above grade. The bracket for the mid-mount arterial luminaire will be mounted to a light pole approximately 16 feet above grade.

GENERAL

2. (a) Information Required. Each bidder must submit with his proposal the following information relative to the brackets he proposes to furnish:
 1. Outline drawing (electronic format).
 2. Complete description and weight
 3. Manufacturer's name and catalogue designation of the bracket.
- (b) Sample. One complete bracket with hardware, of the manufacture intended to be furnished, must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days from the receipt of notice.
- (c) Assembly. Each bracket must be delivered completely assembled, wired, and ready for installation. Each bracket must come complete with all necessary mounting hardware. Three one conductor #12 pole wire will be installed in each bracket by the supplier. This cable will be 18 feet in length for the residential bracket and 25 feet in length for the arterial bracket.
- (d) Warranty. The manufacturer must warrant the performance and construction of the brackets to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of one (1) year after the bracket has been placed in service. Any bracket, or part thereof, not

performing as required, or developing defects within this period must be replaced by the manufacturer without expense to the City.

BRACKET

3. (a) Material. Each arm must be constructed of cast aluminum conforming to ASTM B26/B26M, Grade 319. A steel pipe must be inserted into the arm to provide added strength. The steel must conform to ASTM A595, Grade A. The pole plate must be constructed of high strength galvanized carbon steel. The tenon must be a minimum of 3/16" in thickness.
- (b) Appearance. The residential bracket arm must conform in appearance and dimensions to that shown on Electrical Standard Drawing Number 959. The arterial bracket arm must conform in appearance and dimensions to that shown on Electrical Standard Drawing Number 959A.
- (c) Construction. Castings must have smooth external surfaces free from protuberances, dents, cracks, or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited. All wire ways must be smooth and free from any sharp edges. The pipe end at the tenon must have a plastic grommet, or otherwise made free of any sharp edges, to protect the wire.
- (d) Structure. The contoured back plate for the residential bracket must be fastened to the street light pole with two(2), 3/8-16 X 1-1/4 inch stainless steel bolts with two(2) split lock washers (bolts and washers will be provided with this item). The back-plate for the arterial bracket must allow for the option of band mounting by two 5/8 inch steel bands (banding will not be provided under this specification). The bracket arm must be expected to withstand normal vibrations, wind, and inclement weather and not fail or become loose.

PAINTING

5. (a) Surface Preparation. Exterior surfaces of the bracket arm must be prepared by "Solvent Cleaning" per SSPC-SP1 using a solvent recommended for aluminum surfaces such as "Sherwin Williams MEK #R6K10." Solvent must be used as per written instructions of manufacturer to remove all oil, grease, dirt and contaminants.
- (b) Primer Type. Within one hour of surface preparation, surfaces must be primed using a primer specifically recommended for aluminum surfaces such as "Sherwin Williams Industrial Wash Primer #P60GZ."
- (c) Primer Application. Primer must be applied in accordance with written instructions of manufacturer to produce a minimum dry thickness film of 3.0

mils. Primer must dry for a minimum of 30 minutes and a maximum of 60 minutes before application of finish coat.

- (d) Finish Coat. Finish coat must be a polyurethane enamel specifically recommended for use over a primed aluminum surface. Two (2) coats of finish must be applied. Each coat must be a minimum of 1.5 mils dry thickness.
- (e) Color will be gloss black or silver as specified on the order.
- (f) Alternate painting methods may be considered.

WIRE

- 6. Each bracket will have individual insulated conductors of the length and number described previously. Each wire shall be EPR insulated. Cable shall be rated at 600 volts. The cable shall meet the requirements of ICEA S-95-658, UL44 (RHW-2), and UL854 (USE-2). The insulation shall be color coded: one conductor red, one conductor black, and one conductor green.

PACKAGING

- 7. (a) Packing. Each bracket with wire installed must be securely packed in a suitable carton so that it will not be damaged by shipment and/or handling. Back plates and bolts will be packed separately within the same carton.
- (b) Marking. Each carton must be clearly marked on the outside in letters not less than three-eighths (3/8) inch tall with the legend: "ORNAMENTAL MID-MOUNT RESIDENTIAL BRACKET" or "ORNAMENTAL MID-MOUNT ARTERIAL BRACKET", the appropriate City Commodity Code Number, the name of the manufacturer, the date of manufacture, and the contract number under which the brackets are being furnished.

**ELECTRICAL SPECIFICATION 1558
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED DECEMBER 4,2014**

ADVANCED TRANSPORTATION CONTROLLER AND CABINET

1. GENERAL REQUIREMENTS

1.1 This specification details the requirements for traffic signal control equipment for use in the City of Chicago.

1.2 (For contract construction only) If requested by the City, the contractor must provide a sample to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. The sample must consist of the controller, cabinet, load switches, conflict monitor and all appurtenant wiring and equipment completely assembled as a working unit. This sample will be regarded as a finished production sample and conformance or non-conformance to these specifications will be based on the sample submitted.

(For City commodity contract only) If requested by the Chief Procurement Officer, within forty-five (45) days from the receipt of such request, the bidder must provide a sample to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. The sample must consist of the controller, cabinet, load switches, conflict monitor and all appurtenant wiring and equipment completely assembled as a working unit. If the sample is acceptable and the bidder is awarded a contract, the sample will become the property of the City of Chicago with a suitable credit issued to the contract.

1.3 All tests as outlined herein or in the referenced specifications must be regarded as minimum requirements. The contractor must submit his testing procedure for approval prior to performing any testing functions. Upon successful completion of all testing, certified test reports must be submitted for each unit. Units not successfully passing these tests or lacking proper documentation will be rejected.

1.4 Standards. Equipment furnished under this specification must meet the appropriate requirements of the following standards organizations, as required within the body of this specification:

American Association of State Highway and Transportation

Officials (AASTHO)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
Manual on Uniform Traffic Control Devices (MUTCD)
National Electrical Manufacturers Association (NEMA)
Occupational Safety and Health Administration (OSHA)
Underwriters Laboratories (UL)

- 1.5 Standard Drawings. The Standard Electrical Drawing 962 “Load Switch and Conflict Assignment”, Standard Electrical Drawing 964 “Traffic Controller Cabinet Back Panel and Power Supply, 1 Of 2” and Standard Electrical Drawing 965 “Traffic Controller Cabinet Back Panel and Power Supply, 2 of 2” , and Standard Drawing 909 “Fiber Optic Patch Panel” are integral parts of this specification.
- 1.6 Manufacturers. The manufacturer of the controller and of each major component must demonstrate a knowledge of past production, or have been actively engaged in the sale and/or service of traffic signal controllers, cabinets, and the other equipment herein described, as demonstrated by a submitted list of comparable projects. The manufacturer must be a recognized company that manufactures ATC controllers, such as Econolite, McCain, Siemens, U.S. traffic, or equal.
- 1.7 Warranty. The manufacturer must warranty the performance and construction of the traffic signal controllers to meet the requirements of this specification, and must warranty all parts, components, and appurtenances against defects in design, material, and workmanship for a period of one (1) year after acceptance. In the event of defects or failures during this period, the manufacturer must repair and/or replace all defective or failed parts or appurtenances at no expense to the City.

2. CONTROLLER REQUIREMENTS

- 2.1 ATC. The controller must be an Advanced Transportation Controller (ATC) meeting the requirements of the specification “Advanced Transportation Controller (ATC) Standard Version 5.2b” dated June 26, 2006, and the requirements of NEMA-TS2-2003. The referenced specification is a joint effort of AASTHO, NEMA, and ITE. Since each user agency has different controller needs, for the City of Chicago the controller must meet the programming modifications and options listed in the ATC Matrix as indicated in Table A. All software necessary to make the controller operational must be included.
- 2.2 Power. The controller must operate on 120 volt, 60 cycle (± 3 Hertz), single phase alternating current. The controller must function in the range from 89 to 135 Volts a.c. The power consumed must be under 50VA.

- 2.3 Packing. (For City commodity contracts only) Each controller, with all its component parts, must be suitably packed in a single container in such a manner as to prevent damage to the contents in shipment and handling.
- 2.4 Instructions. One (1) complete set of up to date instructions providing complete information on installation, adjustment, operation and maintenance, including both up to date "Logic Schematics" and "Electronic Circuit" diagrams, of these controllers, must be furnished to the Division of Electrical Operations for approval prior to the first shipment of controllers. All information, including photos and schematics, must reference to the controller being furnished on this contract and must be a high quality, completely legible reproduction. Upon approval, one complete set of data must be furnished with each controller.
- 2.5 Training. (For City commodity contracts only) The contractor must provide training at the City's facilities. The training must be on the actual equipment provided under the contract, and must include, but not be limited to, programming all features, connecting and wiring, and troubleshooting. Training manuals are required (training manuals should include instructions in a teaching-type format). Training material must be provided for up to thirty (30) City personnel. Training must be divided into three (3) one week sessions. The timing of these sessions will be determined after contract award and must take place within the contract period. Each week may contain more than one training class (i.e. 2-3 day classes). Each training class may have up to ten (10) personnel. Classes must be structured for both field personnel and shop personnel. The manufacturer must provide all material and equipment necessary for the classes.
- 2.6 Chassis. The chassis shall be aluminum with a powder coat finish. No plastic chassis or composite chassis will be allowed. The controller must physically fit into existing 'M', 'P', and 'SUPER P' cabinets configured for City of Chicago applications, so that retrofitting will not be a problem. The controller must not exceed the following dimensions: 10.5 inches high, 10.5 inches deep, and 15 inches wide.
- 2.7 Processor / Memory. At a minimum, the processor will be:
- Clock speed - 300MHz
 - Non-volatile Memory - 32MB Flash
 - DRAM - 64MB
 - SRAM - 1MB
- (All memory and firmware must be stored in flash memory. No EPROMS will be allowed.)
- 2.8 Display. The display shall be a 16 x 40 backlit LCD using a 6 x 8 character font. Display and keypad must be permanently attached to chassis. Detachable keypads will not be allowed.

- 2.9 Environmental. The controller must operate in the temperature range of -34° Celsius to +74° Celsius. The controller must operate within the relative humidity of 5% to 95%.
- 2.10 All printed circuit boards must be mounted vertically.
- 2.11 Encapsulation of 2 or more discrete components into circuit modules is prohibited except for transient suppression circuits, resistor networks, diode arrays, solid-state switches, optical isolators and transistor arrays. All encapsulated components must be second sourced and must be of such design, fabrication, nomenclature or other identification as to be purchased from a wholesale distributor or from the component's manufacturer as a standard product. Custom encapsulated components are not allowed.
- 2.12 Obsolete components. Components no longer supported by the manufacturer, components not recommended for new designs, components which have been discontinued or which the contractor should have reasonably been expected to know were discontinued, or components which the vendor/manufacturer has announced plans to discontinue at the time of the bid/contract must not be used in the design of any subassemblies provided under this contract.
- 2.13 The controller must meet the functional and environmental requirements of NEMA TS2 2003. The use of 2070s, 170s, BIUs, SIUs, or similar devices is not allowed.
- 2.14 As allowed by ATC v5.2b, Section 8.1.1, the controller will utilize NEMA 'A', 'B', and 'C' I/O connectors, except for the HMC-1000 and LMD40 I/O variants. Pin assignments for NEMA 'A', 'B', and 'C' connectors must follow the NEMA TS2 2003 standards for I/O. Port 2 must be the ATC v5.2b pin-limited version of NEMA TS2 Port 2. Port 4 (C50S) must be a 9-pin connector with only limited signals being required.

Special function connector for the TS2-2 must follow the CPC style "D" pin outs as follows:

CPC MSD Pin	Function
1	Flash
2	Offset 1
3	Interconnect Common
4	User defined input 6
5	Offset 2
6	Offset 3
7	Time Plan A
8	User defined input 7
9	User defined input 8

10	Call to Free
11	Call to week 10
12	Time Plan B
13	Time Plan C
14	Time Plan D
15	Alt Seq A
16	Alt Seq B
17	Alt Seq C
18	Dimming
19	Monitor status bit C
20	System Input
21	Alt Seq D
22	Monitor status bit A
23	Monitor status bit B
24	Veh Det 13
25	Veh Det 9
26	Veh Det 10
27	Veh Det 11
28	Polarizing Pin
29	Veh Det 12
30	Veh Det 14
31	Veh Det 15
32	Veh Det 16
33	SGO/Conditional Service
34	Preempt input 5
35	Preempt output 1
36	Preempt output 2
37	Interconnect inhibit
38	Time Clock sync
39	Sync inhibit
40	Preempt input 1
41	Preempt input 2
42	Preempt input 3
43	Preempt output 3
44	Polarizing Pin
45	Preempt output 4
46	Preempt output 5
47	System Out
48	Preempt output 6
49	Preempt input 4
50	Clock Ckt 9 (Aux 1)
51	Clock Ckt 10 (Aux 2)
52	Clock Ckt 11 (Aux 3)
53	Clock Ckt 12 (Aux 4)
54	Clock Ckt 13 (System)

55	Clock Ckt 8 (Flash)
56	Clock Ckt 3 (Offset 1)
57	Clock Ckt 4 (Offset 2)
58	Clock Ckt 5 (Offset 3)
59	Clock Ckt 1 (T/P A)
60	Clock Ckt 2 (T/P B)
61	Clock Ckt 6 (T/P C)
62	Clock Ckt 7 (T/P D)
63	Preempt input 6

2.15 Downward compatibility with existing City of Chicago cabinets.

- (1) The controller must be of a modular design allowing for the ability to exchange I/O modules to allow for use in existing City of Chicago HMC-1000, LMD40, and standard NEMA TS2-2 cabinets. This I/O module must be “plug and play”. The controller’s firmware must detect the type of I/O installed (HMC-1000, LMD40 or NEMA TS2) and provide the proper user interface. Adapter harnesses for the HMC-1000, LMD40 and Setcon clock will not be allowed.
- (2) The HMC-1000 I/O module must be pinned as follows:

63 Pin Connector	Function
1	Output 20
2	Output 11
3	Manual Advance
4	Stop Time
5	Output 24
6	Offset 1
7	Offset 3
8	Output 15
9	Preempt 2
10	Advance
11	Output 23
12	Restart
13	Output 32
14	Offset 2
15	Output 16
16	Preempt 1
17	Output 25
18	Output 28
19	Spare 1

20	Spare 2
21	Output 7
22	Output 18
23	Output 21
24	Output 22
25	Dial 3
26	Dial 2
27	Output 1
28	Output 14
29	Output 4
30	Output 29
31	Output 27
32	Output 17
33	Output 9
34	Output 19
35	Dial 4
36	On-Line
37	Flashing Bus
38	Manual
39	Output 30
40	Output 31
41	Output 12
42	Output 10
43	Output 2
44	Output 3
45	Output 13
46	Output 8
47	Output 26
48	Logic Ground
49	Not Used
50	Not Used
51	Output 5
52	Output 6
53	Logic Ground
54	Logic Ground
55	Not Used
56	Not Used
57	Not Used
58	Not Used
59	24 V.D.C
60	Not Used
61	115 Volts AC
62	AC Neutral
63	Chassis Ground

- (3) The LMD40 I/O module contains 4 I/O connectors, MSA, MSB, MSD, and communications connectors which must be pinned as follows:

LMD40 MSA	Pin	Voltage Level
Actuation 3	A	DC
24 V.D.C	B	DC
Voltage Monitor	C	DC
Actuation 1	D	DC
Actuation 2	E	DC
Preemption 2	F	DC
Preemption 1	G	DC
Interval Advance	H	DC
Stop Time	J	DC
MCE (Manual Control)	K	DC
External C/S/O	L	DC
Signal Plan 2	M	DC
Signal Plan 3	N	DC
System Cont/AZ Reset	P	DC
External Start	R	DC
Remote Flash (AC)	S	120 VAC
Interconnect Common	T	120 VAC
AC – (Common)	U	AC
Chassis Ground	V	Earth Ground
Logic Ground	W	DC Reference
Output 1	X	DC
Output 2	Y	DC
Output 3	Z	DC
Output 4	a	DC
Output 5	b	DC
Output 6	c	DC
Output 7	d	DC
Output 8	e	DC
Output 9	f	DC
Output 10	g	DC
Output 11	h	DC
Output 12	i	DC
Output 13	j	DC
Output 14	k	DC
Output 15	m	DC
Output 16	n	DC
AC+ input	p	120 VAC
Output 17	q	DC

Output 18	r	DC
Output 19	s	DC
Output 20	t	DC
Output 21	u	DC
Spare Output	v	DC
Spare Output	w	DC
Spare Output	x	DC
Cycle 2 (User Defined)	y	120 VAC
Cycle 3 (User Defined)	z	120 VAC
Split 2	AA	120 VAC
Split 3	BB	120 VAC
Output 22	CC	120 VAC
Output 23	DD	120 VAC
Offset 1	EE	120 VAC
Offset 2	FF	120 VAC
Offset 3 (user def 1)	GG	120 VAC
Output 24	HH	DC

LMD40 MSB	Pin	Voltage
Output 25	A	DC
Output 26	B	DC
Output 27	C	DC
Output 28	D	DC
Output 29	E	DC
Output 30	F	DC
Output 31	G	DC
Output 32	H	DC
Output 33	J	DC
Output 34	K	DC
Output 35	L	DC
Output 36	M	DC
Output 37	N	DC
Output 38	P	DC
Output 39	R	DC
Output 40	S	DC
Actuation 4	T	DC
Hold	U	DC
Force Off	V	DC

LMD40 MSD	Pin	Voltage
Flash Monitor 1	1	120 VAC
Cycle 5	2	120 VAC
PE Clear 1	3	DC

PE Clear 3	4	DC
Flash Monitor 2	5	120 VAC
Spare Input 4	6	120 VAC
System Input	7	120 VAC
AZ Reset (Absolute Zero)	8	DC
PE Clear 2	9	DC
UD 6 Input	10	DC
Call to week 10	11	DC
Signal Plan 6	12	DC
Signal Plan 7	13	DC
Signal Plan 8	14	DC
Actuation 5	15	DC
Actuation 6	16	DC
Actuation 7	17	DC
Spare input 1	18	DC
UD 7 Input	19	DC
Actuation 8	20	DC
Actuation 9	21	DC
Actuation 10	22	DC
Spare input 2	23	DC
UD 8 input	24	DC
Sys Command (Ckt 13)	25	DC
Flash Attained	26	DC
PE Active	27	DC
Polarization	28	DC
System Out	29	DC
Preempt input 3	30	DC
Preempt input 4	31	DC
Preempt input 5	32	DC
Signal Plan 5 in	33	DC
Call to FREE op	34	DC
Output 41	35	DC
Output 42	36	DC
Interconnect Inhibit	37	DC
Spare input 3	38	DC
Sync Inhibit	39	DC
Dimming	40	DC
Added Time inhibit	41	DC
Time Clock Sync	42	DC
Output 43	43	DC
Polarization	44	DC
Output 44	45	DC
Output 45	46	DC
Output 46	47	DC
Output 47	48	DC

Signal Plan 4	49	DC
Aux 1 (Ckt 9)	50	DC
Aux 2 (Ckt 10)	51	DC
Aux 3 (Ckt 11)	52	DC
Aux 4 (Ckt 12)	53	DC
Output 48 (FF Enable)	54	DC
Flash Out (Ckt 8)	55	DC
Offset 1 (Ckt 3)	56	DC
Offset 2 (Ckt 4)	57	DC
Offset 3 (Ckt 5)	58	DC
Cycle 2 (Ckt 1)	59	DC
Cycle 3 (Ckt 2)	60	DC
Split 2 (Ckt 6)	61	DC
Split 3 (Ckt 7)	62	DC
Fast Flash Image	63	DC

LMD40 Communication Connector (15 pin sub-D)	PIN	Voltage
System Detector 11	1	DC
System Detector 12	2	DC
System Detector 13	3	DC
System Detector 14	4	DC
System Detector 15	5	DC
System Detector 16	6	DC
System Detector 17	7	DC
System Detector 18	8	DC
Monitor Status bit B	9	DC
Monitor Status bit A	10	DC
Monitor Status bit C	11	DC
DC User Defined in #1	12	DC
Logic Ground	13	DC
DC User Defined in #2	14	DC
DC User Defined in #3	15	DC

- (4) The Setcon I/O connector will be resident on the HMC1000 version of the ASTC I/O.

Setcon Clock Connector	PIN	Voltage
Output 1	1	DC
Output 2 (Dial 2)	2	DC
Output 3 (Dial 3)	3	DC
Output 4 (Dial 4)	4	DC
Output 5 (Offset 1)	5	DC
Output 6 (Offset 2)	6	DC

Output 7 (Offset 3)	7	DC
Output 8 (Flash)	8	DC
Sync Output	9	DC
Sync Input	10	DC
Not used	11	N/A
Logic Ground	12	DC
Not Used	13	N/A
Not Used	14	N/A
Not Used	15	N/A
Not Used	16	N/A

2.16 Communication.

- (1) NTCIP (National Transportation Communications for ITS Protocol).
 - a. The controller must be compliant with NTCIP Standards as outlined in NEMA TS2 – 2003 and must be tested and documented for compliance.
 - b. Global objects must be compliant to NTCIP 1201 v2.26 or later.
 - c. Actuated Signal Controller objects must be compliant to NTCIP 1202 v2.19f or later.
- (2) Serial ports, one of which must be set as either RS-232 or RS-485.
- (3) Ability to add an internal GPS module.
- (4) Ethernet. The controller must be equipped with a minimum of two front panel mounted 10/100Mb Ethernet ports.
- (5) A single port USB interface must be provided to facilitate database transfers, re-flashing of operation software and log transfer.
- (6) The unit must be fully compatible with, and fully functional within, the City's existing MIST system (Management Information System for Transportation). MIST is a product of Telvent-Farradyne. All available functions and capabilities that exist within existing MIST controllers must be available within this unit, as well as being compatible with the ATC LMD40 unit and the ATC NEMA unit. Any additional software or hardware necessary to fully integrate the controller into the MIST system must be provided by the bidder and will be considered as part of the requirements of this specification.
- (7) A Windows based laptop utility software must be provided for data

transfers and monitoring of controller operation.

- (8) A fiber-optic modem must be provided, if required. The modem must be compatible with existing City fiber interconnect systems. The modem may be internal or external to the controller.

2.17 Software operation.

- (1) The controller must have the ability to re-synch a minimum of 8 cycle lengths to an “absolute zero” reference point. It must be possible to set absolute zero by either global command or individual cycle length.
- (2) In addition to hardwire input, it must be possible to set Absolute Zero via keyboard command or fiber optic communication.
- (3) The controller must have the ability to operate in two modes of operation, selectable by time of day:
 - a. Actuated control per NEMA TS2 – 2003.
 - b. Pre-timed Interval based control per NEMA TS2 – 2003.
- (4) The controller must have the ability to transfer between actuated control and interval based control by time of day schedule.
- (5) The controller must have 32 Pre-timed plans
 - a. Each plan will allow for up to 32 timing intervals
 - b. Each plan will allow for 64 circuit outputs. Each output must be individually programmable per interval.
- (6) The controller must have 100 coordination plans.
- (7) The controller must provide 6 preempts per NEMA TS2-2003.
- (8) The controller will offer security as follows:
 - a. Two 4 digit security codes can be programmed (one for timing data, one for signal plan data), which when activated, allow data changes. These codes must automatically de-activate 10 minutes after the last user keystroke. It must be possible to re-program the security codes if the previous security code is known or has been defeated.
 - b. It must not be possible to read the security code from the

controller's display.

- c. It must be possible to access the controller in the case of a lost security code through a "back door" which must be provided only by the controller manufacturer. This "back door" security code must change based upon the controller's internal calendar.

3. CONFLICT MONITOR

- 3.1 General. Each controller must be furnished with a NEMA conflict monitor unit for checking for conflicts in the signal output circuits. The conflict monitor must be capable of monitoring a minimum of twelve (12) distinct channels. It must be a self-contained unit with its own power supply and not be located within the timer housing.
- 3.2 Programming Board. A removable programming board must be supplied with the monitor for programming signal compatibility. The circuits for programming must be composed of soldered jumper wires. Diode or dip switch type programming will not be acceptable. The programming board must contain no circuitry or components other than the wire jumpers and the wire jumper soldering devices.
- 3.3 Flashing Circuit Energizing. The conflict monitor must be programmed to put the controller in a flashing sequence upon detection of a failure or conflicting signal display. The controller must also be programmed to energize the flash circuit if the conflict monitor is removed or loses its supply voltage. The conflict monitor must have a manual reset button to return the controller to normal operation after conflict circuit operation is no longer necessary.
- 3.4 Stop Time Circuit. A stop-time control circuit must be supplied from the conflict monitor to force the timer unit to stop timing upon detection of a conflict.
- 3.5 Indicator. The front panel of the conflict monitor housing must have an indicator which will be activated when a conflict or failure occurs as per Section 6 of NEMA Spec. TS1-1983.
- 3.6 Latch Circuit. The conflict monitor must have a latch circuit, insuring that if a voltage monitor failure occurs, the intersection remains in conflict until reset.
- 3.7 Memory. The conflict monitor must have the ability to store, in memory, a minimum of ninety-nine (99) conflict events, including date of conflict and channels conflicting.
- 3.8 Conflict Monitor Assignments
 - (1) Conflict monitor channels must be assigned as follows:

Channel 1	Load Switch 1	Phase 1 Vehicle
Channel 2	Load Switch 2	Phase 2 Vehicle
Channel 3	Load Switch 3	Phase 3 Vehicle
Channel 4	Load Switch 4	Phase 4 Vehicle
Channel 5	Load Switch 5	Phase 5 Vehicle
Channel 6	Load Switch 6	Phase 6 Vehicle
Channel 7	Load Switch 7	Phase 7 Vehicle
Channel 8	Load Switch 8	Phase 8 Vehicle
Channel 2W	Load Switch 9	Phase 2 Ped
Channel 4W	Load Switch 10	Phase 4 Ped
Channel 6W	Load Switch 11	Phase 6 Ped
Channel 8W	Load Switch 12	Phase 8 Ped
Channel 9	Load Switch 13	Overlap A
Channel 10	Load Switch 14	Overlap B
Channel 11	Load Switch 15	Overlap C
Channel 12	Load Switch 16	Overlap D

- (2) It must be possible for the user to change conflict assignments without unsoldering any connections.
- (3) All unused channels - vehicle or pedestrian - must be neatly tied or terminal mounted in such a manner that they are readily available in front of the panel. If tied, the harness wires must be labeled. If terminal mounted, the terminations must be labeled.
- (4) A terminal must be provided for the red enable feature.
- (5) A terminal must be provided for the hook up of any unused red channels to AC.
- (6) Controller monitoring must consist of; voltage monitor, 24 VDC I, 24 VDC II.
- (7) The output relay must operate a sixty (60) ampere, normally open, "A" type mercury contactor without the use of an external or "cabinet interface" relay.

4. P TYPE CABINET

- 4.1 Housing. Each controller must be furnished completely housed in a Type 5052-H32 aluminum housing of 0.125 inch thickness. All cabinets must be provided with factory installed 1 1/8" x 1/2" deep channels. Four channels must be provided for each cabinet side and back. All shelves, panels and individual

equipment items must be mounted to these channels using 1.0" channel nuts with 1/4-20 bolts. All items mounted on panels must be securely fastened by bolting into drilled and tapped holes. No pop rivet or similar fastening methods will be accepted. Cabinets must be P Type with nominal dimensions of 55" high by 44" wide by 26" deep. Manufacturer will be Erpel, Hubbell, Southern Manufacturing Company, or approved equals.

- 4.2 Door. The cabinet must have a main door and a police door hinged with one-quarter inch (1/4") minimum, continuous, removable stainless steel pins. The doors must be closely fitted to a neoprene gasket making the doors dust, water and weather resistant. The doors must be interchangeable with any other doors from any other controller.
- (1) Main Door. Opening of the main door must provide complete access to the cabinet interior. The door must be embossed, subject to approval, with the legend "CITY OF CHICAGO-TRAFFIC CONTROL" in letters at least one (1) inch high. The door must have stops at 90, 150 and 180 degrees, from the closed position. The door latch must have three (3) point locking with rollers at the ends of the latch rods. The latch handle must be capable of being padlocked. The key lock for the latch mechanism must be a Corbin cylinder lock with a #2 key. Two (2) keys must be furnished with each cabinet.
 - (2) Police Panel Door. The police panel door must be furnished with a lock for a modified Chicago police key per sample to be furnished to the successful bidder. This key must have a shaft of at least one and three quarter inches (1-3/4") in length. Two keys must be furnished with each cabinet.
- 4.3 Cabinet Ventilation. A fan, having a minimum air movement capacity of 100 CFM, must be mounted in the air baffle in the top of the cabinet with an air outlet built into the roof overhang. The main door must be louvered and equipped with a removable, standard, commercially available aluminum dust filter. The ventilation openings must be equipped with removable covers for summer operation. No external fan housings or air outlets will be allowed. Any other method must be approved.
- 4.4 Shelf. The cabinet must contain a vertically adjustable shelf large enough to accept the solid state controller and all other shelf mounted devices.
- 4.5 Size. The exterior dimensions of the cabinets will be approximately fifty-five (55) inches high by forty-four (44) inches wide by twenty-six (26) inches deep for P Type cabinets, and must conform to N.E.M.A. 3R pad mounted specifications. The bolt pattern must be a four (4) point pattern with the bolt notches being in the center of each side.

- 4.6 Finish. The exterior surfaces of the cabinet must be smooth. All drilled, tapped, or punched holes on the outer surface must be filled with liquid metal and ground smooth, and slotted screw heads must be ground smooth flush with surface. Bolts extending through cabinet wall must be round head, carriage, square shoulder type and fastened on the inside of the cabinet with an Esna nut and necessary gaskets to insure the weatherproofing integrity of the cabinet. The finished cabinet must be thoroughly degreased in a wash process and dried in a heated chamber. A thermosetting, ultra violet resistant, polyester powder coat must be electrostatically applied to all cleaned and treated surfaces and cured to a hard, mar resistant finish in a heated chamber at a temperature recommended by the powder coat paint manufacturer. Exterior color must conform to Federal Standard 595, and either be City of Chicago green color No. 14110 or gloss black color. Exterior color must be as defined in the contract, and color samples must be submitted for approval prior to acceptance of cabinet. Cabinet interior must be glossy white and may be either baked enamel or thermosetting, polyester powder coat. For either process, the interior must be prepared as described above. If the baked enamel finish is used, it must be preceded by one (1) coat of primer.

5. **POWER SUPPLY**

- 5.1 A sixty (60) ampere main breaker must be inserted in series with the line.
- 5.2 An un-fused terminal bus must be provided for ground side of the power supply and signal conductor commons.
- 5.3 Individual circuit breakers must be supplied for: (a) AC+ lights, 50 amperes; (b) AC+ control, 10 amperes; (c) duplex outlet supply, 15 amperes.
- 5.4 The incoming line must contain lightning protection devices consisting of, but not limited to, a metal oxide varistor and gas type arrestor. The gas type arrestor must be on the line side of the radio interference filter.
- 5.5 Contactor: A sixty (60) ampere, normally open, "A" type mercury contactor must be supplied for opening and closing the AC supply to the signal bus. The contactor must be mounted in such a manner on the power supply panel that accidental contact does not produce a safety hazard.
- 5.6 R.I.S. Filter: A radio interference suppression filter rated at sixty (60) amperes minimum must be installed in line with the main power supply, after the sixty (60) ampere circuit breaker.
- 5.7 Ground. The grounded side of the power supply must be continuous throughout the controller and must be grounded to the controller cabinet in an approved manner meeting OSHA requirements.
- 5.8 Polarity. The phase conductors of the signal circuits must have the same polarity

as the phase side of the power supply, and the common conductor(s) must be of the same polarity as the grounded side of the power supply.

6. LOAD SWITCH BAY

6.1 General. A panel must be provided for mounting the load switch jacks, flash transfer relay jacks, flasher jack, auxiliary relays, time clock jacks, switches, flash change combination terminals, and terminals for field signal connections under non-interconnected operation. See Standard Electrical Drawings 964 and 965.

6.2 Wiring. Panel wiring must be neatly laced and properly terminated individual conductors. They must be insulated and properly sized for their application.

6.3 Load Circuits. Each load circuit must be capable of carrying fifteen (15) amperes continuously at a temperature of 74°C (165° F).

6.4 Bus Feeds. Bus feeds must be capable of carrying fifty (50) amperes continuously at a temperature of 74° C (165° F).

6.5 Equipment. The wiring panel must include, but not be limited to, the following:

(1) Ten (10) ampere fuses with barrier type fuse holders must be installed between the load switch signal output circuits and field terminals for signal light conductors. Each terminal must be the barrier type with sufficiently long screws to accept four (4) #12 AWG solid conductors. The terminals must be located at least two inches (2") above the bottom of the cabinet.

(2) Switching Device. The signal load switching device must be a three (3) circuit, solid state, jack mounted load switch which meets the N.E.M.A. Publication TS-1, Part 5 requirements. Each load switch must be rated for a minimum fifteen (15) ampere continuous resistive load and must mate with an S-2412-SB panel socket. Sixteen (16) load switches are to be provided with each cabinet, as defined in the contract.

(3) User Programmable Interface. Two (2) sets of terminal blocks must be provided between the machine logic output and the input side of the load switches. By terminating all machine logic output on one set of terminals and all load switch input to the other set, an interface is thus created by which the machine logic can be readily connected to any of the load switches by means of a jumper wire. The two (2) sets of terminal blocks must be conveniently located in close proximity to each other and must be arranged such that, initially, each function will be factory wired directly from one set of terminals to the other without the need to criss-cross wires between blocks.

(4) Number of Signal Circuits:

- a. Sixteen (16) load bay panel. Each panel must be equipped with sixteen (16) load switch jacks for a minimum of forty-eight (48) signal circuits.
- b. All unused signal circuits must be neatly tied or terminated. If tied, the harness wire must be labeled. If terminated, each termination must be identified.

6.6 Identification. All field terminals must be suitably identified, subject to approval.

7. FLASHING FEATURE

7.1 General. The flasher must be a solid state device, with no contact points or moving parts, producing between 50 and 60 flashes per minute with a 40 to 50 percent duty cycle. The flasher mechanism must be mounted on a type P-406-SB plug which will mate with an S-406-SB socket on the controller panel. The flasher must utilize zero-point switching, with turn-on at the zero voltage point (± 5 degrees) of the power line sinusoid.

7.2 Flasher Panel. A panel must be provided with one (1) terminal wired to the flasher and marked "FL". The panel must be equipped with terminals to provide or omit flashing of all red and yellow outputs.

7.3 Flasher Circuits. Flashers must provide two (2) output circuits to permit alternate flashing of signal phases and must be capable of carrying a minimum of twenty (20) amperes per circuit at 120 volts. The flasher must operate continuously so that flashing power will be available at the field terminal marked "FL". The flasher wiring must divide the loads imposed on the two (2) circuit flashers alternately on each phase.

7.4 Manual Flash. A manual flash switch must provide flashing indication for all circuits. The flash change combination terminals must allow the selection of flashing either yellow or red on the main and/or cross streets, or complete omission of the flashing feature if required.

8. POLICE PANEL

8.1 Auto-Off Flash Switch. Each controller must be provided with an auto-off-flash switch. In the "AUTO" position the signals must be on and the controller timing unit must run normally. In the "OFF" position the signals must be OFF and the controller timing unit must continue to run. In the "FLASH" position the signals must flash and the controller timing unit must continue to run. The auto-off flash switch must be located on the side of the police switch panel that faces outward

when the police door is open.

- 8.2 Auto-Hand Switch. Each controller must have an auto-hand switch on the back side of the police switch panel. This switch must be so arranged that the switch can be physically rotated 180 degrees to provide usage after opening the police panel door. It must be so mounted that the act of rotation does not affect the police switch panel. Switch terminals must not be exposed on either position. The auto-hand switch must provide a means of manually timing the signals by use of a separate, momentary contact, hand switch. Operation of the timer by manual control must provide the same color sequence as an automatic operation with no momentary undesirable indications appearing. Manual control must be possible with the door of the cabinet closed. The hand switch required for manual control must only be supplied when specified in the PROPOSAL. It must be of an approved weatherproof construction with a six (6) foot, retractable, flexible, extension cord to allow connection to the appropriate terminals on the panel of the controller. It must not be possible to manually step through a vehicle clearance interval.
- 8.3 Terminal Block. A two point terminal block must be mounted on the back side of the police switch panel and the hand control circuit terminated on this block. This will be for installation of a hand control cord by others, as required.
- 8.4 Space Requirement. Adequate room must be provided in the police panel section to store the manual switch and retractable cord.

9. RELAYS

- 9.1 Transfer Relays. Eight (8) double pole, double throw, flash transfer relays must be furnished with each controller. These relays must be jack mounted into an S-408-SB, or equivalent, socket mounted on the controller panel.
- 9.2 Contact Arm. Each contact arm must have over travel on the front and back contacts and be independent of any other contact arms. No adjustment of contact pressure or wipe must be necessary. Load capability must be a minimum of fifteen (15) amperes per contact continuously and thirty (30) amperes for one (1) minute. Contacts must be of coin or fine silver or an approved alternate.
- 9.3 Dust Cover. A suitable dust cover must be furnished for each relay.
- 9.4 Relay Mounting and Endurance. All relays supplied must meet their approved specified requirements and must have contacts which cannot be opened by unusual vibrations, shock, or momentary voltage excursions of up to 30%. All relays other than the flash and bus relay must be mounted on a molded base with eleven (11) or eight (8) pins for jack mounting to their respective panel or sub-base, and must be electrically interchangeable with those presently used by the City of Chicago ("MIDTEX", Model 158-92T200 or equal).

10. COMMUNICATIONS INTERFACE PANEL

10.1 Where a communications interface has been specified in the PROPOSAL or contract plans to allow a controller to function as a Master or Secondary controller, then one of the specified options must be provided:

(1) Fiber Optic Communications Interfaces must meet the following requirements:

a. General. The fiber optic communications components must consist of, but not be limited to, an internal fiber optic modem within the controller or an external fiber optic modem, a fiber optic patch panel to interface the modem to field fiber optic cables, and fiber optic jumpers between the modem and patch panel.

b. The secondary fiber modules for the (local) controllers must either be the bi-directional type, as specified in the PROPOSAL or contract plans. All modems must be Electronic Industries Association (EIA) compatible for RS-232 data communications via fiber optic link. Modems must be multi-mode, operate at 850nm wavelength, and provide full-duplex, frequency modulated, asynchronous transmission at data rates of up to 38.4 kbps.

c. The fiber optic patch panel must consist of a 14" long by 5-3/4" wide by 3-1/4" high rack constructed in accordance with Standard Electrical Drawing #909. The rack must be designed to mount on the controller cabinet rails. "ST" type terminals, suitably labeled, must be provided for the connection of field fibers and Modem.

d. The fiber optic jumpers (i.e., optical patch cords) must consist of a single multi-mode fiber in 900 micron orange jacket, with "ST" type connectors factory installed on each end. The jumpers must be 3' long in Secondary (i.e., local) controller cabinets. The jumpers must be connected to the patch panel and supported in such a manner that the minimum bending radius is ten (10) times the diameter of the cable, and the cables exert no strain on the connectors. Each jumper must have a minimum tensile strength of 50 lbs.

(2) Copper Wire Interconnect Panels (Seven Wire, VAC) must meet the following requirements:

a. General. The interconnect panel must serve to isolate interconnect VAC from the controller. The panel must consist of, but not be limited to, seven (7) relays. Each relay interconnect circuit must include an M.O.V. properly rated for protection against lightning and

switching surges injurious to the controller and a barrier type 3AG fuse receptacle and fuse not to exceed five (5) amperes. Each panel must provide a seven (7) wire interface with the T.B.C. functions described below and must provide barrier type terminals suitably labeled for these functions.

- b. The secondary interconnect panel must be wired in such a manner that an VAC input activates a relay sending an input from that relay to the controller. It must have a minimum of seven (7) relays for the following functions; Dial 2, Dial 3, Dial 4, Offset 1, Offset 2, Offset 3, M.U.T.C.D. flash.
- c. The master interconnect panel must provide a means to establish outgoing VAC for a seven (7) wire interconnect system using eight (8) relays. The relays must have 24 VDC coils and be designated as, Dial 2, Dial 3, Dial 4, Sync, Offset 1, Offset 2, Offset 3, M.U.T.C.D. flash. The sync relay must be wired in such a manner that it provides the offset pulse to the contacts of the three (3) Offset relays.
- d. Each relay must be a double pole type, with one pole designated as field interconnect output, and the other designated as controller input. Relay coils must be rated for continuous duty. Relay contacts must be rated for a continuous fifteen (15) AMP resistive load.
- e. A terminal strip must be mounted on the top of the master interconnect panel for controller interface.
- f. The master panel must interface with the T.B.C. terminals as described above.
- g. Each output must be fused as outlined above.

11. WIRING

11.1 General. All electrical conductors must be stranded copper, with a minimum of nineteen (19) strands per conductor, and a concentrically applied 90° C insulation with a 600 VAC rating. Wiring from the fuse block to the first distribution point, and to the controller bus, must be No. 10 AWG. Signal circuit wire must be No. 14 AWG. The wires must be provided with lugs or other approved terminal fittings for attachment to binding posts. All wiring between various parts of the controller must be neatly cabled. All wiring and terminal blocks must be tested for possible short circuits and resistance to ground by a high voltage dielectric test at 1,200 VAC. A wiring harness of adequate length must be provided to the timing device to allow the timer to be placed on top of the cabinet when required.

11.2 All VAC connections to load switches, flasher, and flash transfer relays must be

soldered. All VAC connections on back of terminals must be soldered.

- 11.3 All VDC connections on back of terminals, and load switches must be soldered or connected with pre-approved terminations. All VDC connections to load switches are to be soldered or connected in a manner pre-approved by the City of Chicago's Division of Electrical Operations.

12. TESTING REQUIREMENTS

- 12.1 General. The testing on the controllers must be done as described herein. Environmental testing must be done at the manufacturer's facilities or at an independent laboratory, and must be certified by the manufacturer or the independent laboratory. Functional testing will be done at the City's facilities. All controllers provided under the contract must be tested as stipulated under "Functional Burn-In Testing" and Physical Inspection at the manufacturer's facilities. If the controller is ordered for a specific location, the manufacturer shall program and test the controller at the factory and certify the test results.
- 12.2 N.E.M.A. Environmental Test. One controller, unless approved previously, must be tested, at the manufacturer's expense, in accordance with Part 2 of NEMA Standards Publication TS1-1983. All of the tests listed must be performed with all data properly recorded and certified. If the manufacturer changes the design, fabrication or components of a previously tested and approved controller, then a sample of the controller containing the new design, fabrication or components must be retested at the manufacturer's expense. Any N.E.M.A. environmental test references to minimum recall must include but not be limited to: all sixty-four (64) output circuits must be programmed in a sequence to simulate the normal functioning of the entire controller cabinet assembly; the conflict monitor must have a test board with the allowable channel jumpers installed to simulate normal operation; all thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval.
- 12.3 Functional "Burn In" Testing. The manufacturer of the controller must perform, at his manufacturing facilities, a one hundred (100) hour "burn-in" test on every controller, conflict monitor, and appurtenant devices. This test period must be certified by the manufacturer with supportive documentation and must include the device serial number, dates and times of test periods, and results. Any failed, or nonconforming components, must be replaced at this time. After each component has passed the "burn-in" test, they may be used in the assembly of the complete controller unit. Each completed unit must be subjected to the seventy-two (72) hour function test as described in this specification. The "burn-in" requirement must include a test that uses all sixty-four (64) output circuits in "solid" burn as well as 1 pps and 5 pps for each circuit. All thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval. The documentation for a test program to simulate the controller phasing must be supplied. A copy of the test program must be approved by the City of Chicago's

Division of Electrical Operations prior to testing. Certification of these tests must be attached to the outside of the shipping container. The certification is in addition to any other documentation and/or testing required by these specifications.

- 12.4 Performance Testing Requirements. In addition to the NEMA environmental test and the requirements stated above, satisfactory performance of the traffic signal cabinet and its equipment must be demonstrated prior to shipment from the factory. The manufacturer must submit five (5) copies of his proposed "Test Procedure Document" for approval with the sample requested above. The test procedure must consist of two (2) sections; physical inspection and functional testing. If the test procedure is judged by the Commissioner or his duly authorized representative to be incomplete, inadequate or otherwise deficient, the contractor must revise and resubmit his "test procedure document" until it is approved. No controller will be accepted until the "test procedure document" has been approved.
- 12.5 Performance Testing Documentation. Upon completion of the performance testing, two (2) certified copies of the final results of the approved "Test Procedure Document" must be included with all traffic signal controller production shipments.
- 12.6 Functional Testing of Sample (Only applies to controllers not previously approved by City). Functional testing of the sample(s) must include, but not be limited to, phasing for multiple legged intersections, bridge and railroad pre-empts, flash operation, actuation, and any combinations of these features. Controllers designed to function without railroad pre-empts must be shown to function without the presence of a railroad interconnect. Options for downward compatibility when replacing either HMC1000 controllers or LMD40 controllers must also be demonstrated. In addition, it should be demonstrated that the sample controller(s) function within the MIST system. Any failure must be addressed by the manufacturer within the time frame allotted under this contract.
- 12.7 Physical Inspection. The "physical inspection" portion of the test procedure document must require the manufacturer to perform a physical inspection of workmanship and specification compliance for each traffic signal controller assembly. The inspection must be done using a detailed check list defining items to be inspected and criteria for acceptance. The inspection must include, but not be limited to, the following items:
- (1) Hardware installation.
 - (2) Assembly mounting.
 - (3) Dimensions.
 - (4) Presence of specified devices and materials.
 - (5) Presence of required documents.
 - (6) Labeling and required serial numbers.

- (7) Wiring, including routing, covering, gauge, length, and soldering of terminations.
- (8) Arrangement of equipment for safety and ease of calibration, reprogramming, troubleshooting and maintenance.
- (9) Condition of cabinet body and finish.
- (10) Condition and installation of doors, panels, gaskets and ventilation.
- (11) High voltage test of insulation resistance to ground, with wires installed in cabinet and equipment disconnected.

12.8 Functional Testing. The "functional testing" portion of the Test Procedure must require the manufacturer to perform a complete room-temperature functional test of each complete traffic signal controller assembly for a minimum of seventy-two (72) hours. This test must be designed to concurrently check integrated hardware systems e.g., from simulated input to load switch output including conflict monitor and time base coordinator. All interface/controller interconnections must be tested. All load switch and interconnect relay positions must be tested, regardless of the number of load switches and interconnect relays being purchased. The functions tested must include, but not be limited to, the following:

- (1) Flash logic and operation (color, phases).
- (2) Conflict monitor logic and operation.
- (3) Police panel switch operation.
- (4) Auxiliary panel switches (including fans).
- (5) Interface panel.
- (6) Time switch operation.
- (7) Load switches (with a continuous ten (10) ampere load on each signal circuit).
- (8) Outputs.
- (9) Power interruptions of less than 500 ms.
- (10) Power interruptions of more than 1.0 sec.

13. SHIPMENT AND DELIVERY (Only applies to City commodity contracts)

13.1 Packaging. The cabinets must be shipped on individual pallets. Each cabinet must be individually wrapped and protected so that it can be handled without damage to the cabinet or its finish. If subassemblies or parts are ordered they must be suitably packaged to prevent damage during shipping and handling. All packages should be clearly labeled indicating the contents.

13.2 Delivery. The assembled cabinets, or subassemblies and parts, must be delivered to the Division of Electrical Operations at 2451 South Ashland Avenue, unless otherwise directed. Assembled cabinets, or subassemblies or parts, must be available for testing and shipping within six (6) weeks of the placement of an order.

CHICAGO ATC MATRIX - TABLE A

Since the ATC standard specifies a “family” of controllers, the following options have been selected from the ATC standard (ATC Standard Version 5-2b, June 26, 2006) to meet the City’s needs.

Functional Requirement	ATC Clause #	Status	Details
Shelf Mounted	2.2.1 4.3.2.1	Required	(Shelf mount only)
Use of ATC Engine Board	2.2.2 4.3.2.2 5.1.1 5.1.2 5.3.2 5.3.4 5.3.5 5.3.5.1 5.4.2 5.4.3 5.4.4 5.4.5	Required	
Use of ATC Engine Board	5.2.1	Required	<ul style="list-style-type: none"> Allowed component height below Engine Board PCB provided that the overall envelope remains unchanged, the clearance between the Host Board and Engine Board

			remains as specified, and the Engine Board still fits into a compliant Host Board
Use of ATC Engine Board	5.2.2 5.4.5	Required	In order to show the Ethernet communications to the Engine Board, the following “Reserved” pins can assume the following legacy functions: <ul style="list-style-type: none"> • P1-34: ENET2 Speed • P1-35: ENET2 Link/Activity • P1-36: ENET1 Speed • P1-37: ENET1 Link/Activity
Use of ATC Engine Board	5.3.1	Required	Minimum CPU capability of 500 MIPS
Use of ATC Engine Board	5.3.3	Required	Additionally, must provide a minimum of 16 MB of Flash total to accommodate future applications.
Use of ATC Engine Board	5.4.1	Required	<ul style="list-style-type: none"> • Engine Board shall not draw more than 4W of power from VPRIMARY (due to battery backup in Chicago) • Engine may supplement VSTANDBY_5 with on-board storage for its standby power.
Use of ATC Engine Board	5.4.3	Required	<ul style="list-style-type: none"> • All optional baud rates shall be supported
Parallel I/O	2.2.4	Required	<ul style="list-style-type: none"> • No support required for TS2 Type 1 or ITS cabinets • Must provide parallel I/O for TS2 Type 2 cabinets and legacy parallel I/O interfaces via interchangeable modules
Linux O/S and ATC BSP	2.2.5 4.3.1 4.3.3	Required	
Linux O/S and ATC BSP	2.2.5 4.3.1 4.3.3	Required	
Linux Kernel	Annex A	Required	
Parallel I/O	3.4	Required	Not required to support ITS Cabinet standard (NEMA cabinets are used)

Manage Clock/Calendar functions and synchronize with external source	3.5.1.3	Required	Must also support synchronization with absolute zero.
Manage Clock / Calendar functions and synchronize with External Source	4.1.3	Required	<ul style="list-style-type: none"> • BSP RTC driver shall automatically update the RTC with the OST time once per second with an accuracy of 0.1 seconds • Successive interruptions (e.g. on for 5 minutes, off for 3 minutes over a period of 8 hours) shall not introduce cumulative error
Configure and Verify Parameters	3.5.1.4 4.1.4	Required	
Upload/Download blocks of data	3.5.1.5 4.1.5	Required	
Monitor & Verify Application Status	3.5.1.6 4.1.6	Required	
Operator Control of Application Execution	3.5.1.7	Required	<u>Only</u> a local operator is allowed to manage the starting, stopping and scheduling of one or more applications on the ATC.
Operator Control of Application Execution	4.1.7	Required	
Long Term Storage of Log Data, etc	3.5.1.8 4.1.8	Required	
Support Diagnostics	3.5.3.3 4.3.4	Required	
Modes of Operation	3.7	Required	(Must support Standalone, Direct, and Distributed modes of operation)
Manage/Control a Variety of External Devices	4.2.1	Required	<ul style="list-style-type: none"> • Fixed Ports on the front panel shall be specified by the City • Only SP1 and SP2 are required to be supported on the modem slot • The dedicated synchronous serial port (SP5) is to be used exclusively for supporting a parallel I/O module (NEMA

			TS2 or legacy interface)
Monitor the Status of External Devices	4.2.2	Required	<ul style="list-style-type: none"> Fixed Ports on the front panel shall be specified by the City Only SP1 and SP2 and required to be supported on the modem slot The dedicated synchronous serial port (SP5) is to be used exclusively for supporting a parallel I/O module (NEMA TS2 or legacy interface)
Support future Hardware Upgrades	4.3.2	Required	
Environmental Requirements	5.2.3	Required	
Front Panel Serial Ports	6.2.3.1 6.1.3 6.3.2.1	Required	One serial port on the front panel shall satisfy this section as an EIA-574 (9-pin) and be labeled "Port 2".
Front Panel Serial Ports	6.2.3.1 6.3.2.1	Required	One serial port shall satisfy this section as an EIA-574 (9-pin) with a reduced pin-out (TXD, RXD, and DC Reference at a minimum) and be labeled "Port 4". C50_ENABLE shall not be supported. A second serial port shall fully satisfy this section as an EIA-574 (9-pin) and be labeled "Port 5".
Front Panel Serial Ports	6.2.3.2 6.1.3 6.3.2.2	Required	One serial port shall satisfy this section as an EIA-485 (15-pin) with the TS2 Type 1 Port 1 pin-out and be labeled "Port 1".
Front Panel Ethernet Ports	6.2.3.9 6.3.2.9 7.1.4.4	Required	There shall be a minimum of two Ethernet ports on the Front Panel (one for ENET1, one for ENET2)
User Interface	7.1 7.1.1.2 7.1.4.4 7.1.4.5 7.1.4.7	Required	
User Interface	7.1.1	Required	Must meet City's Minimum requirements
User Interface	7.1.1.1 7.1.2.1 7.1.3 7.1.4.1	Required	<ul style="list-style-type: none"> Data key is not required Front Panel Interface is to be integral to the controller (i.e.

	7.1.5		<p>not removable, no SP6 connector)</p> <ul style="list-style-type: none"> • “Option 1” to be selected but AUX switch is optional • Keypad shall have a minimum of 24 keys • LCD Display shall be graphical with a minimum resolution of 128 rows x 240 columns (up to 16 lines x 40 characters). • LCD pixel size shall be a minimum of 0.32mm x 0.32mm with a minimum pitch of 0.325mm with character size defined as 6 pixels wide x 8 pixels high • Refresh rate is a minimum of 10 times per second (due to larger display requirements) • LCD heater is mandatory to ensure sub-second LCD display response over full temperature range. Heater shall only be active when needed and User is interacting with the controller locally (due to battery backup requirements). • Heater Power shall be up to 15V at 1A current maximum
Power Supply	<p>7.2 7.2.1 7.2.2 7.2.3 7.2.4 7.2.5 7.2.5.1 7.2.5.2 7.2.6.1 7.2.6.2 7.2.6.3 7.2.6.4 7.2.6.6</p>	Required	As applicable for NEMA cabinets only (12 volt not required)
Mechanical/Chassis	<p>7.3.1.3 7.3.1.4</p>	Required	<ul style="list-style-type: none"> • Only Shelf mounted units are acceptable

			<ul style="list-style-type: none"> Only components / connectors specified by the City shall be located on the Front panel. No C1 Type Connectors allowed.
I/O Interfaces	8.1.1 8.2.2 8.2.2.1 8.2.2.2 8.2.2.3	Required	<ul style="list-style-type: none"> Support for TS2 Type 2 and TS1 Interfaces
I/O Interfaces	8.1.2 8.2.2.5	Required	<ul style="list-style-type: none"> Support is only required for NEMA TS2 Type 2, TS1, and other similar legacy interfaces NEMA TS2 Port 1 shall also be provided (for detectors only)
I/O Interfaces	8.2.3	Required	Port 1 Connector shall be provided as specified within this section (only used for detectors)
I/O Interfaces	8.2.1.13	Required	Legacy I/O interfaces shall respond as required.
I/O Interfaces not required	8.2.1	Required	<ul style="list-style-type: none"> No support for Model 332 Cabinets or ITS Cabinets & devices is to be provided
Environmental & Test Procedures	9	Required	All subsections are required
Performance & Material Requirements	10	Required	All subsections are required
Performance & Material Requirements	10.1.15	Required	All PCBs and similar construction mechanisms shall be mounted vertically (i.e. no horizontal PCBs are allowed).
Quality Control	11	Required	All subsections are required

**ELECTRICAL SPECIFICATION 1560
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED JANUARY 14, 2021**

**NEMA TS2-2 SUPER P CABINET WITH ADVANCED TRANSPORTATION
CONTROLLER AND
UNINTERRUPTIBLE POWER SUPPLY**

1. GENERAL REQUIREMENTS

1.1 This specification details the requirements for traffic signal control equipment for use in the City of Chicago. This equipment shall control traffic signal timing and sequencing at an intersection. The equipment shall include a battery back-up system which will maintain power to the signals during a power failure.

1.2 (For contract construction only) If requested by the City, the contractor shall provide a sample to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. The sample shall consist of the controller, cabinet, load switches, conflict monitor and all appurtenant wiring and equipment completely assembled as a working unit. This sample will be regarded as a finished production sample and conformance or non-conformance to these specifications will be based on the sample submitted.

(For City commodity contract only) If requested by the Chief Procurement Officer, within thirty (30) days from the receipt of such request, the bidder shall provide a sample to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. The sample shall consist of the controller, cabinet, load switches, conflict monitor and all appurtenant wiring and equipment completely assembled as a working unit. If the sample is acceptable and the bidder is awarded a contract, the sample will become the property of the City of Chicago with a suitable credit issued to the contract.

1.3 All tests as outlined herein shall be regarded as minimum requirements. The contractor shall submit his testing procedure for approval prior to performing any testing functions. Upon successful completion of all testing, certified test reports shall be submitted for each unit. Units not successfully passing these tests or lacking proper documentation will be rejected. The manufacturer, or manufacturer's representative, must be available for shop testing at the City's facilities.

- 1.4 Standards. Equipment furnished under this specification shall meet the appropriate requirements of the following standards, as required within the body of this specification:

American Association of State Highway and Transportation
Officials (AASTHO)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
Manual on Uniform Traffic Control Devices (MUTCD)
National Electrical Manufacturers Association (NEMA)
Occupational Safety and Health Administration (OSHA)
Underwriters Laboratories (UL)

- 1.5 Standard Drawings. The Electrical Standard Drawing 962 “Load Switch and Conflict Assignment”, Electrical Standard Drawing 964 “Traffic Controller Cabinet Back Panel and Power Supply, 1 of 2”, and Electrical Standard Drawing 965 “Traffic Controller Cabinet Back Panel and Power Supply, 2 of 2” are integral parts of this specification.

- 1.6 Warranty. The manufacturer(s) shall warranty the performance and construction of the traffic signal controller and other major components to meet the requirements of this specification, and must warranty all parts, components, and appurtenances against defects in design, material, and workmanship for a period of one (1) year after acceptance by the City. In the event of defects or failures during this period, the manufacturer(s) must repair and/or replace all defective or failed parts or appurtenances at no expense to the City.

- 1.7 Manufacturer. The manufacturer of the cabinet and controller and the manufacturer of the battery back-up system must demonstrate a knowledge of past production, or have been actively engaged in the sale and/or service of the equipment herein described, as demonstrated by a submitted list of comparable projects.

2. CONTROLLER REQUIREMENTS

- 2.1 ATC. The controller shall be an Advanced Transportation Controller (ATC) meeting the requirements of the specification “Advanced Transportation Controller (ATC) Standard Version 5.2b” dated June 26, 2006 and the requirements of NEMA TS2-2003. The referenced ATC specification is a joint effort of AASTHO, NEMA, and ITE. Since each user agency has different controller needs, for the City of Chicago, the controller shall meet the programming modifications and options listed in the ATC Matrix as indicated in Table A. All software necessary to make the controller operational shall be included.

- 2.2 Power. The controller shall operate on 120 volt, 60 cycle (± 3 Hertz), single phase, alternating current. The controller shall function in the range from 89 to 135 Volts a.c. The power consumed must be under 50VA.
- 2.3 Packing. (For City commodity contracts only) Each controller, with all its component parts, shall be suitably packed in a single container in such a manner as to prevent damage to the contents in shipment and handling.
- 2.4 Instructions. One (1) complete set of up to date instructions providing complete information on installation, adjustment, operation and maintenance, including both up to date "Logic Schematics" and "Electronic Circuit" diagrams, of these controllers, shall be furnished to the Division of Electrical Operations for approval prior to the first shipment of controllers. All information, including photos and schematics, shall reference to the controller being furnished on this contract and must be a high quality, completely legible reproduction. Upon approval, one complete set of data must be furnished with each controller.
- 2.5 Training. If requested, the contractor shall provide training at the City's facilities. The training must be on the actual equipment provided under the contract, and must include, but not be limited to, programming all features, connecting and wiring, and troubleshooting. Training manuals are required (training manuals should include the instructions in a teaching-type format). Training shall be structured for both field personnel and shop personnel. The manufacturer shall provide all material and equipment necessary for the training.
- 2.6 Chassis. The chassis shall be aluminum with a powder coat finish. No plastic chassis or composite chassis will be allowed. The controller must physically fit into existing 'M', 'P', and 'SUPER P' cabinets configured for City of Chicago applications, so that retrofitting will not be a problem. The controller must not exceed the following dimensions: 10.5 inches high, 10.5 inches deep, and 15 inches wide.
- 2.7 Processor / Memory. At a minimum, the processor will be:
- Clock speed - 300MHz
 - Non-volatile Memory - 32MB Flash
 - DRAM - 64MB
 - SRAM - 1MB
- (All memory and firmware must be stored in flash memory. No EPROMS will be allowed.)
- 2.8 Display. The display shall be a 16 x 40 backlit LCD using a 6 x 8 character font. Display and keypad must be permanently attached to chassis. Detachable

keypads will not be allowed.

- 2.9 Environmental. The controller shall operate in the temperature range of -34° Celsius to +74° Celsius. The controller shall operate within the relative humidity of 5% to 95%.
- 2.10 All printed circuit boards shall be mounted vertically.
- 2.11 Encapsulation of 2 or more discrete components into circuit modules is prohibited except for transient suppression circuits, resistor networks, diode arrays, solid-state switches, optical isolators and transistor arrays. All encapsulated components must be second sourced and must be of such design, fabrication, nomenclature or other identification as to be purchased from a wholesale distributor or from the component's manufacturer as a standard product. Custom encapsulated components are not allowed.
- 2.12 Obsolete components, components no longer supported by the manufacturer, components not recommended for new designs, components which have been discontinued or which the contractor should have reasonably been expected to know were discontinued, or components which the vendor/manufacturer has announced plans to discontinue at the time of the bid/contract must not be used in the design of any subassemblies provided under this contract.
- 2.13 The controller shall meet the functional and environmental requirements of NEMA TS2 2003. The use of 2070s, 170s, BIUs, SIUs, or similar devices is not allowed.
- 2.14 As allowed by ATC v5.2b, Section 8.1.1, the controller will utilize NEMA 'A', 'B', and 'C' I/O connectors, except for the HMC-1000 and LMD40 I/O variants. Pin assignments for NEMA 'A', 'B', and 'C' connectors shall follow the NEMA TS2 2003 standards for I/O. Port 2 must be the ATC v5.2b pin-limited version of NEMA TS2 Port 2. Port 4 (C50S) must be a 9-pin connector with only limited signals being required.

Special function connector for the TS2-2 shall follow the CPC style "D" pin outs as follows:

CPC MSD Pin	Function
1	Flash
2	Offset 1
3	Interconnect Common
4	User defined input 6
5	Offset 2
6	Offset 3
7	Time Plan A
8	User defined input 7

9	User defined input 8
10	Call to Free
11	Call to week 10
12	Time Plan B
13	Time Plan C
14	Time Plan D
15	Alt Seq A
16	Alt Seq B
17	Alt Seq C
18	Dimming
19	Monitor status bit C
20	System Input
21	Alt Seq D
22	Monitor status bit A
23	Monitor status bit B
24	Veh Det 13
25	Veh Det 9
26	Veh Det 10
27	Veh Det 11
28	Polarizing Pin
29	Veh Det 12
30	Veh Det 14
31	Veh Det 15
32	Veh Det 16
33	SGO/Conditional Service
34	Preempt input 5
35	Preempt output 1
36	Preempt output 2
37	Interconnect inhibit
38	Time Clock sync
39	Sync inhibit
40	Preempt input 1
41	Preempt input 2
42	Preempt input 3
43	Preempt output 3
44	Polarizing Pin
45	Preempt output 4
46	Preempt output 5
47	System Out
48	Preempt output 6
49	Preempt input 4
50	Clock Ckt 9 (Aux 1)
51	Clock Ckt 10 (Aux 2)
52	Clock Ckt 11 (Aux 3)
53	Clock Ckt 12 (Aux 4)

54	Clock Ckt 13 (System)
55	Clock Ckt 8 (Flash)
56	Clock Ckt 3 (Offset 1)
57	Clock Ckt 4 (Offset 2)
58	Clock Ckt 5 (Offset 3)
59	Clock Ckt 1 (T/P A)
60	Clock Ckt 2 (T/P B)
61	Clock Ckt 6 (T/P C)
62	Clock Ckt 7 (T/P D)
63	Preempt input 6

2.15 Downward compatibility with existing City of Chicago cabinets.

- (1) The controller shall be of a modular design allowing for the ability to exchange I/O modules to allow for use in existing City of Chicago HMC-1000, LMD40, and standard NEMA TS2-2 cabinets. This I/O module shall be “plug and play”. The controller’s firmware must detect the type of I/O installed (HMC-1000, LMD40 or NEMA TS2) and provide the proper user interface. Adapter harnesses for the HMC-1000, LMD40 and Setcon clock will not be allowed.
- (2) The HMC-1000 I/O module shall be pinned as follows:

63 Pin Connector	Function
1	Output 20
2	Output 11
3	Manual Advance
4	Stop Time
5	Output 24
6	Offset 1
7	Offset 3
8	Output 15
9	Preempt 2
10	Advance
11	Output 23
12	Restart
13	Output 32
14	Offset 2
15	Output 16
16	Preempt 1
17	Output 25
18	Output 28

19	Spare 1
20	Spare 2
21	Output 7
22	Output 18
23	Output 21
24	Output 22
25	Dial 3
26	Dial 2
27	Output 1
28	Output 14
29	Output 4
30	Output 29
31	Output 27
32	Output 17
33	Output 9
34	Output 19
35	Dial 4
36	On-Line
37	Flashing Bus
38	Manual
39	Output 30
40	Output 31
41	Output 12
42	Output 10
43	Output 2
44	Output 3
45	Output 13
46	Output 8
47	Output 26
48	Logic Ground
49	Not Used
50	Not Used
51	Output 5
52	Output 6
53	Logic Ground
54	Logic Ground
55	Not Used
56	Not Used
57	Not Used
58	Not Used
59	24 V.D.C
60	Not Used
61	115 Volts AC
62	AC Neutral
63	Chassis Ground

- (3) The LMD40 I/O module contains 4 I/O connectors, MSA, MSB, MSD, and communications connectors which shall be pinned as follows:

LMD40 MSA	Pin	Voltage Level
Actuation 3	A	DC
24 V.D.C	B	DC
Voltage Monitor	C	DC
Actuation 1	D	DC
Actuation 2	E	DC
Preemption 2	F	DC
Preemption 1	G	DC
Interval Advance	H	DC
Stop Time	J	DC
MCE (Manual Control)	K	DC
External C/S/O	L	DC
Signal Plan 2	M	DC
Signal Plan 3	N	DC
System Cont/AZ Reset	P	DC
External Start	R	DC
Remote Flash (AC)	S	120 VAC
Interconnect Common	T	120 VAC
AC – (Common)	U	AC
Chassis Ground	V	Earth Ground
Logic Ground	W	DC Reference
Output 1	X	DC
Output 2	Y	DC
Output 3	Z	DC
Output 4	a	DC
Output 5	b	DC
Output 6	c	DC
Output 7	d	DC
Output 8	e	DC
Output 9	f	DC
Output 10	g	DC
Output 11	h	DC
Output 12	i	DC
Output 13	j	DC
Output 14	k	DC
Output 15	m	DC
Output 16	n	DC
AC+ input	p	120 VAC
Output 17	q	DC
Output 18	r	DC

Output 19	s	DC
Output 20	t	DC
Output 21	u	DC
Spare Output	v	DC
Spare Output	w	DC
Spare Output	x	DC
Cycle 2 (User Defined)	y	120 VAC
Cycle 3 (User Defined)	z	120 VAC
Split 2	AA	120 VAC
Split 3	BB	120 VAC
Output 22	CC	120 VAC
Output 23	DD	120 VAC
Offset 1	EE	120 VAC
Offset 2	FF	120 VAC
Offset 3 (user def 1)	GG	120 VAC
Output 24	HH	DC

LMD40 MSB	Pin	Voltage
Output 25	A	DC
Output 26	B	DC
Output 27	C	DC
Output 28	D	DC
Output 29	E	DC
Output 30	F	DC
Output 31	G	DC
Output 32	H	DC
Output 33	J	DC
Output 34	K	DC
Output 35	L	DC
Output 36	M	DC
Output 37	N	DC
Output 38	P	DC
Output 39	R	DC
Output 40	S	DC
Actuation 4	T	DC
Hold	U	DC
Force Off	V	DC

LMD40 MSD	Pin	Voltage
Flash Monitor 1	1	120 VAC
Cycle 5	2	120 VAC
PE Clear 1	3	DC
PE Clear 3	4	DC

Flash Monitor 2	5	120 VAC
Spare Input 4	6	120 VAC
System Input	7	120 VAC
AZ Reset (Absolute Zero)	8	DC
PE Clear 2	9	DC
UD 6 Input	10	DC
Call to week 10	11	DC
Signal Plan 6	12	DC
Signal Plan 7	13	DC
Signal Plan 8	14	DC
Actuation 5	15	DC
Actuation 6	16	DC
Actuation 7	17	DC
Spare input 1	18	DC
UD 7 Input	19	DC
Actuation 8	20	DC
Actuation 9	21	DC
Actuation 10	22	DC
Spare input 2	23	DC
UD 8 input	24	DC
Sys Command (Ckt 13)	25	DC
Flash Attained	26	DC
PE Active	27	DC
Polarization	28	DC
System Out	29	DC
Preempt input 3	30	DC
Preempt input 4	31	DC
Preempt input 5	32	DC
Signal Plan 5 in	33	DC
Call to FREE op	34	DC
Output 41	35	DC
Output 42	36	DC
Interconnect Inhibit	37	DC
Spare input 3	38	DC
Sync Inhibit	39	DC
Dimming	40	DC
Added Time inhibit	41	DC
Time Clock Sync	42	DC
Output 43	43	DC
Polarization	44	DC
Output 44	45	DC
Output 45	46	DC
Output 46	47	DC
Output 47	48	DC
Signal Plan 4	49	DC

Aux 1 (Ckt 9)	50	DC
Aux 2 (Ckt 10)	51	DC
Aux 3 (Ckt 11)	52	DC
Aux 4 (Ckt 12)	53	DC
Output 48 (FF Enable)	54	DC
Flash Out (Ckt 8)	55	DC
Offset 1 (Ckt 3)	56	DC
Offset 2 (Ckt 4)	57	DC
Offset 3 (Ckt 5)	58	DC
Cycle 2 (Ckt 1)	59	DC
Cycle 3 (Ckt 2)	60	DC
Split 2 (Ckt 6)	61	DC
Split 3 (Ckt 7)	62	DC
Fast Flash Image	63	DC

LMD40 Communication Connector (15 pin sub-D)	PIN	Voltage
System Detector 11	1	DC
System Detector 12	2	DC
System Detector 13	3	DC
System Detector 14	4	DC
System Detector 15	5	DC
System Detector 16	6	DC
System Detector 17	7	DC
System Detector 18	8	DC
Monitor Status bit B	9	DC
Monitor Status bit A	10	DC
Monitor Status bit C	11	DC
DC User Defined in #1	12	DC
Logic Ground	13	DC
DC User Defined in #2	14	DC
DC User Defined in #3	15	DC

- (4) The Setcon I/O connector will be resident on the HMC1000 version of the ASTC I/O.

Setcon Clock Connector	PIN	Voltage
Output 1	1	DC
Output 2 (Dial 2)	2	DC
Output 3 (Dial 3)	3	DC
Output 4 (Dial 4)	4	DC

Output 5 (Offset 1)	5	DC
Output 6 (Offset 2)	6	DC
Output 7 (Offset 3)	7	DC
Output 8 (Flash)	8	DC
Sync Output	9	DC
Sync Input	10	DC
Not used	11	N/A
Logic Ground	12	DC
Not Used	13	N/A
Not Used	14	N/A
Not Used	15	N/A
Not Used	16	N/A

2.16 Communication.

- (1) NTCIP (National Transportation Communications for ITS Protocol).
 - a. The controller shall be compliant with NTCIP Standards as outlined in NEMA TS2 – 2003 and must be tested and documented for compliance.
 - b. Global objects shall be compliant to NTCIP 1201 v2.26 or later.
 - c. Actuated Signal Controller objects shall be compliant to NTCIP 1202 v2.19f or later.
- (2) Serial ports, one of which must be set as either RS-232 or RS-485.
- (3) Ability to add an internal GPS module.
- (4) Ethernet. The controller must be equipped with a minimum of two front panel mounted 10/100Mb Ethernet ports.
- (5) A single port USB interface must be provided to facilitate database transfers, re-flashing of operation software and log transfer.
- (6) The unit must be fully compatible with, and fully functional within, the City's existing traffic signal management system. All available functions and capabilities that exist within existing controllers must be available within this unit, as well as compatible with the ATC LMD40 unit and the ATC NEMA unit. Any additional software or hardware necessary to fully integrate the controller into the City's traffic signal management system must be provided by the bidder/contractor and will be considered as part of the requirements of this specification.

- (7) Windows based laptop utility software must be provided for data transfers and monitoring of controller operation.
- (8) A fiber-optic modem shall be provided, if required. The modem must be compatible with existing City fiber interconnect systems. The modem may be internal or external to the controller.

2.17 Software operation.

- (1) The controller shall have the ability to re-synch a minimum of 8 cycle lengths to an “absolute zero” reference point. It must be possible to set absolute zero by either global command or individual cycle length.
- (2) In addition to hardwire input, it shall be possible to set Absolute Zero via keyboard command or fiber optic communication.
- (3) The controller shall have the ability to operate in two modes of operation, selectable by time of day:
 - a. Actuated control per NEMA TS2 – 2003.
 - b. Pre-timed Interval based control per NEMA TS2 – 2003.
- (4) The controller shall have the ability to transfer between actuated control and interval based control by time of day schedule.
- (5) The controller will have 32 Pre-timed plans
 - a. Each plan will allow for up to 32 timing intervals
 - b. Each plan will allow for 64 circuit outputs. Each output must be individually programmable per interval.
- (6) The controller shall have 100 coordination plans.
- (7) The controller shall provide 6 preempts per NEMA TS2-2003.
- (8) The controller shall offer security as follows:
 - a. Two 4 digit security codes can be programmed (one for timing data, one for signal plan data), which when activated, allow data changes. These codes must automatically de-activate 10 minutes after the last user keystroke. It will be possible to re-program the security codes if the previous security code is known or has been defeated.

- b. It must not be possible to read the security code from the controller's display.
- c. It must be possible to access the controller in the case of a lost security code through a "back door" which is provided only by the controller manufacturer. This "back door" security code must change based upon the controller's internal calendar.

3. CONFLICT MONITOR

- 3.1 General. Each controller shall be furnished with a NEMA conflict monitor unit for checking for conflicts in the signal output circuits. The conflict monitor shall be capable of monitoring a minimum of twelve (12) distinct channels. It must be a self-contained unit with its own power supply and not be located within the timer housing.
- 3.2 Programming Board. A removable programming board shall be supplied with the monitor for programming signal compatibility. The circuits for programming must be composed of soldered jumper wires. Diode or dip switch type programming will not be acceptable. The programming board must contain no circuitry or components other than the wire jumpers and the wire jumper soldering devices.
- 3.3 Flashing Circuit Energizing. The conflict monitor shall be programmed to put the controller in a flashing sequence upon detection of a failure or conflicting signal display. The controller must also be programmed to energize the flash circuit if the conflict monitor is removed or loses its supply voltage. The conflict monitor must have a manual reset button to return the controller to normal operation after conflict circuit operation is no longer necessary.
- 3.4 Stop Time Circuit. A stop-time control circuit shall be supplied from the conflict monitor to force the timer unit to stop timing upon detection of a conflict.
- 3.5 Indicator. The front panel of the conflict monitor housing shall have an indicator which will be activated when a conflict or failure occurs as per Section 6 of NEMA Spec. TS1-1983.
- 3.6 Latch Circuit. The conflict monitor shall have a latch circuit, insuring that if a voltage monitor failure occurs, the intersection remains in conflict until reset.
- 3.7 Memory. The conflict monitor shall have the ability to store, in memory, a minimum of ninety-nine (99) conflict events, including date of conflict and channels conflicting.

3.8 Conflict Monitor Assignments

- (1) Conflict monitor channels shall be assigned as follows:

Channel 1	Load Switch 1	Phase 1 Vehicle
Channel 2	Load Switch 2	Phase 2 Vehicle
Channel 3	Load Switch 3	Phase 3 Vehicle
Channel 4	Load Switch 4	Phase 4 Vehicle
Channel 5	Load Switch 5	Phase 5 Vehicle
Channel 6	Load Switch 6	Phase 6 Vehicle
Channel 7	Load Switch 7	Phase 7 Vehicle
Channel 8	Load Switch 8	Phase 8 Vehicle
Channel 2W	Load Switch 9	Phase 2 Ped
Channel 4W	Load Switch 10	Phase 4 Ped
Channel 6W	Load Switch 11	Phase 6 Ped
Channel 8W	Load Switch 12	Phase 8 Ped
Channel 9	Load Switch 13	Overlap A
Channel 10	Load Switch 14	Overlap B
Channel 11	Load Switch 15	Overlap C
Channel 12	Load Switch 16	Overlap D

- (2) It shall be possible for the user to change conflict assignments without unsoldering any connections.
- (3) All unused channels - vehicle or pedestrian - must be neatly tied or terminal mounted in such a manner that they are readily available in front of the panel. If tied, the harness wires must be labeled. If terminal mounted, the terminations must be labeled.
- (4) A terminal shall be provided for the red enable feature.
- (5) A terminal shall be provided for the hook up of any unused red channels to AC.
- (6) Controller monitoring shall consist of; voltage monitor, 24VDC- I, 24VDC-II.
- (7) The output relay shall operate a sixty (60) ampere, normally open, "A" type contactor without the use of an external or "cabinet interface" relay.

4. SUPER P CABINET

4.1 Housing. Each controller shall be furnished completely housed in a Type 5052-H32 aluminum housing of 0.125 inch thickness. The exterior dimensions of the cabinet shall be approximately 57 inches high, 58 inches wide, and 27 inches deep. The top of the cabinet shall be approximately 58 inches wide and 29 inches deep. The top of the cabinet must have a front to rear slope that will direct rain away from the front cabinet door. Door openings must be double-flanged. The interior of the cabinet will be divided into two compartments. The interior of the main cabinet shall be equipped with four (4) "C" mounting channels on both side walls and two (2) "C" mounting channels on the rear wall. The UPS portion of the cabinet shall be equipped with two (2) "C" mounting channels on each of the two side walls. All shelves, panels and individual equipment items must be mounted to these channels using 1.0" channel nuts with 1/4-20 bolts. All items mounted on panels must be securely fastened by bolting into drilled and tapped holes. No pop rivet or similar fastening methods will be accepted.

4.2 Doors. The cabinet shall have a main door hinged with one-quarter inch (1/4") minimum, continuous, removable stainless steel pins. The hinges themselves will be aluminum secured to the cabinet with stainless steel bolts. The battery compartment door on the side of the cabinet must be similarly hinged. The main cabinet door will be hinged on the right side. The battery compartment door will be hinged on the left side. The doors must be closely fitted to a neoprene gasket making the doors dust, water and weather resistant. The doors must be interchangeable with any other doors from any other controller.

Opening of the main door must provide complete access to the cabinet interior. The door shall be embossed, subject to approval, with the legend "CITY OF CHICAGO-TRAFFIC CONTROL" in letters at least one (1) inch high. The main door and the battery compartment door must have stops at 90, 150 and 180 degrees, from the closed position. The door latches must have three (3) point locking with rollers at the ends of the latch rods. The latch handle must be capable of being padlocked. The key lock for the latch mechanism must be a Corbin cylinder lock with keys to match existing City of Chicago controller cabinets. Two (2) keys must be furnished with each cabinet. Both the main door and the battery compartment door will have stainless steel handles with an 8" shank. The handles must be able to be padlocked. The padlocking arrangement must clear the lock and key.

Police Panel Door. The police panel door on the main door shall be furnished with a lock for a modified Chicago police key per sample to be furnished to the supplier. This key must have a shaft of at least one and three quarter inches (1-3/4") in length. Two keys must be furnished with each cabinet. The door will have a stainless steel piano hinge and be sealed with a neoprene

gasket.

Generator Door. This door will be on the rear of the cabinet. This door will have a stainless steel piano hinge and be sealed with a neoprene gasket. Two keys will be furnished for this door.

- 4.3 Cabinet Ventilation. The main cabinet compartment shall be provided with a mounting assembly to hold the forced air fan system. A fan, having a minimum air movement capacity of 100 CFM, shall be mounted in the air baffle in the top of the cabinet with an air outlet built into the roof overhang. The main door must be louvered and equipped with a removable, standard, commercially available aluminum dust filter. The battery compartment shall have a similar fan system. The battery compartment door must also have a louvered section with a removable dust filter. The ventilation openings must be equipped with removable covers for summer operation. No external fan housings or air outlets will be allowed. Any other method must be approved.
- 4.4 Shelves. The cabinet shall contain a vertically adjustable shelf large enough to accept the solid state controller and all other shelf mounted devices. The battery compartment shall have a minimum of three shelves.
- 4.5 Bolt Pattern. The bolt pattern shall be a four (4) point rectangular pattern matching the corresponding foundation. The dimensions will be 40.75" center-to-center and 18.5" center-to-center.
- 4.6 Finish. The exterior surfaces of the cabinet must be smooth. All drilled, tapped, or punched holes on the outer surface must be filled with liquid metal and ground smooth, and slotted screw heads must be ground smooth flush with surface. Bolts extending through cabinet wall must be round head, carriage, square shoulder type and fastened on the inside of the cabinet with an Esna nut and necessary gaskets to insure the weatherproofing integrity of the cabinet. The finished cabinet must be thoroughly degreased in a wash process and dried in a heated chamber. A thermosetting, ultra violet resistant, polyester powder coat must be electrostatically applied to all cleaned and treated surfaces and cured to a hard, mar resistant finish in a heated chamber at a temperature recommended by the powder coat paint manufacturer. Exterior color must conform to Federal Standard 595 #17038 for gloss black. Cabinet interior must be glossy white and may be either baked enamel or thermosetting, polyester powder coat. For either process, the interior must be prepared as described above. If the baked enamel finish is used, it must be preceded by one (1) coat of primer.

5. POWER SUPPLY

- 5.1 A sixty (60) ampere main breaker shall be inserted in series with the line.
- 5.2 An un-fused terminal bus shall be provided for ground side of the power supply and signal conductor commons.
- 5.3 Individual circuit breakers shall be supplied for: (a) AC+ lights, 50 amperes; (b) AC+ control, 10 amperes; (c) duplex outlet supply, 15 amperes.
- 5.4 The incoming line shall contain lightning protection devices consisting of, but not limited to, a metal oxide varistor and gas type arrester. The gas type arrester must be on the line side of the radio interference filter.
- 5.5 Contactor. A sixty (60) ampere, normally open, "A" type contactor shall be supplied for opening and closing the AC supply to the signal bus. The contactor must be mounted in such a manner on the power supply panel that accidental contact does not produce a safety hazard.
- 5.6 R.I.S. Filter. A radio interference suppression filter rated at sixty (60) amperes minimum shall be installed in line with the main power supply, after the sixty (60) ampere circuit breaker.
- 5.7 Ground. The grounded side of the power supply must be continuous throughout the controller and must be grounded to the controller cabinet in an approved manner meeting OSHA requirements.
- 5.8 Polarity. The phase conductors of the signal circuits shall have the same polarity as the phase side of the power supply, and the common conductor(s) shall be of the same polarity as the grounded side of the power supply.

6. UNINTERRUPTIBLE POWER SUPPLY

- 6.1 General. The uninterruptible power supply (UPS) will consist of batteries which will recharge through the 120 volt electric service line. In the event of a power disruption, the unit will automatically activate. The transfer from utility power to battery power will not interfere with the normal operations of the traffic controller, conflict monitor, or any other part of the traffic system. A generator port will be provided to accept input from an external generator that can operate the traffic signals. The UPS must be the product of an established manufacturer, and suitable for the service required. The UPS must be manufactured by an established manufacturer who has been in the business for a minimum of five (5) years.

6.2 General Operation

- (1) The line power provided by ComEd is nominally 120 volt, single phase, 60 Hertz. The UPS system must take the line power, regulate it, and provide continuous 120 volt, single phase, 60 hertz power to the traffic system. The UPS must regulate the input line voltage within the limits specified herein. The input line voltage must also be transformed and rectified to charge the batteries. Under battery operation, the output from the batteries will go through an inverter to provide the proper A.C. current to provide continuous 120 volt, single cycle, 60 Hertz power to the traffic system. In the event of a power loss, the system must automatically switch to battery operation, without adversely affecting the traffic system. When power is restored, the system must automatically switch back without adversely affecting the traffic system. In the event the UPS system fails, an automatic switch must bypass the UPS and connect unconditioned power from ComEd directly to the traffic system. A manual bypass switch shall also be provided. The system shall be capable of running off a generator. The UPS will allow the generator to be put in or out of the system without adversely affecting the traffic system.
- (2) The system will be capable of providing power for normal full timing mode, flash mode, or a combination of both. The operation will be field programmable to activate at various times, to change operation due to changing battery capacities, and to track alarm conditions, using the touch pad or remotely using the RS-232 interface. Programmability shall be in ASCII formats and shall not require any external or proprietary software. The DB-9 connector for the RS-232 interface shall be located on the front panel of the UPS. The UPS must provide a minimum of 4 hours of full normal timing for a full LED controlled intersection.
- (3) In the event ComEd line voltage falls outside the high and low limits (95VAC and 130VAC should be the default values) the UPS must transfer the load to battery power. The high and low limits shall be programmable.
- (4) The UPS must return to line mode when the ComEd power is restored within the proper limits for a specified period of time. The limits shall be programmable. The default values should be 105VAC and 125VAC. This time shall be programmable and should range from 3 to 30 seconds.
- (5) The transfer time allowed, from disruption of normal utility line voltage to batteries or from batteries back to line voltage, must be such that the traffic signal system is not disrupted. The maximum transfer

time allowed will be 60 milliseconds.

6.3 Specifications

- (1) The UPS capacity will be a minimum of 2000VoltAmps/ 1500 watts.
- (2) The inverter shall have a minimum efficiency of 80%.
- (3) The UPS will have an operating range of between -37°C. to +74°C.
- (4) The manual bypass switch shall be rated at 240 volts, 40 amps.
- (5) The UPS shall have a temperature compensated battery charging system. The charging system must compensate over a range of 2.5mV to 4 mV per degree centigrade per cell. Batteries must not be charged when temperatures exceed 50°C. The temperature sensor shall be located in the cabinet near the batteries.
- (6) The charger shall be rated at 10 amps at 48 VDC.
- (7) When under battery operation the UPS output voltage must be between 110 VAC and 125VAC, with a sine wave with THD less than 3% at 60 Hertz (± 3 Hz).
- (8) The UPS shall be equipped to prevent a malfunction feedback to the utility service or to the cabinet per UL 1778, Section 48 "Back-Feed Protection Test". The upstream back-feed voltage from the UPS must be less than 1 volt AC.
- (9) The UPS shall have a lightning surge protection in compliance with IEEE/ ANSI C.62.41 for 2000 volts AC.
- (10) The UPS shall not weigh more than 50 pounds.
- (11) The UPS shall have a minimum efficiency of 95%.
- (12) The generator bypass switch shall be supplied with a 30 amp, weather-proof locking receptacle and cover plate.

6.4 Computer Control and Display

- (1) The UPS shall include an LCD display with programmable keypad, a red LED and a green LED, and an RS-232 interface.
- (2) The UPS processor shall be capable of indicating, through the

LCD display or the RS-232 interface, the current battery charge status, various input/output voltages, power output, battery temperature, date, time, settings of programmable relays, events, and various other functions.

- (3) The UPS shall provide a temperature control for the cabinet fan.
- (4) The UPS shall be provided with a resettable inverter event counter and a cumulative inverter timer.
- (5) The UPS shall be equipped with an event log for a minimum of 100 events. Each event must have a date and time.
- (6) The UPS shall be capable of performing a self-test.
- (7) Password protection shall be provided.
- (8) The following LED conditions shall be used to indicate current status:

RED FLASHING - Alarm
RED STEADY - Fault
GREEN FLASHING - Battery Mode
GREEN STEADY - Line Mode
- (9) The manual UPS bypass switch will allow the UPS to be maintained or replaced.

6.5 Battery System

- (1) Individual batteries shall be 12 volt, and must be commercially available and easily replaced.
- (2) Four 79ah batteries shall be supplied.
- (3) The batteries will be connected in series. The wiring harness must be color coded and have quick disconnects.
- (4) Batteries must be certified to operate over a temperature range of -25° C. to +74° C.
- (5) The batteries shall be extreme temperature, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (absorbed glass mat/valve regulated lead acid) .
- (6) Maximum recharge time from protective low cut-off to 80% of full

capacity must not exceed 20 hours.

- (7) Thermostat controlled heater strips or pads shall be supplied to keep battery operation efficient.

6.6 Relay Contacts

- (1) The UPS shall provide 6 sets of panel-mounted, potential free, fully programmable relay contacts rated at 1 amp, 120 volt. The relays shall be numbered from C1 to C6.
- (2) Each relay shall be programmable to activate under any number of the following conditions:

ON BATTERY, relay activates when UPS switches to battery power.

LOW BATTERY, relay activates when batteries have reached a certain level of remaining capacity. This is adjustable from 0 to 100%.

TIMER, relay activates after battery power is on for a certain amount of time. This is adjustable from 0 to 8 hours.

ALARM, relay activates after a specific alarm is detected. Alarm conditions include line frequency, low output voltage, no temperature reading, overload, batteries not connected, high temperature, and low temperature.

FAULT, relay activates after a specific fault is detected. Fault conditions include short circuitry, low battery voltage, high battery voltage, high internal temperature, and excessive overload.

OFF, relay is not active.

7. **LOAD SWITCH BAY**

7.1 General. A panel shall be provided for mounting the load switch jacks, flash transfer relay jacks, flasher jack, auxiliary relays, time clock jacks, switches, flash change combination terminals, and terminals for field signal connections under non-interconnected operation. See Electrical Standard Drawings 964 and 965.

7.2 Wiring. Panel wiring must be neatly laced and properly terminated individual conductors. They must be insulated and properly sized for their application.

7.3 Load Circuits. Each load circuit shall be capable of carrying fifteen (15) amperes continuously at a temperature of 165° F. (74° C.).

7.4 Bus Feeds. Bus feeds shall be capable of carrying fifty (50) amperes continuously at a temperature of 165° F. (74° C.).

7.5 Equipment. In addition to the items listed in 2(a), the wiring panel shall include, but not be limited to, the following:

- (1) Ten (10) ampere fuses with barrier type fuse holders shall be installed between the load switch signal output circuits and field terminals for signal light conductors. Each terminal shall be the barrier type with sufficiently long screws to accept four (4) #12 AWG solid conductors. The terminals must be located at least two inches (2") above the bottom of the cabinet.
- (2) Switching Device. The signal load switching device shall be a three (3) circuit, solid state, jack mounted load switch which meets the N.E.M.A. Publication TS-1, Part 5 requirements. Each load switch shall be rated for a minimum fifteen (15) ampere continuous resistive load and must mate with an S-2412-SB panel socket. A minimum of twelve (12) and a maximum of sixteen (16) load switches to be provided with each cabinet, as defined in the contract.
- (3) User Programmable Interface. Two (2) sets of terminal blocks shall be provided between the machine logic output and the input side of the load switches. By terminating all machine logic output on one set of terminals and all load switch input to the other set, an interface is thus created by which the machine logic can be readily connected to any of the load switches by means of a jumper wire. The two (2) sets of terminal blocks must be conveniently located in close proximity to each other and must be arranged such that, initially, each function will be factory wired directly from one set of terminals to the other without the need to criss-cross wires between blocks.
- (4) Number of Signal Circuits:
 - a. Sixteen (16) load bay panel. Each panel shall be equipped with sixteen (16) load switch jacks for a minimum of forty-eight (48) signal circuits.
 - b. All unused signal circuits must be neatly tied or terminated. If tied, the harness wire must be labeled. If terminated, each termination must be identified.

7.6 Identification. All field terminals must be suitably identified, subject to approval.

8. FLASHING FEATURE

- 8.1 General. The flasher must be a solid state device, with no contact points or moving parts, producing between 50 and 60 flashes per minute with a 40 to 50 percent duty cycle. The flasher mechanism shall be mounted on a type P-406-SB plug which will mate with an S-406-SB socket on the controller panel. The flasher must utilize zero-point switching, with turn-on at the zero voltage point (± 5 degrees) of the power line sinusoid.
- 8.2 Flasher Panel. A panel must be provided with one (1) terminal wired to the flasher and marked "FL". The panel must be equipped with terminals to provide or omit flashing of all red and yellow outputs.
- 8.3 Flasher Circuits. Flashers shall provide two (2) output circuits to permit alternate flashing of signal phases and must be capable of carrying a minimum of twenty (20) amperes per circuit at 120 volts. The flasher must operate continuously so that flashing power will be available at the field terminal marked "FL". The flasher wiring must divide the loads imposed on the two (2) circuit flasher alternately on each phase.
- 8.4 Manual Flash. A manual flash switch shall provide flashing indication for all circuits. The flash change combination terminals must allow the selection of flashing either yellow or red on the main and/or cross streets, or complete omission of the flashing feature if required.

9. POLICE PANEL

- 9.1 Auto-Off Flash Switch. Each controller must be provided with an auto-off-flash switch. In the "AUTO" position the signals will be on and the controller timing unit will run normally. In the "OFF" position the signals will be OFF and the controller timing unit will continue to run. In the "FLASH" position the signals will flash and the controller timing unit will continue to run. The auto-off flash switch must be located on the side of the police switch panel that faces outward when the police door is open.
- 9.2 Auto-Hand Switch. Each controller will have an auto-hand switch on the back side of the police switch panel. This switch must be so arranged that the switch can be physically rotated 180 degrees to provide usage after opening the police panel door. It must be so mounted that the act of rotation does not affect the police switch panel. Switch terminals must not be exposed on either position. The auto-hand switch must provide a means of manually timing the signals by use of a separate, momentary contact, hand switch. Operation of the timer by manual control must provide the same color sequence as an automatic operation with no momentary undesirable indications appearing. Manual control must be possible with the door of the cabinet closed. The hand switch required for manual control must only be supplied when specified in

the contract. It must be of an approved weatherproof construction with a six (6) foot, retractable, flexible, extension cord to allow connection to the appropriate terminals on the panel of the controller. It must be possible to manually step through a vehicle clearance interval.

9.3 Terminal Block. A two point terminal block must be mounted on the back side of the police switch panel and the hand control circuit terminated on this block. This will be for installation of a hand control cord by others, as required.

9.4 Space Requirement. Adequate room must be provided in the police panel section to store the manual switch and retractable cord.

10. RELAYS

10.1 Transfer Relays. Eight (8) double pole, double throw, flash transfer relays shall be furnished with each controller. These relays must be jack mounted into an S-408-SB, or equivalent, socket mounted on the controller panel.

10.2 Contact Arm. Each contact arm must have over travel on the front and back contacts and be independent of any other contact arms. No adjustment of contact pressure or wipe must be necessary. Load capability must be a minimum of fifteen (15) amperes per contact continuously and thirty (30) amperes for one (1) minute. Contacts must be of coin or fine silver or an approved alternate.

10.3 Dust Cover. A suitable dust cover must be furnished for each relay.

10.4 Relay Mounting and Endurance. All relays supplied must meet their approved specified requirements and must have contacts which cannot be opened by unusual vibrations, shock, or momentary voltage excursions of up to 30%. All relays other than the flash and bus relay must be mounted on a molded base with eleven (11) or eight (8) pins for jack mounting to their respective panel or sub-base, and must be electrically interchangeable with those presently used by the City of Chicago.

11. COMMUNICATIONS INTERFACE PANEL

11.1 Where a communications interface has been specified to allow a controller to function as a Master or Secondary controller, then one of the specified options must be provided:

(1) Fiber Optic Communications Interfaces must meet the following requirements:

a. General. The fiber optic communications components must

consist of, but not be limited to, an internal fiber optic modem within the controller or an external fiber optic modem, a fiber optic patch panel to interface the modem to field fiber optic cables, and fiber optic jumpers between the modem and patch panel.

- b. The modem must either be a multi-directional "star" type or a bi-directional type, as specified in the contract. All modems must be Electronic Industries Association (EIA) compatible for RS-232 data communications via fiber optic link. Modems must be multi-mode, operate at 850nm wavelength, and provide full-duplex, frequency modulated, asynchronous transmission at data rates of up to 38.4 kbps.
 - c. The fiber optic patch panel must consist of a 14" long by 5-3/4" wide by 3-1/4" high rack constructed in accordance with City of Chicago Electrical Standard Drawing #909. The rack must be designed to mount on the controller cabinet rails. "ST" type terminals, suitably labeled, must be provided for the connection of field fibers and Modem.
 - d. The fiber optic jumpers (i.e., optical patch cords) must consist of a single multi-mode fiber in 900 micron orange jacket, with "ST" type connectors factory installed on each end. The jumpers must be 3' long in Secondary (i.e., local) controller cabinets and 6' long in Master controller cabinets. The jumpers must be connected to the patch panel and supported in such a manner that the minimum bending radius is ten (10) times the diameter of the cable, and the cables exert no strain on the connectors. Each jumper must have a minimum tensile strength of 50 lbs.
- (2) Copper Wire Interconnect Panels (Seven Wire, VAC) must meet the following requirements:
- a. General. The interconnect panel must serve to isolate interconnect VAC from the controller. The panel must consist of, but not be limited to, seven (7) relays. Each relay interconnect circuit must include an M.O.V. properly rated for protection against lightning and switching surges injurious to the controller and a barrier type 3AG fuse receptacle and fuse not to exceed five (5) amperes. Each panel must provide a seven (7) wire interface with the T.B.C. functions described below and must provide barrier type terminals suitably labeled for these functions.
 - b. The secondary interconnect panel must be wired in such a manner that a VAC input activates a relay sending an input from that relay to the controller. It must have a minimum of seven (7) relays for

the following functions; Dial 2, Dial 3, Dial 4, Offset 1, Offset 2, Offset 3, M.U.T.C.D. flash.

- c. The master interconnect panel must provide a means to establish outgoing VAC for a seven (7) wire interconnect system using eight (8) relays. The relays must have 24 VDC coils and be designated as, Dial 2, Dial 3, Dial 4, Sync, Offset 1, Offset 2, Offset 3, M.U.T.C.D. flash. The sync relay must be wired in such a manner that it provides the offset pulse to the contacts of the three (3) Offset relays.
- d. Each relay must be a double pole type, with one pole designated as field interconnect output, and the other designated as controller input. Relay coils must be rated for continuous duty. Relay contacts must be rated for a continuous fifteen (15) AMP resistive load.
- e. A terminal strip must be mounted on the top of the master interconnect panel for controller interface.
- f. The master panel must interface with the T.B.C. terminals as described above.
- g. Each output must be fused as outlined above.

12. RAILROAD INTERCONNECT REQUIREMENTS

- 12.1 General. The railroad preemption will meet the requirements of the ICC (Illinois Commerce Commission) and the requirements of IDOT (Illinois Department of Transportation).
- 12.2 IDOT. The railroad preemption will meet all the requirements of the Illinois Department of Transportation's Standard Specifications for Road and Bridge Construction, adopted January 1, 2012. It must meet all the requirements of Article 1073.01 (c) (2) and Article 1074.03 (a) (5) e.
- 12.3 ICC. The railroad preemption will meet all the requirements of the Illinois Commerce Commission, as stated herein.
 - (1) The railroad preempt relays and the City traffic cabinet in general must be able to be wired as indicated in IDOT's Standard 857006-01 "SUPERVISED RAILROAD INTERCONNECT CIRCUIT". A failure in the interconnection circuit will result in activation of a supervisory failure alarm.
 - (2) Remote Flash. The Remote Flash input to the controller must be

inverted from normal NEMA logic. Instead of grounding the input to Logic Ground (0 volts DC) to activate, the Remote Flash will be normally grounded and will be activated when the input is in the Logic 1 (+24 volts DC) state. This will preclude the installation of a controller without the proper railroad software and a normal controller with standard (non-railroad) software will not be able to run the traffic signals.

- (3) Critical Components Series Loop. All critical components to railroad preemption such as relays and harnesses must utilize the 24 VOLT DC monitor voltage to form a series loop. Removal of any component will result in the traffic signals entering a flashing red condition. The 24 VOLT latch in the Management Malfunction Unit will be programmed, requiring manual reset if a failure in the series loop occurs.
- (4) Controller Preempt Input Verification. Like the supervisory interconnection circuit monitors the integrity of the interconnect cable, this feature monitors the integrity of the controller railroad preemption input and associated wiring within the traffic controller cabinet. This will utilize a secondary railroad preemption input that is normally active (on) when no demand for railroad preemption is present. When a demand for railroad preemption is received, the normal railroad preemptor input is applied and the secondary input is dropped. If both inputs are either simultaneously on or simultaneously off for a time period of more than one (1) second, the controller will recognize this as an input failure. When a failure occurs, the traffic controller will be configured to provide a track clearance interval followed by a flashing red condition. This occurrence will set a preempt input alarm and also will require a manual reset of the controller.
- (5) Track Clearance Green Re-service. Any demand for railroad preemption received at any point in the normal sequence, the emergency vehicle preemption sequence, a bus preemption sequence, or any other form of low priority preemption, or a previously called for railroad preemption sequence will result in the traffic controller providing a track clearance green indication within a “maximum time to track clearance green “ (usually 8 seconds depending upon site specific criteria) and will provide a full track clearance green time interval after the preemption demand was received. The controller software must have the capability to restart the railroad preemption sequence providing a full track clearance green interval from any point within the railroad preemption sequence from the start of track clear green through the entire dwell/hold interval(s) including any exit yellow

and red clearance intervals, if the demand for preemption drops and is reapplied. The number of times the controller is able to react to successive demands for railroad preemption must not be limited. This will be a software based routine that does not require any user programming and must be designed into the software.

- (6) Preemption Priority. Preemptor number 1 is typically assigned to a supervisory failure in the interconnection circuit and preemptor 2 is typically assigned to a normal railroad preemption demand. Preemptor 1 must have priority over preemptor 2. Preemptor 2 must have priority over all other forms of preemption.
- (7) Delay Time. In order to compensate for noisy or intermittent calls, the controller must have a programmable delay timing parameter for railroad preemptors, programmed at 1 second. Any demands for railroad preemption lasting less than this time will be ignored. This will apply to any subsequent demands for railroad preemption that may occur while the controller is still within the railroad preemption sequence from a prior demand.
- (8) Non-Locking Preemption. The controller must have the capability to configure the railroad preemptors as non-locking calls. If a demand for preemption is placed for a duration of less than 1 second (as programmed in the delay timer), the call will not lock and the controller will not initiate the preemption sequence. Furthermore, if an initial demand for preemption is dropped prematurely while the preemption sequence is still timing, the non-locking feature will allow the controller to re-service another demand for preemption.
- (9) Minimum Green before Preemption. The controller must have a separate minimum green timing parameter, programmed at 1 second, that replaces normal controller phase minimum green times when entering railroad preemption. When a demand for preemption is applied, any active phase(s) must terminate immediately or after they have been active for 1 second if the demand occurs at the start of the phase(s). If any indications that are part of the track clearance green are active when the demand for railroad preemption is placed, those indications will not terminate until after the track clearance green interval is completed.
- (10) Railroad Hold/Dwell Interval. The controller must have the capability to display a programmable phase(s) and rest in that phase(s) until the demand for railroad preemption is released. The controller must also have the option to cycle between a set of

programmable phases that don't conflict with the railroad crossing, or rest in an all-red steady state until the demand is released. The necessity for cycling during the hold interval or the use of an all-red steady state is determined by an assessment of the specific site. The controller must have a timing parameter that will provide a minimum hold/dwell time, even if the demand for preemption is dropped prematurely. The controller must be able to re-service any subsequent demands for preemption during this minimum hold/dwell time.

- (11) Railroad Hold/Dwell Extension. The controller must have a timing parameter that will extend the hold/dwell interval for a programmed time after the demand for railroad preemption has been released. The controller must be able to re-service any subsequent demands for preemption during this extension time.
- (12) Pre-signal Timing. When pre-signals are present in advance of a railroad crossing, during normal operation the pre-signal green indications terminate a programmable time (timed overlap) prior to the indications at the intersection. The duration of the timed overlap should not be reduced when leaving normal operation to service other forms of preemption, such as emergency vehicle or bus preemption. If a demand for railroad preemption occurs during the timed overlap portion of the normal sequence, the overlap timer must terminate and the track clear green interval must begin immediately, after the pre-signal yellow and red vehicle clearance intervals are completed.
- (13) Remote Monitoring and Alarms. Capabilities to remotely monitor the traffic controller must be provided, including the capability to monitor the operation of the controller, upload logs/events, and to verify the integrity of the database. In addition, the controller must have the ability to automatically report alarms, such as preempt 1 activation, preemptor input failure, automatic flash, CRC failure, 24 volt failure, and other defined alarms. The controller must have the ability to prevent the remote download of changes to the critical data protected by the railroad preemption security feature.
- (14) Blank-out Signs. If these signs are used for railroad preemption, they should activate immediately with the activation of the railroad interconnect circuit. They should deactivate immediately with the deactivation of the interconnect circuit, not after the controller exits the railroad preemption sequence. Whenever the traffic signals are in flashing red operation, cabinet circuitry must be such that the signs will remain operational if the interconnect circuit activates due to railroad warning device activation.

12.4 CRC. A CRC module with all connections, a USB memory device, software, and any other firmware necessary to make the CRC fully functional will be provided if so designated.

- (1) Hardware. A 16 bit CRC (cyclical redundancy check) module must be provided. The module will connect to the ATC controller using unused I/O pins. Reassignment of unused inputs on the NEMA 'A', 'B', and 'C' connector I/O pins or connection to a proprietary 'D' module's input pins will be acceptable. The final CRC value for the specific intersection requirements will be set on the module for that intersection. Removing the CRC module during normal operation of the intersection, or mismatching the values in the database and the CRC, will result in a fault condition and put the intersection in flash mode.
- (2) Software. The controller software/firmware will provide the logic and control facilities to fully implement CRC error detection. All the data elements (objects) required for the implementation will be contained in a proprietary data block. The software will provide a mechanism to "display" the final CRC value to be set on the CRC module.

A USB memory device will be utilized to 'lock' or 'unlock' the database. When the USB device is inserted into the controller, the controller will display a menu that will include a utility to 'unlock' the database. The USB device will contain a file structure that will allow access to the protected areas of the database. Once 'unlocked', the database can be edited through normal user interfaces. While the database is 'unlocked', the controller will drop the voltage/fault monitor signal to the conflict monitor to keep the intersection in flash. The CRC comparison check will be disabled during this period.

After all the changes to the database are completed, the user will use a utility on the USB to 'lock' the database. After the database is 'locked', another utility will allow the calculated CRC to be displayed. This can be used to configure the CRC module. After the CRC is connected and the USB is removed from the controller, the voltage/fault monitor signal to the conflict monitor will be enabled. A restart will be required to restart the controller.

Once the CRC module has been set (programmed), and the database has been locked, the controller can resume normal operation. The controller firmware will validate the stored CRC against the CRC module's value at least once per second.

13. WIRING

- 13.1 General. All electrical conductors must be stranded copper, with a minimum of nineteen (19) strands per conductor, and a concentrically applied 90° C. insulation with a 600 VAC rating. Wiring from the fuse block to the first distribution point, and to the controller bus, must be No. 10 AWG. Signal circuit wire must be No. 14 AWG. The wires must be provided with lugs or other approved terminal fittings for attachment to binding posts. All wiring between various parts of the controller must be neatly cabled. All wiring and terminal blocks must be tested for possible short circuits and resistance to ground by a high voltage dielectric test at 1,200 VAC. A wiring harness of adequate length must be provided to the timing device to allow the timer to be placed on top of the cabinet when required.
- 13.2 All VAC connections to load switches, flasher, and flash transfer relays must be soldered. All VAC connections on back of terminals must be soldered.
- 13.3 All VDC connections on back of terminals, and load switches must be soldered or connected with pre-approved terminations. All VDC connections to load switches are to be soldered or connected in a manner pre-approved by the City of Chicago's Division of Electrical Operations.

14. TESTING REQUIREMENTS

- 14.1 General. The testing on the controllers must be done as described herein. Environmental testing must be done at the manufacturer's facilities or at an independent laboratory, and must be certified by the manufacturer or the independent laboratory. Functional testing will be done at the City's facilities. All controllers provided under the contract must be tested as stipulated under "Functional Burn-In Testing" and "Physical Inspection" at the manufacturer's facilities. If a controller is ordered for a specific location, the manufacturer shall program and test the controller at the factory and certify the test results.
- 14.2 N.E.M.A. Environmental Test. One controller, unless approved previously, must be tested, at the manufacturer's expense, in accordance with Part 2 of NEMA Standards Publication TS1-1983. All of the tests listed must be performed with all data properly recorded and certified. If the manufacturer changes the design, fabrication or components of a previously tested and approved controller, then a sample of the controller containing the new design, fabrication or components must be retested at the manufacturer's expense. Any N.E.M.A. environmental test references to minimum recall must include but not be limited to: All sixty-four (64) output circuits must be programmed in a sequence to simulate the normal functioning of the entire controller cabinet assembly; the conflict monitor must have a test board with the allowable channel jumpers installed to simulate normal operation; All

thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval.

- 14.3 Functional "Burn In" Testing. The manufacturer of the controller must perform, at his manufacturing facilities, a one hundred (100) hour burn-in test on every controller, conflict monitor, and appurtenant devices. This test period must be certified by the manufacturer with supportive documentation and must include the device serial number, dates and times of test periods, and results. Any failed, or nonconforming components, must be replaced at this time. After each of the components has passed the burn-in test, they may be used in the assembly of the complete controller unit. Each completed unit must be subjected to the seventy-two (72) hour function test as described in this specification. The "burn in" requirement must include a test that uses all sixty-four (64) output circuits in "solid" burn as well as 1 pps and 5 pps for each circuit. All thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval. The documentation for a test program to simulate the normal functioning of the controller phasing must be supplied. A copy of the test program must be approved by the City of Chicago, Division of Electrical Operations prior to testing. Certification of these tests must be attached to the outside of the shipping container. This certification is in addition to any other documentation and/or testing required by these specifications.
- 14.4 Testing Requirements. In addition to the NEMA environmental test and the "burn-in" requirements stated above, satisfactory performance of the traffic signal cabinet and its equipment must be demonstrated. The manufacturer must submit five (5) copies of his proposed "Test Procedure Document" for approval with the sample requested above. The test procedure must consist of two (2) sections; physical inspection and functional testing. If the test procedure is judged by the Commissioner or his duly authorized representative to be incomplete, inadequate or otherwise deficient, the contractor must revise and resubmit his "test procedure document" until it is approved. No controller will be accepted until the "test procedure document" has been approved. Functional testing must include, but not be limited to, phasing for multiple legged intersections, bridge and railroad pre-empts, flash operation, actuation, and any combinations of these features. Controllers designed to function without railroad pre-empts must be shown to function without the presence of a railroad interconnect. Options for downward compatibility when replacing either HMC1000 controllers or LMD40 controllers must also be demonstrated. In addition, it should be demonstrated that the controller functions within the MIST system. Any failure must be addressed by the manufacturer within the time frame allotted.
- 14.5 UPS. Testing of the equipment must verify that the operation meets the requirements of this specification. All equipment must be shown to operate correctly, including the rectifier, charger, inverter, batteries, and control unit.

The UPS must be connected to a dummy load at the factory and tested for performance under various conditions of line voltage and frequency, varying loads, temperature range, and humidity range. The automatic switching must be successfully demonstrated; losing line power and restoration of line power must not adversely affect the operation of the traffic signals. Use of the manual bypass switch must be successfully demonstrated. A generator must be connected to the unit and successfully operate the system without interruption. The batteries must be shown to be able to operate the traffic signals for the specified time. The batteries must be shown to be able to be recharged in the specified time between failures. The control unit, including the LCD display and the RS-232 interface, must be shown to function according to this specification. All reports and event monitoring must be successfully demonstrated. Programming functions must also be shown to work properly.

14.6 Physical Inspection. The "physical inspection" portion of the test procedure document must require the manufacturer to perform a physical inspection of workmanship and specification compliance for each traffic signal controller assembly. The inspection must be done using a detailed check list defining items to be inspected and criteria for acceptance. The inspection must include, but not be limited to, the following items:

- (1) Hardware installation.
- (2) Assembly mounting.
- (3) Dimensions.
- (4) Presence of specified devices and materials.
- (5) Presence of required documents.
- (6) Labeling and required serial numbers.
- (7) Wiring including routing, covering, gauge, length, and soldering of terminations.
- (8) Arrangement of equipment for safety and ease of calibration reprogramming troubleshooting and maintenance.
- (9) Condition of cabinet body and finish.
- (10) Condition and installation of doors, panels, gaskets and ventilation.
- (11) High voltage test of insulation resistance to ground, with wires installed in cabinet and equipment disconnected.

14.7 Functional Testing. The "functional testing" portion of the Test Procedure must require the manufacturer to perform a complete room-temperature functional test of each complete traffic signal controller assembly for a minimum of seventy-two (72) hours. This test must be designed to concurrently check integrated hardware systems e.g., from simulated input to load switch output including conflict monitor and time base coordinator. All interface/controller interconnections must be tested. All load switch and interconnect relay positions must be tested, regardless of the number of load switches and interconnect relays being purchased. The functions tested must

include, but not be limited to, the following:

- (1) Flash logic and operation (color, phases).
- (2) Conflict monitor logic and operation.
- (3) Police panel switch operation.
- (4) Auxiliary panel switches (including fans).
- (5) Interface panel.
- (6) Time switch operation.
- (7) Load switches (with a continuous ten (10) ampere load on each signal circuit).
- (8) Outputs.
- (9) Power interruptions of less than 500 ms.
- (10) Power interruptions of more than 1.0 sec.
- (11) Generator Hook-up.

15. SHIPMENT AND DELIVERY (Only applies to City commodity contracts)

- 15.1 Packaging. The cabinets must be shipped on individual pallets. Each cabinet must be individually wrapped and protected so that it can be handled without damage to the cabinet or its finish. The UPS and cabinet must be wrapped to give protection from the elements, as well as from shipping. If subassemblies or parts are ordered they must be suitably packaged to prevent damage during shipping and handling. All packages should be clearly labeled indicating the contents.
- 15.2 Delivery. The assembled cabinets, or subassemblies and parts, must be delivered to the Division of Electrical Operations at 2451 S. Ashland Avenue, unless otherwise directed. Assembled cabinets, or subassemblies and parts, must be available for testing and shipping within six weeks of the placement of an order.

CHICAGO ATC MATRIX - TABLE A

(ATC Standard Version 5-2b June 26, 2000)

Since the ATC standard specifies a “family” of controllers, the following options have been selected from the ATC standard to meet the City’s needs.

Functional Requirement	ATC Clause #	Status	Details
Shelf Mounted	2.2.1 4.3.2.1	Required	(Shelf mount only)
Use of ATC Engine Board	2.2.2 4.3.2.2 5.1.1 5.1.2 5.3.2 5.3.4 5.3.5 5.3.5.1 5.4.2 5.4.3 5.4.4 5.4.5	Required	
Use of ATC Engine Board	5.2.1	Required	<ul style="list-style-type: none"> Allowed component height below Engine Board PCB provided that the overall envelope remains unchanged, the clearance between the Host Board and Engine Board remains as specified, and the Engine Board still fits into a compliant Host Board
Use of ATC Engine Board	5.2.2 5.4.5	Required	<p>In order to show the Ethernet communications to the Engine Board, the following “Reserved” pins can assume the following legacy functions:</p> <ul style="list-style-type: none"> P1-34: ENET2 Speed P1-35: ENET2 Link/Activity P1-36: ENET1 Speed P1-37: ENET1 Link/Activity
Use of ATC Engine Board	5.3.1	Required	Minimum CPU capability of 500 MIPS
Use of ATC Engine Board	5.3.3	Required	Additionally, must provide a minimum of 16 MB of Flash total to accommodate future applications.
Use of ATC Engine Board	5.4.1	Required	<ul style="list-style-type: none"> Engine Board shall not draw

			<p>more than 4W of power from VPRIMARY (due to battery backup in Chicago)</p> <ul style="list-style-type: none"> • Engine may supplement VSTANDBY_5 with on-board storage for its standby power.
Use of ATC Engine Board	5.4.3	Required	<ul style="list-style-type: none"> • All optional baud rates shall be supported
Parallel I/O	2.2.4	Required	<ul style="list-style-type: none"> • No support required for TS2 Type 1 or ITS cabinets • Must provide parallel I/O for TS2 Type 2 cabinets and legacy parallel I/O interfaces via interchangeable modules
Linux O/S and ATC BSP	2.2.5 4.3.1 4.3.3	Required	
Linux O/S and ATC BSP	2.2.5 4.3.1 4.3.3	Required	
Linux Kernel	Annex A	Required	
Parallel I/O	3.4	Required	Not required to support ITS Cabinet standard (NEMA cabinets are used)
Manage Clock/Calendar functions and synchronize with external source	3.5.1.3	Required	Must also support synchronization with absolute zero.
Manage Clock / Calendar functions and synchronize with External Source	4.1.3	Required	<ul style="list-style-type: none"> • BSP RTC driver shall automatically update the RTC with the OST time once per second with an accuracy of 0.1 seconds • Successive interruptions (e.g. on for 5 minutes, off for 3 minutes over a period of 8 hours) shall not introduce cumulative error
Configure and Verify Parameters	3.5.1.4 4.1.4	Required	
Upload/Download blocks of data	3.5.1.5 4.1.5	Required	

Monitor & Verify Application Status	3.5.1.6 4.1.6	Required	
Operator Control of Application Execution	3.5.1.7	Required	<u>Only</u> a local operator is allowed to manage the starting, stopping and scheduling of one or more applications on the ATC.
Operator Control of Application Execution	4.1.7	Required	
Long Term Storage of Log Data, etc	3.5.1.8 4.1.8	Required	
Support Diagnostics	3.5.3.3 4.3.4	Required	
Modes of Operation	3.7	Required	(Must support Standalone, Direct, and Distributed modes of operation)
Manage/Control a Variety of External Devices	4.2.1	Required	<ul style="list-style-type: none"> • Fixed Ports on the front panel shall be specified by the City • Only SP1 and SP2 are required to be supported on the modem slot • The dedicated synchronous serial port (SP5) is to be used exclusively for supporting a parallel I/O module (NEMA TS2 or legacy interface)
Monitor the Status of External Devices	4.2.2	Required	<ul style="list-style-type: none"> • Fixed Ports on the front panel shall be specified by the City • Only SP1 and SP2 and required to be supported on the modem slot • The dedicated synchronous serial port (SP5) is to be used exclusively for supporting a parallel I/O module (NEMA TS2 or legacy interface)
Support future Hardware Upgrades	4.3.2	Required	
Environmental Requirements	5.2.3	Required	
Front Panel Serial Ports	6.2.3.1 6.1.3 6.3.2.1	Required	One serial port on the front panel shall satisfy this section as an EIA-574 (25-pin) and be labeled "Port 2".
Front Panel Serial Ports	6.2.3.1 6.3.2.1	Required	One serial port shall satisfy this section as an EIA-574 (9-pin) with a reduced

			pin-out (TXD, RXD, and DC Reference at a minimum) and be labeled “Port 4”. C50_ENABLE shall not be supported. A second serial port shall fully satisfy this section as an EIA-574 (25-pin) and be labeled “Port 5.”
Front Panel Serial Ports	6.2.3.2 6.1.3 6.3.2.2	Required	One serial port shall satisfy this section as an EIA-485 (15-pin) with the TS2 Type 1 Port 1 pin-out and be labeled “Port 1”.
Front Panel Ethernet Ports	6.2.3.9 6.3.2.9 7.1.4.4	Required	There shall be a minimum of two Ethernet ports on the Front Panel (one for ENET1, one for ENET2)
User Interface	7.1 7.1.1.2 7.1.4.4 7.1.4.5 7.1.4.7	Required	
User Interface	7.1.1	Required	Must meet City’s Minimum requirements
User Interface	7.1.1.1 7.1.2.1 7.1.3 7.1.4.1 7.1.5	Required	<ul style="list-style-type: none"> • Data key is not required • Front Panel Interface is to be integral to the controller (i.e. not removable, no SP6 connector) • “Option 1” to be selected but AUX switch is optional • Keypad shall have a minimum of 24 keys • LCD Display shall be graphical with a minimum resolution of 128 rows x 240 columns (up to 16 lines x 40 characters). • LCD pixel size shall be a minimum of 0.32mm x 0.32mm with a minimum pitch of 0.325mm with character size defined as 6 pixels wide x 8 pixels high • Refresh rate is a minimum of 10 times per second (due to larger display requirements) • LCD heater is mandatory to ensure sub-second LCD display

			<p>response over full temperature range. Heater shall only be active when needed and User is interacting with the controller locally (due to battery backup requirements).</p> <ul style="list-style-type: none"> Heater Power shall be up to 15V at 1A current maximum
Power Supply	7.2 7.2.2 7.2.3 7.2.4 7.2.5 7.2.5.1 7.2.5.2 7.2.6.1 7.2.6.2 7.2.6.3 7.2.6.4 7.2.6.6	Required	12 V not required As applicable for NEMA cabinets only
Mechanical/Chassis	7.3.1.3 7.3.1.4	Required	<ul style="list-style-type: none"> Only Shelf mounted units are acceptable Only components / connectors specified by the City shall be located on either the Front or Rear panels. No C1 Type Connectors allowed.
I/O Interfaces	8.1.1 8.2.2 8.2.2.1 8.2.2.2 8.2.2.3	Required	<ul style="list-style-type: none"> Support for TS2 Type 2 and TS1 Interfaces
I/O Interfaces	8.1.2 8.2.2.5	Required	<ul style="list-style-type: none"> Support is only required for NEMA TS2 Type 2, TS1, and other similar legacy interfaces NEMA TS2 Port 1 shall also be provided (for detectors only)
I/O Interfaces	8.2.3	Required	Port 1 Connector shall be provided as specified within this section (only used for detectors)
I/O Interfaces	8.2.1.13	Required	Legacy I/O interfaces shall respond as

			required.
I/O Interfaces not required	8.2.1	Required	<ul style="list-style-type: none"> No support for Model 332 Cabinets or ITS Cabinets & devices is to be provided
Environmental & Test Procedures	9	Required	All subsections are required
Performance & Material Requirements	10	Required	All subsections are required
Performance & Material Requirements	10.1.15	Required	All PCBs and similar construction mechanisms shall be mounted vertically (i.e. no horizontal PCBs are allowed).
Quality Control	11	Required	All subsections are required

**ELECTRICAL SPECIFICATION 1565
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED SEPTEMBER 22, 2009**

**TRANCLOSURE/ 100KVA TRANSFORMER (SINGLE PHASE)
12KV PRIMARY WITH 120-240V SECONDARY PANEL**

SUBJECT

1. This specification states the requirements for a single phase transformer and secondary panel in a cabinet. The transformer will take 12,470V line voltage and produce 120 and 240 volt secondary voltage which can then be used for street lighting and traffic signal power. The transformer will be rated at 100KVA. The 120/240 volt secondary panel will have adequate breakers, properly sized, to accommodate the street lighting and traffic signal circuits. The cabinet will be affixed to a concrete foundation.

GENERAL

2. (a) Specifications. The transformer and equipment must meet all applicable ANSI, NEMA, ASTM, and IEEE specifications, including but not limited to, ANSI C37.47 "Specifications for Distribution Fuse Disconnecting Switches", and ANSI C57.12 "General Requirements for Liquid Immersed Distribution Transformers". The cabinet must meet or exceed the requirements of a NEMA rating 3R and must be U.L. listed.
- (b) Acceptance. Transformers and cabinets not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Electrical Operations, and must be interpreted as part of these specifications cooperating to state necessary requirements.
- (d) Sample. One complete transclosure with transformer and equipment of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such a request. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (e) Warranty. The manufacturer must warranty the transformer, equipment, and cabinet against flaws in material or workmanship for a period of one (1) year

from the date of installation. Any transformer, equipment or cabinet developing flaws within this period must be replaced by the manufacturer, including shipment, at no cost to the City.

TRANSFORMER

3. (a) The transformer shall be a single phase pole mount type transformer. The transformer shall be rated at 100KVA. Line (input) voltage shall be 12,470 volts. Secondary (output) voltage shall be both 120 and 240 volts. The transformer shall be rated at 60 hertz alternating current. The transformer must have a high BIL rating (at least 95kv).
- (b) Oil. The transformer shall be oil immersed and self cooled. It shall be capable of continuous operation at the rated KVA without exceeding either a 65° Celsius average temperature rise or an 80° Celsius hot spot temperature rise. The transformer shall be insulated with new, unused mineral oil meeting the requirements of ANSI C57.12, ANSI C57.106, and ASTM 3487 Type II.
- (c) Taps. The transformer shall have external taps on the primary coil side. Taps shall accommodate voltage changes of both $\pm 2.5\%$ and $\pm 5.0\%$ to offset variations in the line voltage.
- (d) Pressure Relief Device. The transformer shall be equipped with a pressure relief device such that excessive pressure build-ups are released without damage to the tank in accordance with ANSI C57.12.25.
- (e) High Voltage Bushings. The transformer shall be equipped with two cover-mounted, wet process porcelain high voltage bushings with clamp style terminals in accordance with ANSI C57.12.20, Table 7.
- (f) Low Voltage Bushings. The transformer shall be equipped with two low voltage bushings with clamp type terminals in accordance with ANSI C57.12.20, Figure 4a.
- (g) Ground Lug. The transformer shall have a ground lug furnished in the low voltage ground provision.
- (h) Interference. The transformer shall be designed to meet REA telephone influence factor requirements, as detailed in REA Specification D-10. The radio influence voltage shall not exceed 100 micro-volts at one Megahertz measured at 110% of the rated voltage, per REA Specification D-10. Noise levels shall not exceed the values specified in NEMA Publication TR 1-0.11.
- (i) Transformer tank. The tank shall be of welded steel construction with a sloped cover for moisture run-off. An insulated coating on the cover should be able to withstand a minimum of 10kV at a 2000 volt/second rate of rise,

tested per ASTM D149 using ¼ inch electrodes.

The tank shall be given a phosphate bath, or sand blasted, then primed with epoxy or vinyl primer (2 mils), and painted with a final coat of a semi-gloss gray polymer (1 mil). The inside of the transformer shall be painted likewise from a point two inches below the oil level up to the top.

A permanent nameplate must be attached to the tank at a convenient point. It shall include pertinent operating information, oil information, and indicate the PCB level (less than 1 ppm).

CABINET REQUIREMENTS

4. (a) **Cabinet.** The cabinet must be sized as shown on Electrical Standard Drawing 891. The cabinet shall meet all of the requirements of Electrical Standard Drawing 891. The cabinet must be rated NEMA 3R. A door restraint must be provided to prevent the door from moving in windy conditions.
- (b) **Doors.** The cabinet shall have two doors, one on the front and one on the back of the cabinet. Each door opening must be double flanged on all four sides. Each door must be hinged on the right side when facing the cabinet. Each door must have a gasket that meets the requirements found in U.L.508 Table 21.1. The gasket must form a weather-tight seal between the cabinet and the door. Each door, when closed, must be flush with the cabinet.
- (c) **Hinges.** Hinges must be continuous and bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts and nylock nuts. Hinges must be made of .093 inch thick aluminum. The hinge leaves must not be exposed externally when the door is closed. Only the hinge knuckles must be visible upon closing the door. The hinge pin must be .250 inch diameter stainless steel and must be capped top and bottom by weld to render it tamper-proof.
- (d) **Latching.** The latching mechanism must be a three-point draw roller type. The pushrods must be aluminum. The rollers must be nylon with a minimum diameter of .875 inches. The center catch must be .187 inch aluminum, minimum.
- (e) **Handles.** Handles must be stainless steel with a .750 inch diameter shank. Handles must have provision for a padlock. The lock must be keyed dead bolt #200725 or equivalent. Two (2) keys must be provided for each cabinet.
- (f) The cabinet shall have an insulated barrier between the high voltage compartment and the low voltage compartment. A dead panel must be on the secondary side of the cabinet.
- (g) **Workmanship.** All control cabinets must be free of flaws, and must have

neat, smooth exterior surfaces. All holes must be accurately located and drilled. All welds must be neatly formed and free of cracks, blow holes, or other irregularities. All inside and outside edges must be free of burrs.

- (h) Painting. The cabinet, door and other parts must be treated by an iron phosphate conversion technique. After which all the parts must be baked dry. A polyester powder coat must then be applied. The inside of the cabinet and door must be white. The outside of the cabinet and door must be gloss black, or another color as specified. A paint chip must be provided upon request.

EQUIPMENT LAYOUT

- 5. (a) The equipment shall be placed as shown on Electrical Standard Drawing 904. The transformer and high voltage equipment will be placed in the high voltage compartment. The secondary panel will be placed in the low voltage compartment.
- (b) Cable for the line voltage shall be rated at 15kv. Arc strangler load-break devices with fusing shall be used as disconnects for the line voltage. The primary side must have adequate over-current protection.
- (c) In the low voltage compartment will be the low voltage panel board which shall be laid out according to the specific project requirements, or as directed by the engineer.

SECONDARY PANELS

- 6. (a) Each panel must be composed of phenolic plastic ½ inches in thickness, or an approved equal. Each panel must be securely bolted to the cabinet using stainless steel hardware.
- (b) Typically for a 200 amp – 2 pole controller, the panel will comply with Electrical Standard Drawing 884. A specific panel layout will be required for each transclosure on a specific project.

SECONDARY ELECTRICAL COMPONENTS

- 6. (a) All components will be as indicated on Electrical Standard Drawing 862, or will be approved equals. Circuit breakers must have thermal magnetic trips. Each breaker must be enclosed in a hard insulated housing. All breakers must be UL listed. The photo-cell relay, must meet City specifications.
- (b) Wiring will be as indicated on Electrical Standard Drawing 862. All wire will have stranded copper conductors, unless indicated otherwise. All wires must be insulated with an approved 125° Centigrade insulation.

- (c) Separate ground and neutral bars shall be provided. Each shall be labeled accordingly. The ground and neutral bars will be permanently connected to each other with a properly sized bare copper wire.

TRANSCLOSURE

- 7. The transclosure must be complete with cabinet, transformer, secondary panels, breakers, contactor, relays, photocell, fusing, and all necessary wiring.

**ELECTRICAL SPECIFICATION 1579
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
JULY 8, 2011**

**HANDHOLE: 30 INCH FIBERGLASS, WITH 24 INCH COMPOSITE COVER
AND FRAME**

SUBJECT

1. This specification states the requirements for a handhole with frame and cover to be used in the ground. The handhole is to be installed in a parkway or a sidewalk, but is not meant to be installed in a street. The handhole, frame, and cover will be entirely dielectric. The handhole will be able to accept conduits and cable for underground street lighting and/or traffic signal circuits. The handhole will provide easy access for cable pulling, troubleshooting cable, and provide for directional changes of cable.

GENERAL

2. (a) Information Required. Each bidder shall submit with his proposal the following information relative to the handhole and/or frame and cover he proposes to furnish:
 1. Shop drawings with all critical dimensions.
 2. Complete description of materials and weights.
 3. Manufacturer's name and catalogue designations.
- (b) Sample. One completely assembled handhole with frame and cover of the manufacture intended to be furnished, shall be submitted upon request of the Chief Procurement Officer within fifteen (15) business days from receipt of notice.
- (c) Technical Organizations.

AASHTO: American Association of State Highway and Transportation Officials
ANSI: American National Standards Institute
ASTM: American Society for Testing and Materials
SCTE: Society of Cable Telecommunications Engineers
- (d) Warranty. The manufacturer shall warrant the performance and construction

of the handhole, frame, and cover to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of three (3) years after the material has been delivered and accepted by the City. Any handhole, frame, or cover, or part thereof, not performing as required, or developing defects within this period must be replaced by the manufacturer without expense to the City. The Commissioner will be the sole judge in determining which replacements are to be made and his decision will be final.

FRAME AND COVER

3. (a) **Material.** The frame and cover shall be formed of polymer concrete. The polymer concrete shall consist of calcareous and siliceous stone, glass fibers, and thermosetting polyester resin. The covers shall be reinforced with fiberglass mats for strength.
- (b) **Appearance.** The frame and cover shall have the overall dimensions as shown on Standard Electrical Drawings 966 and 968. The 24 inch cover shall be interchangeable with any 24 inch cast iron cover currently in use by the City. Covers will be skid resistant. Covers and frames shall be light gray in color. Covers and frames shall fit so that the cover will not have any part of it protruding above the frame edge.
- (c) **Structural Integrity.** The frames and covers shall be rated for ASSTHO H-10 loading and meet the test requirements for ANSI/SCTE 77 Tier 15 loading. The cover shall weigh a minimum of 80 pounds.
- (d) **Extension.** A two inch frame extension made of the same material as the frame shall be provided for use in adjusting the height of the handhole to grade. The extension shall have the dimensions as shown on Standard Electrical Drawing 968. Extensions shall be able to be stacked to provide height variations in two inch increments.
- (e) **Cover Removal Tool.** The tool shall be approximately 30 inches in length. This tool shall be used to easily remove or replace the cover by hooking one of the steel inserts in the cover.

HANDHOLE

4. (a) **Material.** The body of the handhole shall be made of fiberglass.
- (b) **Size.** The handhole shall have a depth of 36 inches and an overall nominal diameter of 30 inches (the diameter will vary depending upon the slant of the wall). The internal volume of the handhole shall not be less than 14 cubic feet. The bottom of the handhole shall be open. The top of the handhole shall

have an opening of not less than 24 inches in diameter. The sides shall be slanted so that the handholes can be stacked within each other (nested). This will facilitate shipping and storage.

- (c) Structural Integrity. The vault shall be rated for ASSTHO H-10 loading and meet the test requirements for ANSI/SCTE 77 Tier 15 loading. The walls of the handhole shall accommodate up to five conduits (2 to 4 inches inside diameter, PVC schedule 80) without compromising the strength of the handhole.
- (d) Cable Brackets. Galvanized steel brackets, as dimensioned on Standard Drawing 967, shall be provided. Four brackets shall be provided for each handhole. Stainless steel mounting hardware for each bracket shall be included, along with installation instructions.

TESTING

- 5. (a) Testing. All testing shall be done and certified by an independent testing facility.
- (b) Interchangeability of covers with different frames, including existing City cast iron frames shall be demonstrated. Covers shall fit snug. The top of the cover and the lip of the frame shall be level. Neither shall protrude above the other at any point.
- (c) Tests shall be performed that demonstrate the structural requirements of the frame, cover, and the handhole.
- (d) Material Testing. Polymer concrete shall meet the latest acceptance criteria for the following ASTM tests:

TEST	ASTM	VALUE
Water absorption	D570	<2%
Slip resistance	C1028	0.60 minimum
Compressive strength	C695	10k psi minimum
Flexural strength	C580	18k psi minimum
Flexural modulus	C580	1,750k psi minimum
Shear strength	D372	8k psi minimum
Abrasive wear	D2486	<0.035 after 2k cycles
Surface flammability	E162	<25
Smoke density	E662	<0.5@1%: <15@4%
Flame extinguishing	D635	Pass
Gardner impact	D5420	No damage
Simulated sunlight	D1501	Pass
Accelerated service	D756-E	Pass
Chemical resistance	D543	No discoloration, strength

		loss
Freeze thaw	C1026	No damage
Fungus resistance	G21	Pass
Salt spray	B117	Pass

PACKAGING

6. (a) Packing. Frames, covers, and handholes shall be secured to pallets. Cable hooks shall be separately packaged, labeled and attached to the pallets for handholes.
- (b) Marking. Each pallet must have a securely attached label clearly marked in letters not less than three-eighths (3/8) of an inch high indicating the contents of the pallet, including quantity, the appropriate City Commodity Code, the name of the manufacturer, the date of manufacture, and the contract number under which the material is furnished.

**ELECTRICAL SPECIFICATION 1590
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
JUNE 4, 2013**

METERED RECEPTACLE CONTROLLER

SUBJECT

1. This specification states the requirements for a receptacle controller and aluminum cabinet for use in controlling receptacles on arterial streets, as well as irrigation systems, clocks, etcetera. These circuits will be metered. The cabinet shall be mounted on top of a ballast base housing, which will be affixed to a concrete foundation. A meter cabinet will be affixed to the outside of the controller cabinet.

GENERAL

2. (a) Specifications. The controller shall conform in detail to the requirements herein stated, to the Federal Standard cited by number, and to the specifications and methods of test of the American Society for Testing and Materials, cited by ASTM Designation Number, in which the most recently published revision will govern. Cabinets must meet or exceed the requirements of a NEMA rating 3R and must be U.L. listed.
- (b) Acceptance. Controllers and cabinets not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Electrical Operations, and must be interpreted as part of these specifications cooperating to state necessary requirements.
- (d) Sample. One complete controller in cabinet of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such a request. The sample must be delivered to the attention of the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (e) Warranty. The manufacturer shall warranty the controller and cabinet against flaws in material or workmanship for a period of two (2) years from the date of delivery. Any controller or cabinet developing flaws within this period must be replaced by the manufacturer, including shipment, at no cost to the City.

DRAWINGS

3. (a) The controller cabinet must conform in detail to requirements shown on Drawing 973.
- (b) All electrical components and wiring must be as shown on Drawing 974.

CONTROLLER CABINET REQUIREMENTS

4. (a) **Material.** The cabinet and the door assembly must be constructed of 5052-H32 sheet aluminum alloy, with a minimum thickness of .125 inches. The base plate must be sheet aluminum of .250 inch thickness.
- (b) **Dimensions.** The overall outside dimensions of the control cabinet must be 36 inches in height by 20 inches in width by 15 inches in depth. Cabinets must have sloped tops to shed water.
- (c) **Cabinet.** The cabinet must be sized as shown on Drawing 973. The cabinet door opening must be double flanged on all four (4) sides. A door restraint must be provided to prevent the door from moving in windy conditions.
- (d) **Door.** The door size must be a minimum of 80% of the front surface area. The door must be hinged on the right side when facing the cabinet. The door must have a gasket that meets the requirements found in U.L.508 Table 21.1. The gasket must form a weather-tight seal between the cabinet and the door. The door, when closed, must be flush with the cabinet.
- (e) **Hinges.** Hinges must be continuous and bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts and nylock nuts. Hinges must be made of .093 inch thick aluminum. The hinge leaves must not be exposed externally when the door is closed. Only the hinge knuckles must be visible upon closing the door. The hinge pin must be .250 inch diameter stainless steel and must be capped top and bottom by weld to render it tamper-proof.
- (f) **Latching.** The latching mechanism must be a three-point draw roller type. The pushrods must be aluminum. The rollers must be nylon with a minimum diameter of .875 inches. The center catch must be .187 inch aluminum, minimum.
- (g) **Handle.** The handle must be stainless steel with a .750 inch diameter shank. The handle must have provision for a padlock. The lock must be keyed dead bolt #200725 or equivalent. Two (2) keys must be provided for each cabinet.
- (h) **Ventilation.** Louvered vents must be provided in the door. Louvers must satisfy the NEMA rod entry test for 3R enclosures. A removable filter must

cover the louvers from inside the door. The filter must be held firmly in place with top and bottom brackets and a springloaded clamp. Exhaust air must be vented out between the top of the cabinet and the door. The exhaust area must be screened with openings of .12 inch by 1.0 inch.

- (i) Equipment Mounts. The cabinet must be equipped with two (2) adjustable C channels on both side walls and on the back wall. The internal dimensions of the channels must be 1.075 inches high by .625 inches wide. All mounting hardware must be furnished.
- (j) Workmanship. All control cabinets must be free of flaws, and must have neat, smooth exterior surfaces. All holes must be accurately located and drilled. All welds must be neatly formed and free of cracks, blow holes, or other irregularities. All inside and outside edges must be free of burrs.
- (k) Painting. The cabinet, door and other parts must be treated by an iron phosphate conversion technique. After which, all the parts must be baked dry. A polyester powder coat must then be applied. The inside of the cabinet and door must be white. The outside of the cabinet and door must be green meeting No. 14110 of Federal standard Number 595, or a gloss black, or another color as specified. A paint chip must be provided upon request.

PANEL

- 5. (a) The panel must be composed of phenolic plastic ½ inch in thickness, or an approved equal. It must be securely bolted to the cabinet using stainless steel hardware.
- (b) The panel shall be sized for the specific application. All holes for attaching components shall be pre-drilled. All components shall be surface mounted.

ELECTRICAL COMPONENTS

- 6. (a) All components will be as indicated on Drawing 974, or will be approved equals. Circuit breakers must have thermal magnetic trips. Each breaker must be enclosed in a hard insulated housing. All breakers must be UL listed. The photo-cell relay, if required, must meet City specifications.
- (b) All wiring shall be accomplished so that all circuits in the cabinet are metered.
- (c) Wiring will be as indicated on the appropriate drawing. All wire will have stranded copper conductors, unless indicated otherwise. All wires must be insulated with an approved 125° Centigrade insulation.
- (d) The main breaker will be a 2-pole rated for 100 amp service. Incoming power

will be 240 volt. All secondary breakers will be 1-pole rated for 20 amp service, 120 volt. All breakers for receptacles will be photo-cell controlled through an automatic electronic switch. All circuits for irrigation, clocks, etcetera will be wired ahead of the automatic electronic switch for continuous power.

METER SOCKET AND ENCLOSURE

7. (a) The meter cabinet shall be attached to the controller cabinet in the position as shown on drawing 973. The cabinet shall be bolted to the controller cabinet with at least four bolts. Appropriate holes shall be drilled in the controller cabinet for the power cable to enter and leave the meter fitting.
- (b) The enclosure shall be rated NEMA Type 3R. The enclosure shall be lockable. A lock and two keys shall be provided. The lock shall meet the requirements of Commonwealth Edison.
- (c) The meter socket shall be single position four terminal. It shall be rated 125 amp and 600 VAC. It shall be ringless. The socket shall meet the applicable requirements of ANSI C12.7. Meter fitting must be CECHA approved, and labeled as such.

**ELECTRICAL SPECIFICATION 1591
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
MARCH 10, 2014**

BREAKAWAY POLE BASE

SUBJECT

1. This specification states the requirements for a breakaway pole base. The base shall be made to bolt to an existing light pole foundation. In turn, a light pole shall be bolted to the top of the base. The base shall be frangible and when impacted with sufficient force it shall break, allowing the pole to fall.

GENERAL

2. (a) Specifications. The base shall conform in detail to the requirements herein stated and to the requirements of the following organizations as cited herein:

American Association of State Highway and Transportation Officials (AASHTO)
American Society for Testing and Materials (ASTM)
American Welding Society (AWS)
Society for Protective Coatings (SSPC)
- (b) Acceptance. Bases not conforming to this specification will not be accepted.
- (c) Drawings. The drawing mentioned herein is a drawing of the Department of Transportation and must be interpreted as part of these specifications cooperating to state necessary requirements.
- (d) Sample. One complete base of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such a request. The sample must be delivered to the attention of the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (e) Warranty. The manufacturer shall warranty the base against flaws in material or workmanship for a period of five (5) years from the date of delivery. Any base developing flaws within this period must be replaced by the manufacturer, including shipment, at no cost to the City.

REQUIREMENTS

3. (a) The base shall be formed of aluminum meeting the requirements of ASTM B-108 alloy 356-T6.
- (b) The base must meet the breakaway requirements of the latest version of AASTHO's Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
- (c) The breakaway base shall be shaped as a transformer type pole base, as shown on Drawing CS-370. It shall be dimensioned as shown in the standard drawing. The base shall meet all of the requirements of standard drawing CS-370.
- (d) Connecting bolts, washers, and nuts shall be provided as part of this specification. There shall be four 1-1/4" (7NC) by 4.5" long galvanized hex head bolts (SAE GR5). There shall be four 1-1/4" (2- 3/4" outside diameter) galvanized washers. There shall be four 1-1/4" galvanized hex nuts.

PAINTING

4. (a) Oil and Grease Removal. All metal surfaces shall be washed with an alkaline detergent.
- (b) Metal Cleaning. All surfaces shall be cleaned by shot blasting in accordance with SSPC-SP10.
- (c) Chemical Pretreatment. The base shall then be treated with a hot pressurized iron phosphate wash and shall then be immediately dried by convection heat.
- (d) Primer Coat. All surfaces are to be coated with a zinc-rich urethane to a minimum dry film thickness of 2.5 mils.
- (e) Finish Coat. All surfaces are to be subsequently coated with an acrylic polyurethane to a minimum dry film thickness of 3 mils.
- (f) Durability. The paint must be capable of passing 1000 hours of salt spray exposure as per ASTM B117 in a 5% NaCl (by weight) solution at 95° F. and 95% relative humidity without blistering. Before testing, the test base must be scribed with an "X" down to bare metal.
- (g) Coating Measurement. Measurement of the coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges".

- (h) Color. Color must be semi-gloss black and must match existing steel or aluminum poles. A color sample must be submitted for approval before fabrication.
- (i) Alternate Methods. Alternate painting methods may be used if approved by the Commissioner.

WELDING

- 5. Every welded joint shall be made in conformity with the proper interpretation of the standard symbols of the American Welding Society. Welds shall be inspected for penetration and soundness by the magnetic particle inspection method or by radiography. If the magnetic inspection process is used, the dry method with the direct current must be employed.

PACKAGING

- 6. Bases must be shipped on pallets. All bases shall be wrapped so as not to be damaged by shipping or handling. Bolts, washers, and nuts shall be attached to each base. Each pallet must be labeled as to the contents. Bases that are chipped or broken will be rejected. Bases with damaged paint surfaces will likewise be rejected.

**ELECTRICAL SPECIFICATION 1593
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED FEBRUARY 11, 2015**

**CABLE ANTI-THEFT DEVICE
FOR HELIX FOUNDATIONS**

SUBJECT

1. This specification covers the requirements for a cable anti-theft device to be used with steel helix foundations with either ten inch diameter bolt circles or fifteen inch diameter bolt circles. The device will secure the cable so as to prevent removal of the cable without removing the pole first.

GENERAL

2. (a) Specifications. The devices must conform in detail to the requirements herein stated and to the specifications and methods of test of the American Society for Testing and Materials cited by ASTM Designation Number of which the most recently published revision will govern.
- (b) Acceptance. Devices not conforming to this specification will not be accepted.
- (c) Drawings. The drawing mentioned herein is a drawing of the Department of Transportation, and is an integral part of this specification.
- (d) Bidders Drawings. If requested, the apparent low bidder must submit detailed scale drawings of the device showing actual dimensions, details, and welds. Shop drawings must be original engineering drawings created by the manufacturer. The drawings must give every dimension necessary to show how the device will function. These drawings must be submitted in electronic format, preferably Microstation 95, if so requested by the City.
- (e) Sample. One complete device of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (f) Warranty. The manufacturer must warrant the performance and construction of the devices to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of three years after the

devices have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any element or weld, or failure of any portion of the painting system. The warranty must be furnished in writing guaranteeing material replacement including shipment, free of charge to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final.

DESIGN

3. (a) Material. Steel must meet or exceed the requirements of ASTM A36.
- (b) Construction. Each device must be dimensioned as shown on Standard Drawing 982. All parts shown on the standard drawing must be supplied as part of this specification.

The device must be powder coated silver or black, as directed on the order.

The clamping device shall be constructed so that cables can only be clamped or un-clamped when the pole is not in place. When the pole is in place the clamping mechanism shall not be accessible. The clamping device can only be installed after the cable is pulled and before the pole is set. When installed, the device and the clamping mechanism shall have a great enough strength that when a pulling force is applied to the cable, the cable will break before it will slip through the device.

Any similar device, other than that shown in Standard Drawing 982, may be considered. The City will be the final judge as to whether a device meets the intent of this specification.

WELDING

4. (a) Standards. Every weld must be made in conformity with the American Welding Society. If so requested, the apparent low bidder must submit a drawing showing the sizes and types of welds, must state the type of electrode, and must describe the welding methods he proposes to employ in fabricating the devices.

TESTING

5. (a) The welds must be inspected for penetration and soundness by the magnetic particle inspection method or by radiography. If the magnetic inspection process is used, the dry method with direct current must be employed.
- (b) The manufacturer must certify the type of steel used to form the devices.

PACKAGING

6. (a) General. The devices must be packaged so as not to incur any damage during shipping and unloading. Materials such as lumber (2"x4" min.), non-marring banding, and other appropriate bundling materials must be used to make a rigid, long lasting, bundle capable of being handled , shipped and stored without shifting or breaking of the contents. Each bundle must be capable of being lifted by a fork lift truck and the bundles must be shipped in a flat bed truck to facilitate unloading.
- (b) All devices will be delivered to the Division of Electrical Operations storage yard at 1539 South Ashland Avenue in Chicago, or to another location within the City as indicated on the order.

**ELECTRICAL SPECIFICATION 1601
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 25, 2016**

SELF-SUPPORTING ALUMINUM STREET LIGHT CABLE

SCOPE

1. This specification describes preassembled, reverse twist, secondary cable consisting of one (1) bare steel reinforced aluminum conductor used as a messenger and neutral in combination with two (2) insulated, stranded, aluminum conductors. Cable will be used on aerial distribution circuits operated at a maximum voltage to ground of 600 volts.

GENERAL

2. (a) **Specifications.** The cable shall conform in detail to the requirements herein stated and to the referenced specifications of the American Society for Testing and Materials (ASTM), the National Electric Code (NEC), Underwriters Laboratories (UL), the Insulated Cable Engineers Association (ICEA), and the National Electrical Manufacturers Association (NEMA), in which the most recently published revisions will govern.
- (b) **Acceptance.** Cable not conforming to this specification will not be accepted.
- (c) **Sample.** If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be provided under this specification, shall be submitted within fifteen (15) business days after receipt of the request.
- (d) **Warranty.** The manufacturer shall warrant the cable to be first class material throughout. The manufacturer will be responsible for any cable failing during normal use within one (1) year after the date of installation. The manufacturer will be responsible for providing the footage of cable necessary to replace the failed cable length (without splices).

CABLE

3. (a) The cable must meet the requirements of ICEA Specification S-76-474 for neutral supported power cable assemblies rated for 600 Volts. Each insulated conductor must be listed with UL as Type RHW-2 or Type USE-2 and must meet the NEC's requirements for these types of cable up to 90° Centigrade in wet or dry conditions.

- (b) Messenger. The messenger must be bare steel reinforced aluminum wire (ACSR) meeting the requirements of ASTM B232.
- (c) Covered Conductors. The covered conductors must be made of compressed stranded aluminum meeting the requirements of ASTM B231.
- (d) Lay. The lay of the stranded conductors must meet the requirements of ASTM
- (e) Joints. No welds are permitted in the messenger. The stranded conductors may be welded, but a welding in one strand shall be at least fifty feet (50') from any other weld in the same wire or any other wire in the conductor.
- (f) Separator. A separator of mylar tape under the insulation, or other equivalent material, shall be provided. The conductor covering shall be of such consistency that linemen will be able to cut and strip the covering with normally used line tools. Any conductor received which does not meet the cutting and stripping requirements will be returned at the supplier's expense.
- (f) Insulation. The insulation must be black cross-linked polyethylene in accordance with the physical and electrical requirements detailed herein, and determined by the test procedures of ASTM D-470, except as otherwise specified. The outside diameter of the insulating covering must be circular and extruded concentrically over the conductor. It must have an average thickness as shown in these specifications, and a minimum thickness of not less than 95% of the average.

PHYSICAL AND ELECTRICAL PROPERTIES

4. (a) Physical Properties - Initial Value.

- | | | |
|----|-----------------------|---------------|
| 1. | Tensile Strength | 1800 psi min, |
| 2. | Elongation at Rupture | 350% min. |

(b) Physical Properties - After Aging.

After oven exposure at $121^{\circ} \pm 1^{\circ}\text{C}$ for 168 hours:

- | | | |
|----|--|----|
| 1. | Tensile strength, min% of unaged value | 80 |
| 2. | Elongation, min % of unaged value at rupture | 80 |

- (c) Moisture Resistance. When tested in accordance with the procedure given in ASTM D-470, except that the water must be maintained at $75^{\circ}\text{C} \pm 1^{\circ}\text{C}$, the insulation must meet the following moisture resistance requirements:

1.	Gravimetric Method:	
	Water absorption, maximum (Mg. per sq. in)	5.0
2.	Electrical Method:	
	Specific inductive capacitance- one day (Max.)	4.0
	Percent (%) change in SIC:	
	1 - 14 days (Max.)	3.0
	7 - 14 days (Max.)	2.0
	Percent (%) change in Power Factor - 1 day (Max.)	1.5
	Stability Factor (Max.)	1.0

- (d) Electrical Characteristics:

1. Dielectric Strength. Each length of insulated conductor must withstand an alternating current potential as shown in Table I for an exposure period of five (5) minutes when tested in accordance with ASTM D-470.
2. Insulation Resistance. The insulation resistance of the insulated conductor must not be less than that corresponding to a constant of 25,000 at 15.6°C (60°F).

- (e) Cold Bend Test Requirement. The insulated conductor must pass the "Cold-Bend, Long-Time Voltage Test on Short Specimens" of ASTM D-470 except that the test must be at minus 55°C .

CABLE ASSEMBLY

5. (a) Cabling. The insulated conductors must be reverse twisted about the messenger one (1) to one and one quarter ($1\text{-}1/4$) revolutions in each direction so that each conductor occupies all of the positions on the periphery of the circle periodically with an approximate distance between reversals of four feet (4').

- (b) Binding of Cable. The insulated conductors shall be bound to the messenger without fillers. The binder wire or tape shall have sufficient strength to support the assembly, but in no case will it be smaller than a #10 AWG equivalent. The binder shall be flat without sharp edges. Its strength shall be suitable for installation by the use of stringing blocks and must not itself tear, nor cut, or otherwise damage the conductor insulation. The binder wire must be applied with a left hand lay of five and one-half inches (5-1/2") \pm one half inch (1/2").

SIZE OF SECONDARY CABLE

6. The insulated conductor must be No. 8 AWS – 7 strands. The bare neutral conductor must be No. 8 with 6 strands of aluminum around 1 strand of steel.

TESTING

7. (a) General. Tests shall be performed on insulation and completed cables in accordance with applicable standards as listed in these specifications. Where standards are at variance with each other or with other portions of this specification, the most stringent requirements, as determined by an engineer from the Division of Engineering, shall apply. Included in these tests will be a 70,000 BTU per hour flame test in accordance with IEEE 383.
- (b) Number of Tests. Insulation tests shall be conducted on samples taken every 25,000 feet or fraction thereof of each conductor size. In no case will samples be taken closer than 15,000 feet apart.
- (c) Test Reports. No cable may be shipped until certified copies of all factory tests have been reviewed and approved by the engineer.
- (d) Acceptance. Where the cable fails to conform to any of the tests specified herein, the following will apply:
1. Insulation or Jacket Tests. Samples must be taken from each reel and must successfully conform to all tests specified herein. Reels from which samples fail to conform, will be rejected.
 2. Completed Cable (Reel) Tests. Any reel which fails to conform to testing will be rejected.

PACKING AND SHIPPING

8. (a) Reels. The cables must be shipped in 1000 foot lengths on non-returnable reels which shall be capable of withstanding, without damage, shipping, outside storage and handling during installation. "City of Chicago" shall be clearly printed on one (1) outside reel flange, and the insulated conductors on the beginning end shall not protrude beyond the reel flange. The bare neutral shall be securely stapled on the outside of the flange. The dimension of the reel flange must not be larger than thirty-eight inches (38") in diameter, the drum sixteen inches (16"0) in diameter, and eighteen inches (18") inside traverse. If reels are to be shipped on flange side, they must have two inch (2") spacers separating them for accessibility to fork lift trucks.
- (b) Length. The cable must be shipped in lengths shown above with a zero plus (+) tolerance and a ten percent (10%) minus (-) tolerance. Lengths shorter than minus ten percent (-10%) must not be shipped as they will not be accepted.

IDENTIFICATION

9. (a) Cable Identification. The cable must be identified by a permanently inscribed legend on each insulated conductor in white lettering. The legend must have the following information at a minimum: conductor size(AWG), 600V, XLPE, 90°, RHW-2 or USE-2, manufacturer's name, date of manufacturer, and phase number. All markings must be a minimum of one-eighth inch (1/8") in height. Marking shall be at approximately two (2) foot intervals.
- (b) Reel Marking. Each reel must be tagged on both the inside and outside of one reel flange with the following information which must be indelibly imprinted on a 2" x 4" brass tag: Purchaser's name and address, wire description, Purchase, or Contract, order number, size designation, net length, manufacturer's name, date of manufacture and gross weight.

**ELECTRICAL SPECIFICATION 1602
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 9, 2021**

**ROADWAY LED LUMINAIRE
ORNAMENTAL ACORN FOR RESIDENTIAL
STREETS**

1. SUBJECT

- A. This specification states the requirements for an ornamental Acorn Light Emitting Diode (LED) outdoor lighting luminaires. The specified LED luminaires will be used to replace existing High Pressure Sodium (HPS) and Ceramic Metal Halide (CMH) luminaires on Chicago residential streets. The LED luminaires will be integrated into a centralized lighting management system.

2. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Vibration”
- ANSI C136.37-2011, “American National Standard for Solid State Light Sources

Used in Roadway and Area Lighting”

- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment–Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The bidder shall submit the following information pertaining to the specified luminaire:

- a. Completed ATTACHMENT G – Submittal Form

b. Product Data Sheets.

- i. Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
- ii. LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
- iii. LED light source data sheet
- iv. Surge protection device data sheet - if applicable

c. Photometric Performance Data

If so requested by the Chief Procurement Officer, the bidder shall provide photometric calculations, within fifteen (15) days of such request, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index. LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the Design Lights Consortium (<https://www.designlights.org/content/QPL/ProductSubmit/LabTesting>).

ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

Photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

IES TM-21-11 calculation standards must be applied to photometric calculations specified herein:

- deriving the lumen maintenance (lamp lumen depreciation) factor.
- ANSI/IES LM-80-15 in-situ temperature measurement testing and

(ISTMT) reports containing data used in TM-21 calculations must also be submitted. TM-21 calculations must apply to the maximum LED case temperature from ISTMT, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pdf).

Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).

Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).

Product Sample. Upon a request from the Chief Procurement Officer, a sample of the luminaire that the bidder proposes to submit must be delivered to the City, within fifteen (15) days of such a request. Sample must be representative production unit and be supplied at no cost to the City.

C. Assembly.

Each luminaire must be delivered completely assembled, wired, and ready for installation.

D. Warranty.

The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.

- The inability of a luminaire to be dimmed will constitute a luminaire failure.
- Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
- The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.

E. Manufacturing Experience and Capacity

The manufacturer must demonstrate at least a five year history of manufacturing LED roadway and outside area luminaires. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

3. CAPITAL

- (a) Material. Each capital shall be die-cast aluminum conforming to ASTM B85, Grade 360. The top of the luminaire globe shall be spun aluminum, .090 inches

thick. The finial shall be cast aluminum conforming to ASTM B26, grade 319.

- (b) Appearance. The capital shall conform in appearance to that shown on Electrical Standard Drawing Number 958.
- (c) Construction. Castings must have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited.
- (d) Structural Integrity. The capital shall fit over a 3" high by 3" O.D. tenon. The attachment to the bracket must provide the structural integrity to hold the luminaire firmly in place during the vibrations anticipated due to passing heavily loaded vehicles, wind loading, and inclement weather. A minimum of 3/16" thickness of metal must be provided where the set screws are inserted to minimize the possibility of stripping the threads when the set screws are tightened into place. The set screws must be 5/16-18 stainless steel hex head screws. A minimum of three (3) set screws must be provided, evenly spaced at 120° apart.

4. PAINTING

- (a) Surface Preparation. Exterior surfaces of the capital shall be prepared by "Solvent Cleaning" per SSPC-SP1 using a solvent recommended for aluminum surfaces such as "Sherwin Williams MEK #R6K10." Solvent must be used as per written instructions of the manufacturer to remove all oil, grease, dirt and contaminants.
- (b) Primer Type. Within one hour of surface preparation, surfaces must be primed using a primer specifically recommended for aluminum surfaces such as "Sherwin Williams Industrial Wash Primer #P60GZ."
- (c) Primer Application. Primer shall be applied in accordance with written instructions of the manufacturer to produce a minimum dry thickness film of 3.0 mils. Primer must dry for a minimum of 30 minutes and a maximum of 60 minutes before application of finish coat.
- (d) Finish Coat. Finish coat shall be a polyurethane enamel specifically recommended for use over a primed aluminum surface. Two (2) coats of finish must be applied. Each coat must be a minimum of 1.5 mils dry thickness.
- (e) Durability. The paint must be capable of passing 1000 hours of salt spray as per ASTM B117.
- (f) Color will be silver or anodized, as specified on the order. Color samples will be approved by the Commissioner.
- (g) Alternate painting methods will be considered where the contractor can demonstrate to the satisfaction of the Commissioner that these methods have been in successful use for a five (5) year minimum period.

5. COMPONENT MOUNTING

- (a) Modular Construction. All electrical components shall be securely mounted to the capital by means of easily removable stainless steel captive thumb screws or by

easily operated stainless steel latches. The luminaire shall be designed to allow easy access to quick disconnects, terminal blocks and components for installation and maintenance.

- (b) Quick Disconnect. Wiring from the terminal block to the components must utilize a three (3) conductor, phenolic, polarized, quick disconnect device.
- (c) Interchangeability. The driver must be mutually field interchangeable so that units can be restored to working condition without trouble shooting components.

6. ELECTRICAL COMPONENTS

LED Optical Arrays

The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.

Terminal Block

A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible location.

Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.

Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.

Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

LED Driver:

Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.

Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.

Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .

Total Harmonic Distortion (THD). The driver input current must have specified THD

in accordance to ANSI C82.77-2014. THD must be $\leq 32\%$.

Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.

Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.

Electrical Transient Immunity.

- Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
- Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Enhanced (10 kV / 5 kA) combination wave test level.
- Transient Immunity Testing Requirements
- During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
- If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
- For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
- Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface must be 0-10 VDC as per the requirements of ANSI C136.41. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

Wiring.

All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16

AWG conductor at a minimum.

All wires within a single circuit path must be of the same size.

No wire-nut splicing will be allowed.

No unnecessary splices will be allowed.

Quick disconnects must be provided for all components.

All wires must be properly terminated.

Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

7. ACORN GLOBE

- (a) Appearance. The Acorn Globe must conform in appearance and design to that shown on Electrical Standard Drawing Number 958.
- (b) Top. The spun aluminum top and bottom globe sections will be secured with a .5 inch overlap design using 4 #10-24 stainless steel pan head screws with 4 aluminum nutserts providing a mechanical lock. A sealant must also be applied to make the globe dust-proof.
- (c) Material. The globe bottom must consist of a clear DR acrylic lens having a minimum cross-section of 3/32", securely bonded to an aluminum base to provide a solid key for the set screws fastening it to the capital. The lens must provide maximum resistance to ultra-violet degradation along with maximum mechanical durability. The globe must have prismatic to obtain an IES Type II/ III distribution. The globe must be attached to the capital with 4 5/16-18 hex head screws evenly spaced at 90° apart. Lock nuts must be provided.
- (d) Optional House Side Reflector. A house-side reflector shall be provided if requested. The reflector shall be mounted to a removable bracket. The reflector shall be mounted on the bracket and attached by a spring clamp, or other suitable means. The reflector shall be constructed of aluminum and polished to a high specular finish. Reflectance of the reflecting surfaces shall not be less than 75%. Measurements shall be made with a reflectometer using the fiber-optic method. The reflector shall be sized so that it fits through the globe neck and the globe can be removed without any interference from the reflector.
- (e) Gaskets. Gasketing must be provided for the interface of the globe and capital to effectively provide a dustproof optical assembly. This proposed gasketing material must be shown to have been effective in other applications for a minimum period of five (5) years. Should the optical system also require a filter, it must be a charcoal "breathing" filter of adequate size to provide effective filtering of particle and gaseous contaminants.

- (f) Alternate Designs. Other globe designs providing the required photometrics and giving equal performance and structural rigidity will be considered. However, no alternates will be allowed without the express written consent of the Commissioner.
- (g) The completed luminaire must be listed by an independent, nationally recognized testing laboratory to verify that the luminaire does not present an electrical or fire hazard.

8. PHOTOMETRIC REQUIREMENTS

- (a) The manufacturer must demonstrate that the luminaire shall meet or exceed the specified photometric requirements. The manufacturer must provide photometric calculations using published luminaire data as part of the submitted package. Submittal information must include computer calculations which demonstrate achievement of all listed performance requirements. Computer calculations must be performed for roadway lighting and for sidewalk/parkway lighting. The submitted roadway lighting calculations must be done in accordance with I.E.S. RP-8-14, and must include point-by-point illuminance and luminance, as well as listings of all indicated averages and ratios. The submitted sidewalk/parkway calculations must be done in accordance with I.E.S. RP-8-14, and must include point-by-point horizontal illuminance and vertical illuminance, as well as listings of all indicated averages and ratios.
- (b) Unless otherwise indicated, the light distribution will be classified as medium-semicutoff-Type II or Type III (M-S-II or M-S-III), as defined in Appendix E of I.E.S. RP-8-14.
- (c) Performance Requirements using this luminaire only (normally this luminaire will be used in conjunction with another luminaire):

- 1. Roadway Illuminance:

Average Horizontal	0.48fc
Uniformity Ratio Av/Min	5:1
- 2. Roadway Luminance:

Average Luminance	0.5 cd/m ²
Uniformity Ratio Av/Min	5.1:1
Uniformity Ratio Max/Min	26:1

The above requirements should be achieved using a light loss factor(LLF) of 0.7.

- (d) Typical Roadway. Lighting should be designed for the specific roadway designated in the project. If there is no specific location, typical roadway values should be used. Typical values are as follows:

1. Right-of way	66'
2. Curb-to-curb	34'

3. Mounting height	10'
4. Setback	3'
5. Arm Length	0'
6. Overhang	0'
7. Staggered Pattern	
8. Pole Spacing Same Side	240'
9. Pavement	R3

9. TESTING

- (a) Testing. All testing must be done on a prototype of the actual luminaire to be provided under this specification. If recent test results are available, they may be considered as meeting the testing requirements of this specification. The Commissioner or Commissioner's representative will have the final approval of which tests are adequate.
- (b) The manufacturer will be responsible for all costs associated with the specified testing, incidental to this contract.
- (c) Photometric testing must be in accordance with IES recommendations. The photometric tests must be conducted with a reference lamp and ballast. The tests, at a minimum, must yield:
 - 1. An isofootcandle chart with maximum candela and half maximum candela trace.
 - 2. An isocandela diagram.
 - 3. Maximum plane and maximum cone plots of candela.
 - 4. A candlepower table (house and street side).
 - 5. A coefficient of utilization chart.
 - 6. A luminous flux distribution table.
- (d) The luminaire must meet the electrical and photometric requirements of IESNA LM -79.
- (e) The luminaire must meet the lumen maintenance requirements of IESNA LM -80.
- (f) The luminaire must meet the requirements of IESNA TM-21 for long term maintenance of LED light sources.
- (g) The LEDs must meet the requirements for chromaticity per ANSI C78.377.
- (h) The following applicable UL standards shall be met:
 - 1. 8750 LED Light Sources in Lighting Products
 - 2. 1598 Luminaires
 - 3. 1012 power units other than Class 2
 - 4. 1310 Class 2 power units
 - 5. 2108 low voltage lighting systems
- (i) Additional Types of Testing.
 - 1. Interchangeability of all component parts.

2. Thermal testing in accordance with U.L. Standard 1572 or Standard 1598. The fixture must be placed in a controlled 25° Celsius environment and be energized for a minimum of 8 hours. At no time will any of the components exceed the manufacturer's recommended operating temperatures. At no time will any surface of the refractor exceed the manufacturer's recommended temperature limits.
3. Vibration testing in accordance with ANSI Standard C136.31. Upon completion of the test, all set screws, castings, and components must be secure and undamaged. The luminaire will not be energized during the test, and will not include the LED's and fuses. However, the luminaire must be fully operational after the test.
4. Moisture testing in accordance with U.L. Standard 1572 or Standard 1598. The luminaire will be subjected to a water spray from various directions for a sufficient amount of time to verify that the inside lamp compartment stays dry and that the fixture does not take on water. After the water spray the inside of the refractor must remain dry and the fixture should be demonstrated to operate properly.

10. PACKAGING

- (a) Packing. Each luminaire assembly must be securely packed in a suitable carton so that it will not be damaged by shipment and/or handling.
- (b) Marking. Each carton containing a luminaire must be clearly marked on the outside in letters not less than three-eighths (3/8) inch tall with the legend: "ORNAMENTAL, RESIDENTIAL MID-MOUNT, ACORN, LED". The appropriate City Commodity Code Number, the name of the manufacturer, the date of manufacture, and the contract number under which the luminaire is furnished shall also be listed.

Article I. ATTACHMENT G - Product Submittal Form

Lighting Context	e.g. Alleys		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power—maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10V	<input type="checkbox"/> Dimmable, DALI	
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

**ELECTRICAL SPECIFICATION 1604
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
Revised April 10, 2018**

LUMINAIRE: LED, VIADUCT/ELEVATED STRUCTURE RETROFIT

SUBJECT

1. This specification states the requirements for an LED (light emitting diode) luminaire. The luminaire will be for a one-to-one replacement of existing luminaires currently in use under viaducts and mounted under CTA elevated structures. The luminaires will have adjustable trunnion brackets for mounting. The LED luminaires will be integrated into a centralized lighting management system.

GENERAL

2. (a) References:
American National Standards Institute (ANSI)
 - ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
 - ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
 - ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
 - ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
 - ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
 - ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
 - ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
 - ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment – Luminaire Vibration”
 - ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”

American Society for Testing and Materials (ASTM)

- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B209-14, “Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- ANSI/IES RP-22-11, “Tunnel Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Standard 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60529-2004, “Degrees of Protection Provided by Enclosures (IP Code)”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

(b) Submittal Requirements:

The bidder, if so requested, must submit the following information pertaining to the specified luminaire within fifteen (15) days of such request:

1. Completed Table A – Submittal Form

2. Product Data Sheets.

Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, and weight (pounds).

LED Driver data sheet – including information described in LED Driver Requirements Section 4(c).

LED light source data sheet

Surge protection device data sheet - if applicable

3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.

ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

IES TM-21-11 calculations that derive the lumen maintenance (lamp

lumen depreciation or LLD) factor applied to photometric calculations specified herein.

ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted. TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
5. Vibration Testing - the luminaire must be tested in accordance with ANSI C136.31 at a vibration level of 5G.
6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.

(c) Assembly.

Each luminaire must be delivered completely assembled, wired, and ready for installation.

- (d) **Warranty.**
The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 7-10 luminaires for verification of light output per IES LM-79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.
- (e) **Manufacturing Experience and Capacity**
The manufacturer must demonstrate at least a five year history of manufacturing LED roadway and outside area luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely man

CONSTRUCTION

3. (a) **Weight.** The net weight of this luminaire must not be more than 30 pounds.
- (b) **Housing.** The housing must be precision die-formed, seam welded aluminum. The aluminum must be marine-grade (3003 alloy or equivalent). Alternate materials will be considered. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. All heat shields and heat sinks will be integral to the luminaire.

The housing will be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation. The housing will have the general appearance of Electrical Standard Drawing 981.

A wiring compartment capable of accepting a .75 inch threaded conduit

fitting to accommodate an electrical whip must be included..

- (c) Mounting brackets. Each housing must have two trunnion type brackets. One bracket must be mounted to each end panel of the housing with appropriate screws or bolts. The brackets will allow the luminaire to be positioned up to 90° in either direction from the horizontal. The brackets must be marked on the outside indicating the degrees of angle. The brackets will provide for positive locking in the desired position.
- (d) Door and Lens. A replaceable high impact UV resistant polycarbonate drop lens will cover the LED array. This lens will be attached to a door. The door must be of the same aluminum as the housing. The door will be hinged on one side such that when opened the door will fall open toward the roadway. The other side of the door will be attached to the housing with latches, allowing tool-less entry. The door will allow easy access to the driver and terminal strip (unless the terminal strip is in a separate accessible wiring compartment).

In order to make a dustproof assembly, a gasket of silicone rubber or other specifically approved material must be provided.

- (e) Hardware. All fasteners necessary to make a firm assembly must be furnished in place. All hardware must be of stainless steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with aluminum.
- (f) Finish. The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness. Surface texture and paint quality will be subject to approval. Color must be as specified in the purchase order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.
- (g) Ingress Protection. The luminaire housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013. The optical system must have a rating of IP66 or better.
- (h) The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.
- (i) The luminaire must be rated to operate between -40° to +50° Celsius.

- (j) The luminaire must meet the requirements of ANSI C136.22 for internal labeling.
- (k) The luminaire must be labeled for field identification according to ANSI C136.15.

ELECTRICAL COMPONENTS

- 4. (a) LED Optical Array. The LED arrays must be optimized for the required roadway photometrics. The arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
- (b) Terminal Board. A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible location. It must provide all terminals needed to completely prewire all luminaire components.

The terminal board must have plated copper or plated brass, clamp-type pressure terminals of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G. The terminals for connection of internal components must be either the screw-clamp or quick disconnect type.

- (c) Driver Requirements:
 - 1. Voltage. The electronic driver must operate at a nominal input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240. When operated at any supply voltage between 80% and 110 % of its rated supply voltage, a driver must supply proper current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
 - 2. Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015.
 - 3. Power Factor. The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. Power factor must be equal to or greater than .9.
 - 4. Total Harmonic Distortion. The driver input current must have

Total Harmonic Distortion (THD) specified in accordance to ANSI C82.77-2014. Total harmonic distortion must be less than 20%.

5. Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
6. Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.

(d) Electrical Transient Immunity.

1. Dielectric Withstand Testing. Luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
2. Electrical Transient Immunity. Luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Enhanced (10kV/5kA) combination wave test level.
3. Transient Immunity Testing Requirements.

During electrical transient immunity testing, the device under test (DUT) must be connected to the power source through a series coupler/decoupler network(CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and the CDN input and the CDN output and the DUT.

If the AC main is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.

For pre-test DUT characterization, the diagnostic measurements must, at a minimum, include real power, input current(RMS), power factor, and current distortion factor (THD) when operating at full output.

4. Manufacturer must indicate whether failure of the electrical transient immunity system can possibly result in disconnect of power to the luminaire.

(e) Wiring. All components must be completely factory wired with non-fading, color coded leads. All wires within a single circuit path must be of

the same size. No wire nuts will be allowed. No unnecessary splices will be allowed. The use of wiring smaller than #16 AWG will require the written approval of the Commissioner. Quick disconnects must be provided for all components. All wires must be properly terminated.

(f) Control Device Receptacle and Cap.

1. Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.
2. 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
3. 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
4. Receptacle Wire Leads must all be properly terminated.
5. Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
6. Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

(f) Component Mounting. All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

PHOTOMETRIC REQUIREMENTS

5. (a) Color Temperature. The correlated color temperature must be a nominal 3000 kelvin.
- (b) Lumen Maintenance. LED arrays must deliver a minimum of 90% of the initial lumen output at 36,000 hours of operation.
- (c) Light Loss Factor. The light loss factor must be calculated as per IES RP-8-14 using the following three factors.
 1. LED Lumen Depreciation (LLD). Calculated at 60,000 hours as per

Section 2(b)3. Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration, but must be indicated as such.

2. Luminaire Dirt Depreciation.(LDD). Should be .86.
3. Luminaire Ambient Temperature Factor (LATF). Should be .96.

(d) Roadway Luminance:

Average Luminance	2.5 cd/m ²
Uniformity Ratio avg/min	3:1
Uniformity Ratio max/min	5:1
Max veiling Luminance	0.5

(e) Roadway Conditions. The luminaires must meet the requirements for the following physical conditions:

Right-of-way	66'
Curb-to-curb	46'
Sidewalk	10' each side
Mounting height	13'
Tilt	45°
Setback	10'
Arm length	0'
Spacing	30'
Pavement	R3

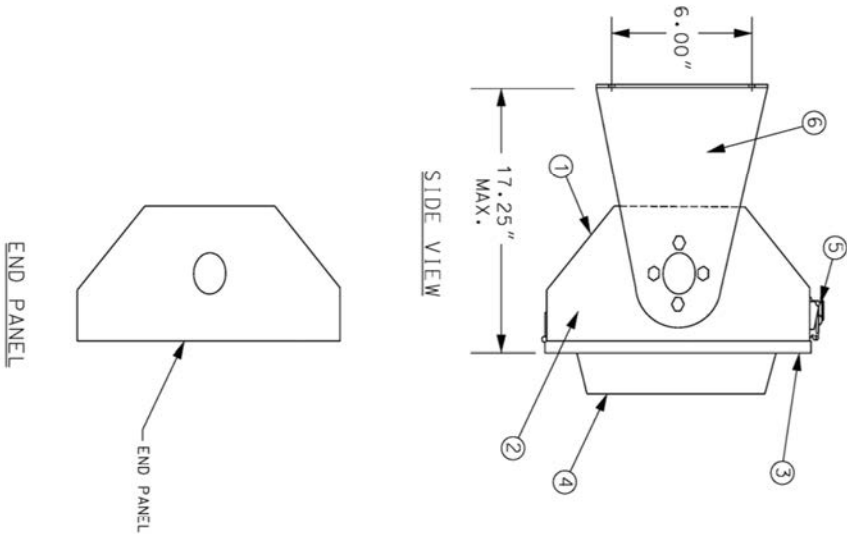
PACKAGING

6. (a) Packing. Each luminaire assembly must be securely packed in a suitable carton so as not to be damaged in shipment and handling.
- (b) Marking. Each carton containing a luminaire must be clearly marked on the outside in letters not less than three-eighths (3/8) inch tall with the legend: "LUMINAIRE, LED, VIADUCT". The appropriate City Commodity Code Number, the name of the manufacturer, the date of manufacture, and the contract number under which the luminaire is furnished shall also be listed.

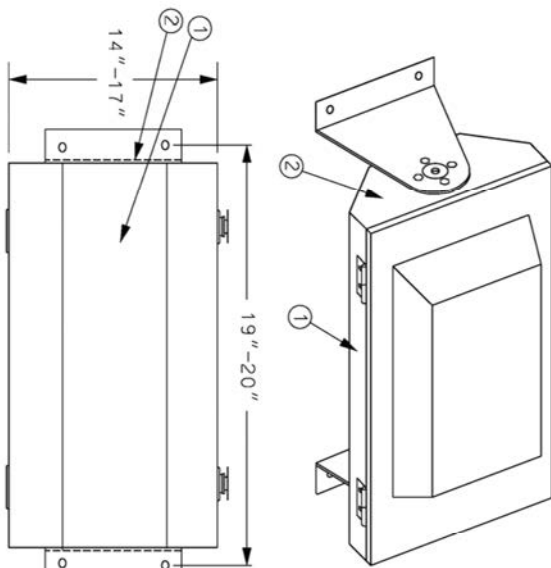
TABLE A
PRODUCT SUBMITTAL FORM

PRODUCT INFORMATION	DATA	UNITS/REFERENCE
Luminaire Manufacturer		
Luminaire Model Number		complete ordering information
Initial luminous flux		lumens
Initial input power		watts
Maintained input power		watts
Input voltage range		volts
Initial LED drive current		milliamps
Maintained LED drive current		milliamps
Correlated Color Temperature(CCT)		kelvin
Color rendering Index (CRI)		
Luminaire Weight		pounds
Rated Driver Life		years
Electrical Transient Immunity		kV/kA ANSI C136.2
Vibration Test		5G ANSI C136.31
Warranty period		years
IES LM-80 test duration		hours IES LM-80 Report
LED lumen maintenance at 36,000 hours		% TM-21 Calculator
Max LED Case Temperature		°C ISTMT Report

DATE: 9/14/2016
FILE: C:\Users\aviu\Desktop\981_09142016.dgn



- 1) HOUSING
- 2) END PANEL
- 3) LENS DOOR/COVER ASSEMBLY
- 4) LENS
- 5) LATCHES
- 6) END MOUNT TRUNNION BRACKET



DATE	REVISION	
A/09/14/2016		
VIADUCT / EL STRUCTURE LUMINAIRE		
CITY OF GUNDOG DEPT. OF UTILITIES BUREAU OF ELECTRICAL ENGINEERING		
DESIGNED BY	DATE	DWG. NO.
B. CARTER		981
CHECKED BY	DATE	SCALE
F. KARAGIANES		NONE
SUPERVISING ENGINEER		
SCALE NONE		

**SPECIFICATION 1606
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 10, 2017**

ARTERIAL STREET LIGHTING CONTROLLER

SUBJECT

1. This specification states the requirements for an arterial street lighting controller and aluminum cabinet for use in controlling arterial street lighting circuits. The cabinet shall be mounted on top of a ballast base housing, which will be affixed to a concrete foundation.

GENERAL

2. (a) Specifications. The controller shall conform in detail to the requirements herein stated, to the Federal Standard cited by number, and to the specifications and methods of test of the American Society for Testing and Materials, cited by ASTM Designation Number, in which the most recently published revision will govern. Cabinets must meet or exceed the requirements of a NEMA rating 3R and must be U.L. listed.
- (b) Acceptance. Controllers and cabinets not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, Division of Electrical Operations, and must be interpreted as part of these specifications cooperating to state necessary requirements.
- (d) Sample. One complete controller in cabinet of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such a request. The sample must be delivered to the attention of the Engineer of Electricity, Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- (e) Warranty. The manufacturer shall warranty the controller and cabinet against flaws in material or workmanship for a period of two (2) years from the date of delivery. Any controller or cabinet developing flaws within this period must be replaced by the manufacturer, including shipment, at no cost to the City.

DESIGN

3. (a) Drawings. The control cabinet must conform in detail to requirements shown on Drawing 876 for a 100 Amp application and to Drawing 880 for a 200 Amp application.
- (b) Material. The cabinet and the door assembly must be constructed of 5052-H32 sheet aluminum alloy, with a minimum thickness of .125 inches. The base plate must be sheet aluminum of .250 inch thickness. All electrical components and wiring must be as shown on the appropriate drawings.
- (c) Dimensions. The overall outside dimensions of the 100amp control cabinet must be 36 inches in height by 20 inches in width by 15 inches in depth. The overall outside dimensions of the 200 amp control cabinet must be 41 inches in height by 25 inches in width by 16 inches in depth. Cabinets must have sloped tops to shed water.

CABINET REQUIREMENTS

4. (a) Cabinet. The cabinet must be sized as shown on either Drawing 876 or Drawing 880, depending on the controller amp rating. The cabinet door opening must be double flanged on all four (4) sides. A door restraint must be provided to prevent the door from moving in windy conditions.
- (b) Door. The door size must be a minimum of 80% of the front surface area. The door must be hinged on the right side when facing the cabinet. The door must have a gasket that meets the requirements found in U.L.508 Table 21.1. The gasket must form a weather-tight seal between the cabinet and the door. The door, when closed, must be flush with the cabinet.
- (c) Hinges. Hinges must be continuous and bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts and nylock nuts. Hinges must be made of .093 inch thick aluminum. The hinge leaves must not be exposed externally when the door is closed. Only the hinge knuckles must be visible upon closing the door. The hinge pin must be .250 inch diameter stainless steel and must be capped top and bottom by weld to render it tamper-proof.
- (d) Latching. The latching mechanism must be a three-point draw roller type. The pushrods must be aluminum. The rollers must be nylon with a minimum diameter of .875 inches. The center catch must be .187 inch aluminum, minimum.
- (e) Handle. The handle must be stainless steel with a .750 inch diameter shank. The handle must have provision for a padlock. The lock must be

keyed dead bolt #200725 or equivalent. Two (2) keys must be provided for each cabinet.

- (f) Ventilation. Louvered vents must be provided in the door. Louvers must satisfy the NEMA rod entry test for 3R enclosures. A removable filter must cover the louvers from inside the door. The filter must be held firmly in place with top and bottom brackets and a spring-loaded clamp. Exhaust air must be vented out between the top of the cabinet and the door. The exhaust area must be screened with openings of .12 inch by 1.0 inch.
- (g) Equipment Mounts. The cabinet must be equipped with two (2) adjustable AC@ channels on both side walls and on the back wall. The internal dimensions of the channels must be 1.075 inches high by .625 inches wide. All mounting hardware must be furnished.
- (h) Workmanship. All control cabinets must be free of flaws, and must have neat, smooth exterior surfaces. All holes must be accurately located and drilled. All welds must be neatly formed and free of cracks, blow holes, or other irregularities. All inside and outside edges must be free of burrs.
- (i) Painting. The cabinet, door and other parts must be treated by an iron phosphate conversion technique. After which, all the parts must be baked dry. A polyester powder coat must then be applied. The inside of the cabinet and door must be white. The outside of the cabinet and door must be green meeting No. 14110 of Federal standard Number 595, or a gloss black, or another color as specified. A paint chip must be provided upon request.

PANEL

- 5. (a) The panel must be composed of phenolic plastic ½ inch in thickness, or an approved equal. It must be securely bolted to the cabinet using stainless steel hardware.
- (b) The panel will be sized, cut, and drilled as shown on the appropriate standard drawing. For a 100 amp and 200 amp – 2 pole controller, the panel must comply with Drawing 984. For a 100 amp and 200 amp – 3 pole controller, the panel must comply with Drawing 984. If alternate components are proposed, the panels must be sized accordingly.

ELECTRICAL COMPONENTS

- 6. (a) All components will be as indicated on the appropriate drawing, or will be approved equals. Circuit breakers must have thermal magnetic trips. Each breaker must be enclosed in a hard insulated housing. All breakers must be UL listed. The photo-cell relay, if required, must meet

City specifications.

(b) Wiring will be as indicated on the appropriate drawing. All wire will have stranded copper conductors, unless indicated otherwise. All wires must be insulated with an approved 125° Centigrade insulation.

(c) For a 3-wire, 1-phase, 240 volt ComEd input, components and wiring will be as indicated on Standard Drawing 983 (for either 100 amp or 200 amp service). For a 4-wire, 3-phase, 120/208 volt ComEd input, components and wiring will be as indicated on Standard Drawing 983 (for either 100 amp or 200 amp service).

THIS SPECIFICATION SHALL NOT BE ALTERED

**ELECTRICAL SPECIFICATION 1607
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 10, 2017**

RESIDENTIAL STREET LIGHTING CONTROLLER

SUBJECT

1. This specification states the requirements for a residential street lighting controller and cabinet for controlling residential street lighting circuits. The controller is intended to be mounted to a Commonwealth Edison wood pole.

GENERAL

2. (a) Organizations. Specifications from the following organizations are referenced in this specification:

ASTM – American Society for Testing and Materials
NEMA – National Electrical Manufacturers Association
UL – Underwriters Laboratories

- (a) Specifications. The controller and cabinet must conform in detail to the requirements herein stated, to the specifications ASTM, cited by ASTM designation number, in which the most recently published revision will govern. Cabinets must meet or exceed the requirements of a NEMA 4X enclosure type and must be U.L. listed.
- (b) Acceptance. Controllers not conforming to this specification will not be accepted.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation, and must be interpreted as part of these specifications cooperating to state necessary requirements.
- (d) Sample. One complete controller of the manufacture intended to be furnished must be submitted upon request of the Chief Procurement Officer within fifteen (15) business days after receipt of such a request. The sample must be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.

- (e) Warranty. The manufacturer must warranty the controller and cabinet against flaws in material or workmanship for a period of two (2) years from the date of delivery. Any controller, cabinet, or components developing flaws within this period must be replaced by the manufacturer, including shipment, at no cost to the City.

DESIGN

- 3. (a) Drawings. The controller and cabinet must conform in detail to requirements shown on Electrical Standard Drawing 985.
- (b) Dimensions. The overall outside dimensions of the control cabinet must be 19.5 inches in height by 17.5 inches in width by 9.6 inches in depth. Cabinets must have sloped tops to shed water.

CABINET REQUIREMENTS

- 4. (a) Cabinet. The cabinet must be classified as NEMA 4X. The cabinet and the door must be constructed of gray, hot molded, fiberglass reinforced polyester resin compound with a minimum of 20% glass fibers by weight. Fiberglass material must meet UL 746C requirements with halogen-free and self-extinguishing characteristics. The enclosure should be listed under UL standard 508. The cabinet door opening must be double flanged on all four (4) sides. The cabinet will be made of one piece of molded fiberglass.
- (b) Door. The door will be fabricated of one-piece of fiberglass. The door size must be as shown on Electrical Standard Drawing 985. The door must be hinged on the left side when facing the cabinet. The door must have a gasket that meets the requirements found in U.L.508 Table 21.1. The gasket must form a weather-tight seal between the cabinet and the door.
- (c) Hinge. Hinge must be a continuous stainless steel piano hinge bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts and nylon insert lock nuts. The hinge leaves must not be exposed externally when the door is closed. Only the hinge knuckles must be visible upon closing the door. The hinge pin must be .250 inch diameter stainless steel and must be capped top and bottom by weld to render it tamper-proof.
- (d) Latching. Two (2) quick release, padlockable, stainless steel latches must be provided.
- (e) Cable Openings. The top of the cabinet must have an opening to accommodate a cord grip for a cable up to 1.375 inches in diameter. The bottom of the cabinet must have an opening to accommodate a 2.0 inch schedule 40 rigid galvanized steel conduit. The cord grip and conduit hub

must be included as part of the cabinet assembly.

- (f) Cabinet Mounts. The cabinet must be equipped with two (2) galvanized steel brackets, a minimum of 1/16" in thickness, which will allow mounting to a wood pole. Each bracket will be mounted to the back of the cabinet with two (2) 1/4-20 stainless steel hex head bolts with washers, and nuts. Each bracket will be formed of a single piece of galvanized steel, 16" by 6". The top of the bracket will be straight and have two holes drilled to accept the mounting bolts of the cabinet. The lower part of the bracket must be bent to form two "wings" to fit around the ComEd pole. Each wing will be drilled to accept 1/2-13 X 4" stainless steel lag bolts. All bolts will be included.

PANEL

5. The panel must be composed of phenolic plastic 1/2 inch in thickness. It must be securely bolted to the cabinet using stainless steel hardware. The panel must have holes cut into it, and holes drilled into it, to accept mounting of all the electrical components. The location of the components must be as indicated on Electrical Standard Drawing 985.

ELECTRICAL COMPONENTS

6. (a) Circuit breakers must have thermal magnetic trips. Each breaker must be enclosed in a hard case insulated housing. The frame must be rated for 100 amp service at 240 volts. The minimum interrupting capacity will be 18,000 r.m.s. amperes at 240 volts. All breakers must be UL listed.
- (b) Wiring will be as indicated on Electrical Standard Drawing 985. All wire will have stranded copper conductors. All wires must be insulated with an approved 125° Centigrade insulation.
- (c) All components will be as indicated on Drawing 985, or approved equals.

THIS SPECIFICATION SHALL NOT BE ALTERED

**ELECTRICAL SPECIFICATION 1608
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 2, 2021**

**ROADWAY LIGHTING CONTROL
SMART NODES**

1. SUBJECT

This specification states the requirements for smart lighting control nodes. Each external or internal individual node is to be wired to an individual roadway luminaire. A third node will be used for control of a group of luminaires. Each node shall be connected to a wireless mesh network. There are three nodes specified. One node will consist of a standard twist-lock type (external node) which will be mounted to a matching receptacle on the outside of a roadway luminaire. The second type node will be mounted internally to a luminaire (internal node). The third type of node shall control a group of luminaires on a common circuit (circuit node). The nodes shall provide two-way wireless communications between the luminaires and the City's smart lighting system. Functions shall consist of energy monitoring, on/off control, dimming, and outage reporting.

2. GENERAL

2.1 Information Required. Each bidder shall submit with his proposal the following information relative to the nodes he proposes to furnish.

- (1) Manufacturer's catalog description, including manufacturer's name and catalog ordering numbers.
- (2) Specification sheets.
- (3) Any other information as required herein.

2.2 Assembly. Each control node shall be delivered completely assembled, wired, and ready for installation.

2.3 Warranty. The manufacturer shall warrant every node against any defects due to design or workmanship developing within a period of five (5) years after the nodes have been accepted by the City. This will be interpreted particularly to mean failure of any component impairing the proper operation of the unit. Any

- node developing defects within this period shall be replaced by the manufacturer at their sole expense and without cost to the City.
- 2.4 Sample. If so requested, a sample of the nodes of the manufacture intended to be furnished under this contract must be submitted to the Division of Electrical Operations within fifteen (15) days upon receipt of a request from the Chief Procurement Officer.
- 2.5 The manufacturer shall be ISO 9001 certified for quality management in the manufacturing field.
- 2.6 Nodes shall be FCC compliant for non-electrical interference.
- 2.7 Compliance. The nodes shall conform in detail to the requirements herein stated, and to the standards herein cited, of which the latest revisions shall govern.

3. HOUSING

- 3.1 Housings shall be molded of a UV stabilized polycarbonate, pigmented to an approved color. The housing is required to be impact resistant.
- 3.2 A weather-proof, permanent label shall be attached to each unit indicating the manufacturer's name, month and year of manufacture, model and serial number, voltage and load ratings, and provision for marking installation and removal dates.
- 3.3 The dimensions of the external twist-lock node shall not exceed 5" high by 3.5" in diameter. The external node shall not weigh more than 10 ounces.
- 3.4 The dimensions of the internal node shall not exceed 2.5" high, 4.25" length, and 3.5" width. The internal node shall not weigh more than 11 ounces.
- 3.5 The internal smart node and the circuit smart node shall have lead wires of approximately 12 inches.
- 3.6 The external node shall have a neoprene or other approved gasket attached to the base to effectively seal the connections against weather and dust.

4. ENVIRONMENTAL

- 4.1 The nodes shall operate within the temperature range of -40° C to +70° C.
- 4.2 The external node shall have an ingress protection rating of IP66.

- 4.3 The internal node shall have an ingress protection rating of IP65.
- 4.4 The circuit node shall have an ingress protection rating of IP65.

5. ELECTRICAL

- 5.1 The nodes must function properly within the existing City lighting circuits and the power distribution system as provided by ComEd. Existing conditions shall not adversely affect the nodes, nor keep them from performing properly.
- 5.2 Power consumption shall be less than 2watts (at 120 volts).
- 5.3 The nodes must be stable and reliable over the range of 105 to 305 volts A.C., at 50/60 cycles.
- 5.4 Surge Arrestor. Over voltage protection shall be provided for the control components and the load circuit by means of a metal oxide varistor (MOV) or other specifically approved type arrestor. It must limit high voltage surges to a value at least 20% below the basic impulse insulation level (BIL in accordance with EEI-NEMA) of the control. The MOV must be rated for a minimum of 320 joules 6KV/3KA. In both external and internal nodes, the MOV must be mounted internally in the control housing.
- 5.5 Switching Relay. The ON-OFF switching operations shall be accomplished by normally closed contacts which must be opened by means of a rugged, properly rated, magnetic relay, subject to approval. The switching shall be positive and free of chatter and/or sticking of contacts. The contractor must provide test data verifying that contact chatter does not exceed 5 milliseconds when operated under loads as herein specified. The relay must have contacts of silver alloy, tungsten, or other specifically approved material.
- 5.6 Capacity. Maximum pass-through current shall be 10 amps. Maximum loading shall be 1500VA (960 watts).
- 5.7 Circuit nodes shall have an external antenna. The antenna shall be capable of being mounted to a cabinet and be weather hardened and vandal resistant. Lead wires for the antenna shall be included with each circuit node. A single antenna shall be capable of being shared by multiple nodes.
- 5.8 External twist-lock nodes shall be 7-pin. Internal nodes and circuit nodes shall have 7 lead -in wires. The circuit node shall also have wires for the antenna.

6. OPERATION

- 6.1 The external nodes shall meet the requirements of ANSI C136.10 for twist-lock controls, as well as UL 773. All nodes shall meet the requirements of ANSI C136.41 for dimming control.
- 6.2 Internal nodes shall be able to communicate with the network even when installed inside the metal housing of a luminaire.
- 6.3 If an external node loses communication, then operation will default to the photocell. If the photo-cell malfunctions, the control will default to the on position.
- 6.4 If an internal node or circuit node loses communication, then the default operation of the node will provide power to the luminaire and the luminaire will remain on or be turned on.
- 6.5 Ability for Light turn-on or turn-off by programmed schedule.
- 6.7 0-10VDC driver control, allowing dimming.
- 6.8 Remote control and reporting (two-way communications).
- 6.9 Metering.
 - (1) Energy metering (0.5% accuracy).
 - (2) Energy metering by hour, day, minute, with record keeping.
 - (3) Metering Range: 105 to 305 VAC, 10A RMS (ANSI C12.20)

7. PHOTO-CONTROL

- 7.1 The internal smart nodes and the circuit smart nodes shall not have a built-in photocell.
- 7.2 The external twist-lock node shall have a built-in photocell.
 - (1) Photoconductive Cell. The photocell shall consist of a suitable substrate, a chemically inert electrode material and a thin layer of photosensitive cadmium sulfide or other acceptable photosensitive material. It must be hermetically sealed in a glass to metal package to prevent moisture and contamination damage. Plastic cased cells are not acceptable. Filtered silicon sensors in clear epoxy cases are also acceptable. The cell must not

be subject to overloading due to the demand of the design circuit nor the ambient temperatures surrounding the cell.

- (2) The external node control must be calibrated at 120V AC for a "turn-on" setting of 1.50 ± 0.30 horizontal foot candles of natural illumination with a 2-5 second turn OFF delay. The "turn-off" setting must be adjusted to one and one half (1.5) times the "turn-on" setting. The external node control must have a 1-2 second turn ON delay.

8. NETWORKING

The control nodes must operate on an open standards secure (WiSun) IEEE 802.15.4g wireless mesh based multi-application network with embedded Itron (formerly Silver Springs Network) communications.

The control nodes shall support Frequency-Hopping Spread Spectrum up to 300kbps mesh networking as well as automatic data routing with self-configuration, auto-healing & redundant uplinks.

The nodes shall operate within the City's Itron network.

9. SECURITY

The control nodes must have full application and link-layer security with full PKI (Public Key Infrastructure), Advanced Encryption Standard AES-128 or AES 256, and embedded firewall which includes. integrated multi-layer security with end-to-end encryption and capability to prohibit unauthorized access.

10. PACKAGING

- 10.1 Carton. Each smart lighting control node shall be individually packed in a carton of adequate strength and properly secured and protected to prevent damage to the unit during shipment, handling and storage. A master carton shall contain multiple units, each in individual cartons.

- 10.2 Marking. Each carton shall be clearly marked on the outside with the legend "SMART LIGHTING INTERNAL CONTROL NODE", "SMART LIGHTING EXTERNAL CONTROL NODE", or "SMART LIGHTING CIRCUIT NODE" (or similar as appropriate), with the number of units in the carton: volt-ampere load rating, voltage, manufacturer's name and catalogue number, and shipping or manufacturing date.

**ELECTRICAL SPECIFICATION No. 1609
CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING
OCTOBER 20, 2017**

**OUTDOOR LED LUMINAIRE SPECIFICATIONS:
RESIDENTIAL STREETS, ALLEYS, & ARTERIAL STREETS (Cobra Head)**

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) outdoor lighting luminaires. The LED luminaires will be integrated into a centralized lighting management system.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Vibration”
- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and

Area Lighting Equipment–Dimming Control Between an External Locking Type Control and Ballast or Driver”

- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form
2. Product Data Sheets.
 - a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
 - b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
 - c) LED light source data sheet
 - d) Surge protection device data sheet - if applicable
3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire’s submittal package, that demonstrate the luminaire’s photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

 - a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.
 - b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.
 - c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.
 - d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.
 - ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.

- TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the Design Lights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the Design Lights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.

- The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
- During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

E. Manufacturing Experience and Capacity

The manufacturer must demonstrate at least a five year history of manufacturing LED roadway and outside area luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

III. CONSTRUCTION

A. Weight

The net weight of these luminaires must not be more than 30 pounds.

B. Housing.

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Mounting Provisions.

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

D. Access Door-Panel.

An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

E. Hardware.

All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment to the mast arm, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

F. Finish.

The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

G. Ingress Protection.

1. The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.
2. The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

H. General Luminaire Requirements

1. The luminaire must be rated to operate between -40° to +50° Celsius.
2. The luminaire must have the option of adding a house side shield. The shield should be designed to be easily installed in the field. The house side shield must be composed of a sturdy material capable of withstanding vibrations and weather conditions. The shield must cut off light trespass at approximately one mounting height behind the pole.
3. The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver
4. The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the Digital Addressable Lighting Interface (DALI) protocol. This information will be transmitted through the networked Lighting Management control system.

I. Electrical Components

1. LED Optical Arrays
 - a) The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible location.
 - b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
 - c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
 - d) Terminal block terminals for internal component connections must

be either the screw-clamp or quick disconnect type.

3. LED Driver:

a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.

b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.

c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .

d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 32\%$.

e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.

f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.

g) Electrical Transient Immunity.

- Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
- Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Enhanced (10 kV / 5 kA) combination wave test level.
- Transient Immunity Testing Requirements
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the

power supply and CDN input and the CDN output and DUT.

- If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
- For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
- Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be DALI (Digital Addressable Lighting Interface) as per the requirements of IEC 62386. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

4. Wiring.

- a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.
- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.

5. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.
- b) 7-pin Receptacle. The luminaire control receptacle must be fully

prewired and compliant with ANSI C136.41.

- c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
- d) Receptacle Wire Leads must all be properly terminated.
- e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
- f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

6. Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.

To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).

2. Lumen Maintenance.

- a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
- b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.
 - (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
 - (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
 - (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

3. Color Attributes

- a) Color Rendering Index (CRI) shall be no less than 65.
- b) Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

ATTACHMENT A (below) lists the photometric performance requirements for luminaires used in the following typical municipal outdoor lighting applications:

- Modern Residential Streets - staggered poles on both sides.
- Arterial Streets – two-sided opposite pole spacing
- Arterial Streets – two-sided staggered pole spacing

ATTACHMENT A – Photometric Performance Requirements

STREET PARAMETERS				
TYPICAL LIGHTING CONTEXT	RESIDENTIAL	ARTERIAL		
POLE CONFIGURATION*	STAGGERED	OPPOSITE	STAGGERED	
RIGHT OF WAY (Width)	66 ft.	100 ft.	80 ft.	66 ft.
IES PAVEMENT CLASS	R3	R3	R3	R3
STREET WIDTH (Curb to Curb)	34 ft.	80 ft.	60 ft.	48 ft.
LANES (Incl Prking &Median)	4	7	6	4
PARKWAY (Width)	10 ft.	4 ft.	4 ft.	N/A
SIDEWALK (Width)	6 ft.	6 ft.	6 ft.	9 ft.
HEIGHT TO LUMINAIRE	18 ft.	33 ft.	33 ft.	33 ft.
MAST ARM LENGTH	8 ft.	12 ft.	12 ft.	8 ft.
POLE SETBACK (From Curb to Center of Pole)	3 ft.	3 ft.	3 ft.	3 ft.
IN-LINE POLE SPACING	220 ft.	210 ft.	210 ft.	210 ft.
MAINTAINED PERFORMANCE REQUIREMENTS				
LUMINAIRE REQUIREMENTS	STAGGERED	OPPOSITE	STAGGERED	
Max Input Power - Default /Normal Luminance (Watts)	120	180	180	180
Default/Normal AVG. Luminance (cd/m ²)	≥1.5	≥1.7	≥1.7	≥1.7
AVG/MIN Uniformity Ratio	≤ 6:1	≤ 3:1	≤ 3:1	≤ 3:1
MAX/MIN Uniformity Ratio	≤10:1	≤ 5:1	≤ 5:1	≤ 5:1
MAX Veiling Luminance Ratio	≤ 0.4	≤ 0.3	≤ 0.3	≤ 0.3
AVG. Boosted Luminance (cd/m ²) [Add-Alternate]	≥2.25	≥2.5	≥2.5	≥2.5
SIDEWALK				
Default AVG. Horizontal Illuminance (fc)	≥0.50	≥0.50	≥0.50	≥0.50
AVG.MIN Uniformity Ratio (Horizontal Illuminance)	≤ 4:1	≤ 4:1	≤ 4:1	≤ 4:1
LIGHT TRESPASS RESTRICTIONS - (as measured in a vertical plane 10' beyond ROW ≤3' height)				
MAX Vertical Illuminance	≤ 0.07	≤ 0.3	≤ 0.30	≤ 0.30

ATTACHMENT B - Product Submittal Form

Lighting Context	e.g. Alleys		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power—maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10V	<input type="checkbox"/> Dimmable, DALI	
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

**ELECTRICAL SPECIFICATION 1610
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
OCTOBER 20, 2017**

SPLIT PEDESTAL BASE: FOR CHICAGO 2000 LIGHT POLE ASSEMBLY

SUBJECT

1. This specification states the requirements for a split pedestal base (Clamshell) for installation on a 10 inch by 34 foot- 6 inch tapered tubular, 3 gauge and 7 gauge steel anchor base poles with mast arm supports. This specification will address the requirements for a split fiberglass base without doors.

SUBMITTAL INFORMATION REQUIRED

2. (a) Manufacturer's Shop Drawings. Scaled manufacturer's shop drawings showing actual split pedestal base dimensions and details. Shop drawings must be original engineering drawings created by the manufacturer; photocopied or scanned copies of the Standard Drawings will not be accepted, and will be rejected as an incomplete submittal.

Dimensions must include but will not be limited to: base height, width, pattern, and fluting. Details must include scaled and dimensioned plan views, front elevations, side elevations, and section views as required.

- (b) Manufacturer's catalog cut sheets showing split pedestal base designation, and catalog number.
- (c) Manufacturer's specifications including fabricating materials and processes.
- (d) Manufacturer's written installation instructions and maintenance manuals including recommendations and/or procedures for storage, assembly, orientation, and installation.
- (e) Sample. If requested by the Chief Procurement Officer, one completely assembled split pedestal base with hardware and all components, of the manufacture intended to be furnished, shall be submitted for review within fifteen (15) business days from receipt of notice. The sample base must be coordinated with an existing 34 foot-6 inch tapered tubular for accuracy of fit.

(f) Warranty. The manufacturer must warrant the performance and construction of these split pedestal bases to meet the requirements of this specification and must warrant all parts, components, and appurtenances against defects due to design, workmanship, or material developing within a period of five years after the bases have been delivered. This will be interpreted particularly to mean structural or mechanical failure of any component, or failure or fading of the surface color. The warranty must be furnished in writing guaranteeing replacement, including shipment, free of charge to the City, of any split pedestal base, which, as determined by the Commissioner, would develop aforesaid failures. Any split pedestal base, or part thereof not performing as required or developing defects within this period, must be replaced by the manufacturer at no cost to the City. The Commissioner will be the sole judge in determining which replacements are to be made and the Commissioner's decision will be final. Any cost for the warranty as specified must be incidental to this contract.

GENERAL

3. (a) Products. Split pedestal bases must be the products of established manufacturers and must be suitable for the service required. Split pedestal bases which are proposed must be the products of a single manufacturer. The manufacturer shall have been in the business for at least five years.
- (b) Specifications. The split pedestal bases must conform in detail to the requirements herein stated, and to the Specifications and Methods of Test of the American Society for Testing and Materials cited by ASTM Designation Number, of which the most recently published revision will govern.
- (c) Drawings. The drawings mentioned herein are drawings of the Department of Transportation being an integral part of this specification cooperating to state the necessary requirements.
- (d) Design. The base must conform in design and dimensions to Standard Electrical Drawings 808, 824, 827 and modified to accommodate non-fluted pole 986.
- (e) Approval. Whenever "approval" and "approved" are used in this specification they will mean a written approval by the Commissioner to be secured prior to proceeding with manufacture of the split pedestal bases.
- (f) Commissioner's Review. The Commissioner will be the sole judge in determining the submitted split pedestal bases compliance with this specification. The Commissioner's decision will be final.

CONSTRUCTION OF FIBERGLASS BASE

4.
 - (a) Each pedestal base must be formed of a fiberglass composite consisting of a polyester resin and containing a minimum of 65% fiberglass by weight. The resin must contain no clay fibers. The composite must be UV and weather resistant. Alternate materials may be considered. Each base half must be permanently marked on the inside identifying it as a base for a Chicago 2000 assembly.
 - (b) The split pedestal base must conform in detail and dimensions to Standard Electrical Drawings 808, 824, 827 and 986.
 - (c) The two halves of the clamshell must be identical to each other. They must be perfectly matched and when installed there shall be no more than a 0.125 inch gap between the inside top of the assembled base and the outside surface of the mast.
 - (d) Once installed, the base should be designed to remain in place without the use of set screws. An installed base should not be able to be shifted or rotated.
 - (e) The color of the base must be gloss black and must match the color of existing and proposed light 3 gauge and 7 gauge steel anchor base poles with mast arm supports. The resin must contain color pigment throughout. The pigment must be even throughout the thickness of the base. A finish coat of urethane enamel must be applied to the surface of the base to a minimum dry thickness of 1.5 mils. The resin color must match the enamel color. A paint sample on fiberglass must be submitted for approval prior to production. The paint manufacturer's name and any information necessary to acquire the same color for the pole must be provided. The contractor must supply one quart of touch-up paint for every 50 bases ordered.
 - (f) The texture of the fiberglass base exterior surface must be equal to that of a cast iron base. Acceptance of the aesthetic appearance of the base will be by the Commissioner.
 - (g) The two halves of the shroud must be affixed by means of screws as shown on the Standard Drawings. The screws must fit so that the halves of the base are drawn together so that the edges of the base fit snug against each other. Threaded stainless steel inserts in the base must be used to affix the screws. The screws must not detract from the appearance of the base. Other methods of attachment may be considered. Any method of attachment must be approved by the Commissioner.

TESTING

5. (a) Testing. All completed fiberglass bases must be available for testing. Unless specifically authorized in writing, all tests must be at the manufacturer's plant. A record of every test must be made and a certified copy of the test record must be submitted to the Commissioner before the units are shipped. Tests shall be standardized according to ASTM requirements or other suitable organization's standards. The manufacturer must provide evidence that the bases are structurally sound and are able to take the normal abuse of salt spray, freeze-thaw cycles, and exposure to moisture. The bases must be impact resistant and must be resistant to UV damage.

PACKAGING

6. (a) General. The split pedestal bases must be carefully inspected at the factory prior to shipment to assure that the bases are complete and free of defects. When bases are stacked together, they must be supported with suitable spacers or must otherwise be protected from dents and other potential shipping damage. The spacing and protective materials must be suitable for and usable in the storage of the bases. All hardware must be packaged in a clear container and labeled as to size, quantity, and part association.
- (b) Packaging. The split pedestal bases must be shipped on pallets with at least six units per pallet. Each base must be individually wrapped and protected so that it can be bundled and unbundled without damage to the base or its finish. The base wrapping must be labeled to identify the base. Specific instructions must be securely attached to each pallet indicating the proper methods of storage. In addition, each pallet must contain specific instructions on the installation of the split pedestal bases. Instructions must be printed on a fiber based paper with a permanent ink so that instructions will be completely legible after weathering outdoors for a minimum of 5 years. The pallets must be labeled in 3/8 inch high lettering indicating the type of base as "FIBERGLASS BASE FOR CHICAGO 2000 SYSTEM", the part number, the manufacturer, the date of manufacture, and the contract number.
- (c) Hardware. Any hardware not attached to the bases must be carefully wrapped and securely attached to each pallet. Hardware must be packaged in a clear bag with a label indicating the type of hardware and quantity. Payment will be withheld for any units provided without the appropriate hardware, or for any missing or improper packaging or labeling. Cracked,

broken, chipped or damaged units will also be considered as incomplete quantities as regards payment.

- (d) Touch-up Paint. Touch-up paint and appurtenant materials must be packaged in units sufficient for the number of bases on each pallet. These units will be securely attached to each pallet.

**ELECTRICAL SPECIFICATION 1611
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 9, 2021**

**ROADWAY LED LUMINAIRE
ORNAMENTAL TEARDROP FOR ARTERIAL STREETS**

I. SUBJECT

- A. This specification states the requirements for an ornamental Tear Drop LED street light luminaire. The luminaire shall be for arterial street lighting. The overall shape of the luminaire shall be historic teardrop. The LED luminaires will be integrated into a centralized lighting management system. The luminaire must include a fitter and must be fabricated for attachment to a 2" O.D. steel mast arm on a Chicago 2000 light pole system. The luminaire shall be mounted at 30 feet above grade.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid

- Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Vibration”
- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The bidder shall submit the following information pertaining to the specified luminaire type:

A. Completed ATTACHMENT B – Submittal Form

B. Product Data Sheets.

a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).

b) LED Driver data sheet – including information described in LED Driver Requirements Section III-D-3.

c) LED light source data sheet

d) Surge protection device data sheet - if applicable

C. Photometric Performance Data

If requested by the Chief Procurement Officer, the bidder shall provide photometric calculations, within fifteen (15) days of such request, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.

b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.

- ANSI/IES LM-80-15 and in-situ temperature measurement testing

(ISTMT) reports containing data used in TM-21 calculations must also be submitted.

- TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the Design Lights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the Design Lights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

- D. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
- E. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 1 (1.5 G).
- F. Product Sample. If requested by the Chief Procurement Officer, a sample of the luminaire that the bidder proposes to provide must be submitted to the City within fifteen (15) days of such request. The sample must be a representative production unit and be supplied at no cost to the City.
- C. Assembly.
Luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.

- The inability of a luminaire to be dimmed will constitute a luminaire failure.
- Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
- The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded. The luminaire must perform with the power provided by ComEd.

E. Manufacturing Experience and Capacity

The manufacturer must demonstrate at least a five year history of manufacturing LED roadway and outside area luminaires. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

III. CONSTRUCTION

A. Cast Housing and Fitter

1. Material

- a) Each housing and fitter must be cast aluminum, ASTM Grade 356, conforming to the Aluminum Association Standards for Aluminum Sand and Permanent Mold Castings, Washington, D.C., March 1980.
- b) The housing and fitter must conform in detail and dimensions to the applicable portions of Electrical Standard Drawing 931.
- c) Each casting must be die cast or made by the permanent mold process; sand castings will not be acceptable.
- d) Minimum thickness will be 3/16", excluding the fitter attachment to the pole, and will be uniform within each casting and throughout all castings in an entire order. Inconsistencies in casting thickness will be cause for rejection of the entire lot.

2. Appearance

- a) Castings will have smooth external surfaces free from protuberances, dents, cracks, or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited.

3. Housing

- a) The housing must enclose the LED array, electronic driver, terminal block, with provision for proper mounting of these parts.
- b) The housing must be of such size and surface area, or must have "heat

sink” characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions.

4. Fitter

- a) The fitter must be suitable for attachment over the end of a two inch (2") steel mast arm inserted against a built-in pipe stop. The slip-fitter must be designed to permit adjustment of not less than three (3) degrees above and below the axis of the mounting bracket to compensate for slight misalignment. The fitter attachment to the pole mast arm must provide the structural integrity to hold the luminaire firmly in place during the vibrations anticipated due to wind loading, passing elevated trains and heavily loaded vehicles. Two 3/8-16, stainless steel (type 304) U-shape bolts must be used to secure the fitter to the pole mast arm. A minimum of 3/4" thickness of metal will be provided where the U-bolts are inserted to minimize the possibility of stripping the threads when the hardware is tightened into place. The hardware must include 3/8" x 16 threaded, stainless steel bolts and nuts; four sets of nuts and washers must be provided where the cobra-head style leveling device and fitter attaches to mast arm. The U-bolts must be properly installed and torqued in accordance with the manufacturer's written installation instructions. The fitter must be securely threaded into the cast housing such that it will remain an integral part of the luminaire during the vibrations described above. The slip-fitter will contain an approved shield around the pipe entrance to block entry of birds.

B. Cast Housing and Fitter Painting

1. Oil and Grease Removal
 - a) All metal surfaces must be washed with an alkaline detergent to remove any oils or grease.
2. Chemical Pretreatment
 - a) The cleaned metal surfaces must be rinsed with de-ionized water
 - b) Treated with a hot, pressurized phosphate wash and sealer
 - c) Rinsed again with de-ionized water, and then dried by convection heat.
3. Exterior and Interior Coat
 - a) A thermosetting, weathering, polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform four mil thickness in a one coat application.
 - b) This powder coat must be cured in a convection oven at a minimum 400°F to form a high molecular weight fusion bonded finish.

4. Alternate Methods
 - a) Alternate coating methods may be reviewed and tested on a case-by-case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified
 5. Durability
 - a) Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% Na Cl (by weight) solution at 95°F and 95% relative humidity without blistering.
 - b) Before test, the panel must be scribed with an "X" down to bare metal.
 6. Coating Measurement
 - a) Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges", except that the lowest "single spot measurement" must not be less than 3.0 mils.
 7. Color
 - a) Preferred color will be gloss black. A 4" square color chip sample must be submitted for approval prior to fabrication.
 - b) The chip sample must be of the same material as the capital, and must include the manufacturer's name and the manufacturer's color name as well.
 - c) The sample must also include any other information which will be required to purchase the same color for the poles and split pedestal bases.
- C. Optical Assembly
1. Refractor
 - a) The refractor shall be pressed DR acrylic. It must be clear and free from imperfections.
 - b) It must contain prisms where necessary, and must be optically designed to redirect by refraction the light from the array and reflector to produce the desired light pattern.
 - c) The refractor must conform to that shown on the Electrical Standard Drawing 931.
 - d) The holder-door must be a precision, aluminum ASTM Grade 356 permanent mold casting which must be hinged to the luminaire housing and must open downward approximately 90 degrees to allow servicing.

- e) The hinging arrangement must be of rugged construction with corrosion resistant hinge fittings.
- f) The hinge must prevent the holder-door from disengaging and dropping in case it should swing open.
- g) The door must also be connected to the housing with a stainless steel cable. The refractor must be securely held in the holder-door. The entire assembly should be easily disconnected for replacement. When closed, the holder-door must lock the assembly in precise optical alignment with the housing.
- h) A sturdy, positive-acting, spring loaded latch will permit single-glove-handed release, and on closing, the holder-door must provide a definite snap action or visual indication that it is locked.
- i) A silicone rubber, EPDM (ethylene propylene diene monomer), or EPR (ethylene propylene rubber) gasket must be fixed in place to seal the refractor door to the main housing.
- j) A “breathing” filter of Fiberglass or other approved material must be incorporated in the reflector for sealed optical units. It must effectively filter out dirt and particle size contaminants.

D. Electrical Components

- 1. LED Optical Array.
 - a) The LED arrays shall be optimized for the required roadway photometrics. The arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
 - b) The optical assembly shall consist of the LED array, the refractor, the refractor holder-door, gasketing, and all associated items.
 - c) The LED optical assembly shall be rated IP66 for ingress protection for dust and water.
 - d) The optical unit as a whole must provide as similar as an IES Medium Cut-off Type II/III distribution.
- 2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible location.
 - b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire

components, must be provided.

- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage.
 - The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz.
 - It must automatically sense the input voltage and adjust the output accordingly.
 - The City uses nominal input voltages of 120, 208, and 240 for street lighting.
 - When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 32\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- g) Electrical Transient Immunity:
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.

- Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Enhanced (10 kV / 5 kA) combination wave test level.
- Transient Immunity Testing Requirements:
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.

- If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.
- h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range. Wiring.
- a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.
- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.
4. Control Device Receptacle and Cap.
- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing or appropriate location with provision for proper positioning of the control device.
- b) 7-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41.
- c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
- d) Receptacle Wire Leads must all be properly terminated.

- e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
 - f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications
5. Component Mounting.
- All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

A. Light Pollution.

To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).

B. Lumen Maintenance.

1. LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
2. Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.
 - a) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
 - b) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
 - c) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

C. Color Attributes

1. Color Rendering Index (CRI) shall be no less than 65.
2. Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

A. City of Chicago Typical Ornamental Lighting Contexts

ATTACHMENT A (below) lists the photometric performance requirements for luminaires used in the following typical municipal outdoor arterial ornamental lighting applications:

- Arterial Streets – two-sided opposite pole spacing
- Arterial Streets – two-sided staggered pole spacing

ATTACHMENT A – Photometric Performance Requirements

TYPICAL LIGHTING CONTEXT	ARTERIAL		
	OPPOSITE	STAGGERED	
POLE CONFIGURATION*			
RIGHT OF WAY (Width)	100 ft.	80 ft.	66 ft.
IES PAVEMENT CLASS	R3	R3	R3
STREET WIDTH (Curb to Curb)	80 ft.	60 ft.	48 ft.
LANES (Incl. Parking & Median)	7	6	4
PARKWAY (Width)	4 ft.	4 ft.	N/A
SIDEWALK (Width)	6 ft.	6 ft.	9 ft.
HEIGHT TO LUMINAIRE	30 ft.	30 ft.	30 ft.
MAST ARM LENGTH	8 ft.	8 ft.	8 ft.
POLE SETBACK (From Curb to Center of Pole)	3 ft.	3 ft.	3 ft.
IN-LINE POLE SPACING	100 ft.	150 ft.	175 ft.
LUMINAIRE REQUIREMENTS	OPPOSITE	STAGGERED	
Max Input Power - Default /Normal Luminance (Watts)	180	180	180
Default/Normal AVG. Luminance (cd/m ²)	≥1.7	≥1.7	≥1.7
AVG/MIN Uniformity Ratio	≤ 3:1	≤ 3:1	≤ 3:1
MAX/MIN Uniformity Ratio	≤ 5:1	≤ 5:1	≤ 5:1
MAX Veiling Luminance Ratio	≤ 0.3	≤ 0.3	≤ 0.3
AVG. Boosted Luminance (cd/m ²) [Add-Alternate]	≥2.5	≥2.5	≥2.5
SIDEWALK			
Default AVG. Horizontal Illuminance (fc)	≥0.50	≥0.50	≥0.50
AVG. MIN Uniformity Ratio (Horizontal Illuminance)	≤ 4:1	≤ 4:1	≤ 4:1
LIGHT TRESPASS RESTRICTIONS - (as measured in a vertical plane 10' beyond ROW ≤3' height)			
MAX Vertical Illuminance	≤ 0.3	≤ 0.30	≤ 0.30

ATTACHMENT B - Product Submittal Form

Lighting Context	e.g. Arterial Ornamental Wide		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial		lumens	
Luminaire input power—initial		watts	
Luminaire input power— maintained		watts	
Luminaire input voltage- nominal range		volts	
LED drive current - initial		milliamps	
LED drive current - maintained		milliamps	
CCT (correlated color temperature)		kelvin	
CRI (color rendering index)			
EPA (effective projected area) - nominal		sq. ft.	
Luminaire Weight - nominal		lbs.	
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10V	<input type="checkbox"/> Dimmable, DALI	
LED driver- rated life		years	
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31		<input type="checkbox"/> Level 2	
Luminaire warranty period		years	
IES LM-80 test duration		hours	IES LM-80-15 report
LED lumen maintenance at 36,000 hours		%	TM-21 calculator
Max. LED case temperature		degrees Celsius	ISTMT report

**ELECTRICAL SPECIFICATION 1612
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 9, 2021**

**ROADWAY LED LUMINAIRE:
ORNAMENTAL ACORN FOR ARTERIAL STREETS**

I. SUBJECT

- A. This specification states the requirements for an ornamental Acorn LED street light luminaire. The luminaire shall be for arterial street lighting. The overall shape of the luminaire shall be historic acorn. The LED luminaires will be integrated into a centralized lighting management system. The luminaire shall be mounted on a tenon at a mounting height of 14, 16 or 23 feet above grade and be similar to an IES Type II/III medium non-cutoff distribution. The luminaire will be used to provide roadway lighting for arterial streets.

II. GENERAL

- A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment–Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The bidder shall submit the following information pertaining to the specified luminaire:

A. Completed ATTACHMENT B – Submittal Form

B. Product Data Sheets.

a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).

b) LED Driver data sheet – including information described in LED Driver Requirements Section III-D-3.

c) LED light source data sheet

d) Surge protection device data sheet - if applicable

C. Photometric Performance Data

If requested by the chief Procurement Officer, the bidder shall provide photometric calculations, within fifteen (15) days of such request, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.

b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.

- ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.

- TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pdf).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the Design Lights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the Design Lights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

- D. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
- E. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 1 (1.5 G).
- F. Product Sample. Upon a request from the Chief Procurement Officer, a sample of the luminaire that the bidder proposes to submit must be delivered to the City, within fifteen (15) days of such a request.. Sample must be representative production unit and be supplied at no cost to the City.
- C. Assembly.
Luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded. The luminaire must be operable with the

power conditions supplied by ComEd.

E. Manufacturing Experience and Capacity

The manufacturer must demonstrate at least a five year history of manufacturing LED roadway and outside area luminaires. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

III. CONSTRUCTION

A. Capital and Finial

1. Material

- a) Each capital and finial shall be cast aluminum conforming to American Die casting Standard ADC-1-C9-83 grade 380.
- b) The capital shall fit over a 3" high by 3" O.D. tenon.
- c) The capital attachment to the tenon shall provide the structural integrity to hold the luminaire firmly in place during the vibrations anticipated due to passing heavily loaded vehicles, wind loading, and inclement weather.
- d) A minimum of 3/16" thickness of metal must be provided where the set screws are inserted to minimize the possibility of stripping the threads when the set screws are tightened into place.
- e) The set screws must be 5/16-18 stainless steel hex head screws. A minimum of three (3) set screws must be provided, evenly spaced at 120° apart.
- f) The finial shall be securely attached to the acorn globe such that it will remain in place during the vibrations described above.
- g) The casting must have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited.
- h) Each casting must be die cast or made by the permanent mold process; sand castings will not be acceptable.
- i) Minimum thickness will be 3/16", and will be uniform within each casting and throughout all castings in an entire order. Inconsistencies in casting thickness will be cause for rejection of the entire lot.

2. Appearance

- a) The capital shall conform in appearance to that shown on Electrical Standard

Drawing Number 912.

- b) Similar designs must be approved by the Commissioner. The Commissioner's decision of what constitutes a similar design will be final.

B. Cast Housing and Fitter Painting

1. Oil and Grease Removal
 - a) All metal surfaces must be washed with an alkaline detergent to remove any oils or grease.
2. Chemical Pretreatment
 - a) The cleaned metal surfaces must be rinsed with de-ionized water
 - b) Treated with a hot, pressurized phosphate wash and sealer
 - c) Rinsed again with de-ionized water, and then dried by convection heat.
3. Exterior and Interior Coat
 - a) A thermosetting, weathering, polyester powder coat must be applied electrostatically to all cleaned and treated surfaces to a uniform four mil thickness in a one coat application.
 - b) This powder coat must be cured in a convection oven at a minimum 400°F to form a high molecular weight fusion bonded finish.
4. Alternate Methods
 - a) Alternate coating methods may be reviewed and tested on a case-by-case basis. However, no coating method will be accepted unless the Commissioner judges such alternate to be equal to the coating herein specified
5. Durability
 - a) Both the exterior and interior coats must be capable of passing 1,000 hours of salt spray exposure as per ASTM B117 in a 5% Na Cl (by weight) solution at 95°F and 95% relative humidity without blistering.
 - b) Before test, the panel must be scribed with an "X" down to bare metal.
6. Coating Measurement
 - a) Measurement of coating thickness must be done in accordance with SSPC-Pa 2-73T, "Measurement of Dry Paint Thickness with Magnetic Gauges", except that the lowest "single spot measurement" must not be less than 3.0 mils.
7. Color
 - a) Preferred color will be gloss black. A 4" square color chip sample must be submitted for approval prior to fabrication.

- b) The chip sample must be of the same material as the capital, and must include the manufacturer's name and the manufacturer's color name as well.
- c) The sample must also include any other information which will be required to purchase the same color for the masts, mast arms and split pedestal bases.

C. Optical Assembly

1. Acorn Globe and Reflector

- a) The Globe shall be constructed of clear, V825 HID acrylic utilizing a slip-fit 1/2" overlap, two piece which eliminates a "butt-glue" seam appearance.
- b) The Globe must conform to that shown on Electrical Standard Drawing 912.
- c) The bottom optical section of the globe must have a neck opening of 7-1/4" at the smallest diameter and an outside dimension of 8" at the bottom; be a minimum of 12-3/4" in height and 16 1/2" in width at the top.
- d) The top section of the globe must be "Victorian" in appearance; a minimum of 13" in height and 16.313" in width with 100 horizontal prisms to evenly diffuse light. If so requested, a full top reflector of the same diameter as the globe shall be installed between the halves and secured to the globe. The top and bottom sections shall be secured in a slip-fit overlap design using four #10 -24 x 5/8 stainless steel pan head screws with four aluminum nutserts providing a mechanical lock. In addition, a sealant must be applied to the two halves to provide a dust-proof seal.
- e) The globe shall be mounted with four 5/16-18 hex head, stainless steel bolts with stop nuts mounted into the die cast fixture housing.
- f) The hex head bolts must securely contact an aluminum globe neck ring connected to the acorn globe. The globe must be clearly marked and keyed so that it will be properly installed to provide the required house side/street side photometrics. The mounting must afford the rigidity necessary to prevent the globe from twisting or rattling when subjected to the vibrating forces of passing elevated trains or heavily loaded vehicles. The mounting must not preclude any globe from being mutually interchangeable with any other globe intended for this function.
- g) A top reflector and a house-side reflector shall be provided, if requested.
- h) The reflectors shall be mounted to a removable bracket.
- i) The small dome shaped top reflector, approximately 6.5 inches in diameter and 3 inches deep shall be mounted on the bracket and attached by a spring clamp, or other suitable means.

- j) The side reflector shall be mounted to the same bracket. The reflectors shall be constructed of aluminum and polished to a high specular finish. Reflectance of the reflecting surfaces shall not be less than 75%. Measurements shall be made with a reflectometer using the fiber-optic method.

D. Electrical Components

1. LED Optical Array.

- a) The LED arrays shall be optimized for the required roadway photometrics. The arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
- b) The optical assembly shall consist of the LED array, the refractor, the refractor holder-door, gasketing, and all associated items.
- c) The LED optical assembly shall be rated IP66 for ingress protection for dust and water.
- d) The optical unit as a whole must provide as similar as an IES Medium Cut-off Type II/III distribution.

2. Terminal Block

- a) A terminal block of high grade board of molded phenolic plastic shall be mounted to the capital in a readily accessible location.
- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage.
 - The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz.
 - It must automatically sense the input voltage and adjust the output accordingly.
 - The City uses nominal input voltages of 120, 208, and 240 for street lighting.

- When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
 - c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
 - d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 32\%$.
 - e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
 - f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
 - g) Electrical Transient Immunity:
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Enhanced (10 kV / 5 kA) combination wave test level.
 - Transient Immunity Testing Requirements:
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.

- If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.
- h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.
4. Wiring.
- a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.
 - b) All wires within a single circuit path must be of the same size.
 - c) No wire-nut splicing will be allowed.
 - d) No unnecessary splices will be allowed.
 - e) Quick disconnects must be provided for all components.
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5. Component Mounting.
- All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

A. Light Pollution.

To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).

B. Lumen Maintenance.

1. LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.

2. Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.

a) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,

b) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and

c) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

C. Color Attributes

1. Color Rendering Index (CRI) shall be no less than 65.
2. Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

A. City of Chicago Typical Ornamental Lighting Contexts

ATTACHMENT A (below) lists the photometric performance requirements for luminaires used in the following typical municipal outdoor arterial ornamental lighting applications:

- Arterial Streets – two-sided opposite pole spacing
- Arterial Streets – two-sided staggered pole spacing

ATTACHMENT A – Photometric Performance Requirements

TYPICAL LIGHTING CONTEXT	ARTERIAL		
	POLE CONFIGURATION*	OPPOSITE	STAGGERED
RIGHT OF WAY (Width)	80 ft.	66 ft.	66 ft.
IES PAVEMENT CLASS	R3	R3	R3
STREET WIDTH (Curb to Curb)	60 ft.	48 ft.	48 ft.
LANES (Incl. Parking & Median)	6	4	4
PARKWAY (Width)	4 ft.	N/A	N/A
SIDEWALK (Width)	6 ft.	9 ft.	9 ft.
HEIGHT TO LUMINAIRE	23 ft.	23 ft.	16 ft.
MAST ARM LENGTH	1ft.	1ft.	1ft.
POLE SETBACK (From Curb to Center of Pole)	4ft.	4ft.	4ft.
IN-LINE POLE SPACING	125 ft.	200 ft.	X?x ft.
LUMINAIRE REQUIREMENTS	OPPOSITE	STAGGERED	
Max Input Power - Default /Normal Luminance (Watts)	180	180	180
Default/Normal AVG. Luminance (cd/m ²)	≥1.7	≥1.7	≥1.7
AVG/MIN Uniformity Ratio	≤ 3:1	≤ 3.5:1	≤ 3.5:1
MAX/MIN Uniformity Ratio	≤ 5:1	≤ 6:1	≤ 6:1
MAX Veiling Luminance Ratio	≤ 0.5	≤ 0.5	≤ 0.5
AVG. Boosted Luminance (cd/m ²) [Add-Alternate]	≥2.5	≥2.5	≥2.5
SIDEWALK			
Default AVG. Horizontal Illuminance (fc)	≥0.50	≥0.50	≥0.50
AVG.MIN Uniformity Ratio (Horizontal Illuminance)	≤ 4:1	≤ 4:1	≤ 4:1
LIGHT TRESPASS RESTRICTIONS - (as measured in a vertical plane 10' beyond ROW ≤3' height)			
MAX Vertical Illuminance	≤ 0.3	≤ 0.30	≤ 0.30

ATTACHMENT B - Product Submittal Form

Lighting Context	e.g. Arterial Ornamental Wide		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power—maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10V	<input type="checkbox"/> Dimmable, DALI	
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

**ELECTRICAL SPECIFICATION 1614
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
REVISED APRIL 9, 2021**

ROADWAY LED FLOOD LIGHT LUMINAIRE

1. SUBJECT

This specification states the requirements for a Light Emitting Diode (LED) flood light. The flood light will be mounted to either a street light pole or a traffic signal pole. The flood light will be integrated into a centralized lighting management system through a wireless mesh network.

2. GENERAL

2.1 References:

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.31-2015, “American National Standard for Roadway and

Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

2.2 Submittal Requirements:

The bidder shall submit the following information pertaining to the specified luminaire:

- (1) Completed ATTACHMENT A – Submittal Form
- (2) Product Data Sheets.

Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).

LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.

LED light source data sheet

Surge protection device data sheet - if applicable

- (3) Photometric Performance Data:

If so requested by the Chief Procurement Officer, the bidder shall provide photometric calculations, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below. Any information requested must be submitted to the City within fifteen (15) days of such request. :

IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.

ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.

ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be

submitted.

TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator

https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide

([https://www.designlights.org/content/qpl/productssubmit](http://www.designlights.org/content/qpl/productssubmit)).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

- (4) Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 - (5) Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
- 2.3 Sample. If so requested, a sample of the flood light of the manufacture intended to be furnished under this contract must be submitted to the Division of Electrical Operations within fifteen(15) days upon receipt of a request from the Chief Procurement Officer.
- 2.4 Assembly. Each luminaire shall be delivered completely assembled, wired, and ready for installation.
- 2.5 Warranty.
The luminaire manufacturer shall warrant the performance and construction of the luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship

or material developing within a period of ten (10) years from the date of acceptance by the City.

- The inability of a luminaire to be dimmed will constitute a luminaire failure.
- Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
- The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded, and within the existing ComEd power grid.

2.6 Manufacturing Experience and Capacity

The manufacturer shall have at least a five year history of manufacturing LED roadway and outside area luminaires. The manufacturer shall also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

3. CONSTRUCTION

3.1 Weight. The net weight of these luminaires shall not be more than 29 pounds.

3.2 Housing. The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

3.3 Mounting Provisions. The luminaire must include a heavy gauge knuckle fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe or tenon with a minimum of three (3) set screws. The fitter will be fitted with a knuckle joint to allow vertical positioning..

3.4 Access Door-Panel. An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

3.5 Hardware. All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other

non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

- 3.6 Finish. The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

3.7 Ingress Protection:

The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.

The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

3.8 General Luminaire Requirements.

The luminaire must be rated to operate between -40° to +50° Celsius.

The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver

The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the 0-10 VDC Node). This information will be transmitted through the networked Lighting Management control system.

3.9 Electrical Components:

(1) LED Optical Arrays

The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.

(2) Terminal Block

A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible location.

Terminal block wiring; all necessary terminals, pre-wired to all luminaire

components, must be provided.

Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.

Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

(3) LED Driver:

- (a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- (b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- (c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- (d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 32\%$.
- (e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- (f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- (g) Electrical Transient Immunity.
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for

electrical transient immunity, using the Enhanced (10 kV / 5 kA) combination wave test level.

- Transient Immunity Testing Requirements:
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
 - If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.

Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

- (h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

(4) Wiring.

All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.

All wires within a single circuit path must be of the same size.

No wire-nut splicing will be allowed.

No unnecessary splices will be allowed.

Quick disconnects must be provided for all components.

All wires must be properly terminated.

(5) Control Device Receptacle and Cap.

Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.

7-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.

3-prong Shorting Cap that meets ANSI C136.10 must be provided.

Receptacle Wire Leads must all be properly terminated.

Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.

Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

(6) Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

4. PHOTOMETRIC REQUIREMENTS

4.1 The light pattern shall be wide angle with a NEMA 6X6 distribution.

4.2 The initial light output shall be from 25,000 to 28,000 lumens.

4.3 Light Pollution.

(1) Lumen Maintenance.

- (a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
- (b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.

Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,

Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and

Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

(2) Color Attributes

- (a) Color Rendering Index (CRI) shall be no less than 65.
- (b) Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

ATTACHMENT A - Product Submittal Form

Lighting Context	e.g. Alleys		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial		lumens	
Luminaire input power—initial		watts	
Luminaire input power—maintained		watts	
Luminaire input voltage- nominal range		volts	
LED drive current - initial		milliamps	
LED drive current - maintained		milliamps	
CCT (correlated color temperature)		kelvin	
CRI (color rendering index)			
EPA (effective projected area) - nominal		sq. ft.	
Luminaire Weight - nominal		lbs.	
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life		years	
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31		<input type="checkbox"/> Level 2	
Luminaire warranty period		years	
IES LM-80 test duration		hours	IES LM-80-15 report
LED lumen maintenance at 36,000 hours		%	TM-21 calculator
Max. LED case temperature		degrees Celsius	ISTMT report

OUTDOOR CONTROL DEVICE RECEPTACLE FOR LED LUMINAIRE
SPECIFICATION

I. SUBJECT

A. This specification states the requirements for a Control Device Receptacle for outdoor lighting luminaires. The specified control device receptacle for outdoor led luminaires will be on Chicago residential streets, arterial streets, and alleys. The LED luminaires with receptacles will be integrated into a centralized lighting management system.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- A. ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing
- B. ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”

B. Warranty.

The control device receptacle manufacturer must warrant the performance and construction of control device receptacle to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.

III. CONSTRUCTION

A. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.
- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
- c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
- d) Receptacle Wire Leads must all be properly terminated.
- e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
- f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

B. Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

**LUMINAIRE: ORNAMENTAL, LED GASLIGHT STYLE
I.E.S. CUTOFF TYPE II/III DISTRIBUTION**

SUBJECT

1. This specification states the requirements for an ornamental gaslight style LED street lighting luminaire. The luminaire shall have an IES Type II/III cutoff distribution. The luminaire is to be mounted on the tenon of a 12 foot light pole. The LED luminaires will be integrated into a centralized lighting management system.

GENERAL

2. (a) Information. If so requested, the apparent low bidder shall submit the following information relative to the luminaire he proposes to furnish, within fifteen (15) business days of such request:
 1. Outline drawing.
 2. Complete description and weight.
 3. Luminaire efficiency.
 4. Projected area in square feet.
 5. Manufacturer's name and catalogue designation.
 6. Manufacturer's part list.
 7. IES formatted photometric curve in electronic format.
 8. Certified test reports.
- (b) Sample. One completely assembled luminaire of the manufacture intended to be furnished, shall be submitted upon request of the Chief Procurement Officer within fifteen (15) business days from receipt of notice.
- (c) Assembly. Each luminaire must be delivered completely assembled, wired, and ready for installation. The luminaire must consist of the capital and globe as shown on Electrical Standard Drawing 895, LED optical system as required to meet the photometric requirements of this specification, LED assembly, quick disconnects, terminal board, fuses, gaskets and all necessary hardware.
- (d) Warranty. The manufacturer shall warrant the performance and construction of these luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City. A reduction of lighting output of more than 30% within the ten years will constitute luminaire failure. Any luminaire or part thereof, not performing as required, or developing defects within this period must be replaced by a new luminaire, delivered to the City by the manufacturer, without expense to the City. The Commissioner will be the sole judge in determining which replacements are to be made and his decision will be final.

- (e) The manufacturer shall have a history of manufacturing roadway and outside area lighting for a minimum of five years. The manufacturer must demonstrate to the City that the manufacturer has the capacity to supply the quantities required for the contract in a timely manner.
- (f) Organizations. The following organizations' specifications are mentioned herein.
 - ANSI – American National Standards Institute
 - ASTM – American Society for Testing and Materials
 - IEC – International Electrotechnical Commission
 - IES – Illuminating Engineering Society
 - UL – Underwriters Laboratories

CAPITAL

- 3. (a) Material. Each capital, including the harp and roof ring, must be cast aluminum conforming to ASTM B26, Grade 319. The roof or top of the luminaire shall be spun aluminum, .090 inches thick. The finial shall be cast aluminum conforming to ASTM B26, grade 319.
- (b) Appearance. The capital shall conform in appearance to that shown on Electrical Standard Drawing Number 895.
- (c) Construction. Castings must have smooth external surfaces free from protuberances, dents, cracks or other imperfections marring their appearance. Welding or plugging of casting defects is prohibited.
- (d) Structural Integrity. The capital shall fit over a 3" high by 3" O.D. tenon. The attachment to the tenon must provide the structural integrity to hold the luminaire firmly in place during the vibrations anticipated due to passing heavily loaded vehicles, wind loading, and inclement weather. A minimum of 3/16" thickness of metal must be provided where the set screws are inserted to minimize the possibility of stripping the threads when the set screws are tightened into place. The set screws must be 5/16-18 stainless steel hex head screws. A minimum of three (3) set screws must be provided, evenly spaced at 120° apart.

The spun aluminum roof must be made to be easily removed to access the interior of the luminaire. Gasketing must be provided to provide a dust free and moisture free interior.

PAINTING

- 4. (a) Surface Preparation. Exterior surfaces of the capital shall be prepared by "Solvent Cleaning" per SSPC-SP1 using a solvent recommended for aluminum surfaces such as "Sherwin Williams MEK #R6K10." Solvent must be used as per written instructions of the manufacturer to remove all oil, grease, dirt and contaminants.
- (b) Primer Type. Within one hour of surface preparation, surfaces must be primed using a primer specifically recommended for aluminum surfaces such as "Sherwin Williams Industrial Wash Primer #P60GZ."
- (c) Primer Application. Primer shall be applied in accordance with written instructions of the manufacturer to produce a minimum dry thickness film of 3.0

mils. Primer must dry for a minimum of 30 minutes and a maximum of 60 minutes before application of finish coat.

- (d) Finish Coat. Finish coat shall be a polyurethane enamel specifically recommended for use over a primed aluminum surface. Two (2) coats of finish must be applied. Each coat must be a minimum of 1.5 mils dry thickness.
- (e) Durability. The paint must be capable of passing 1000 hours of salt spray as per ASTM B117.
- (f) Color will be semi-gloss black for the capital, rope harp, roof ring, and finial. Color of the roof shall be gloss white. Color samples will be approved by the Commissioner.
- (g) Alternate painting methods will be considered where the contractor can demonstrate to the satisfaction of the Commissioner that these methods have been in successful use for a five (5) year minimum period.

COMPONENT MOUNTING

- 5. (a) Modular Construction. All electrical components shall be securely mounted to the capital by means of easily removable stainless steel captive thumb screws or by easily operated stainless steel latches. The luminaire shall be designed to allow easy access to quick disconnects, terminal blocks and components for installation and maintenance.
- (b) Quick Disconnect. Wiring from the terminal block to the components must utilize a three (3) conductor, phenolic, polarized, quick disconnect device.
- (c) Interchangeability. The driver must be mutually field interchangeable so that units can be restored to working condition without trouble shooting components.

ELECTRICAL COMPONENTS

- 6. (a) LED Optical Array. The LED arrays shall be optimized for the required roadway photometrics. The arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance. The LEDs shall deliver a minimum of 70% of initial lumen output at 100,000 hours (L70 at 100K). LEDs shall provide a color rendition index (CRI) of 70. The color temperature of the LEDs shall be 4000° Kelvin. The optical unit shall have an IP66 rating.
- (b) Terminal Block, Fusing, and Wiring. A barrier type terminal board of molded phenolic plastic shall be mounted to the capital in a readily accessible location. The terminal block must have plated copper or plated brass, clamp type pressure terminals of an approved type which will accommodate incoming wire sizes ranging from #12 AWG to #8 AWG. The luminaire must be prewired from the terminal block to and including the electrical components. Two in-line fuse holders will be wired from the terminal to a quick disconnect; the wiring will continue from the quick disconnect to the components mounted on the plate. By disconnecting the quick disconnect, the electrical components on the mounting plate may be removed as a unit, and easily replaced. The in-line fuse holders must accommodate KTK fuses rated for 10Amp, 600VAC, and 100,1000AMP interrupting capacity. The fuses must be included. In lieu of in-line fuses, a fuse block must be provided which will accommodate the same size fuses.

(c) Driver Requirements:

1. Voltage. The electronic driver shall operate at a nominal input voltage range of between 120 and 277 volts, 60 Hertz.
2. The driver shall provide the proper operating voltage to the LED arrays. Output frequency must be equal to or greater than 120 Hertz to avoid flicker.
3. Power Factor. The power factor of the driver over the design range of input voltages specified above must not be less than 90%.
4. The driver input current must have Total Harmonic Distortion (THD) of less than 20% when operated at nominal line voltage.
5. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
6. The driver shall be short circuit protected and over load protected.
7. The driver must meet the EMI (electromagnetic interference) requirements of the FCC rules and regulations, Title 47 CFR, part 15 and 18.
8. The driver shall have a Class A sound rating per ANSI C63.4.
9. The drive current shall be as recommended by the manufacturer. The current level should be such that the LEDs are not overdriven or underdriven. LED current should produce the most efficient light output without compromising the life of the LEDs.

(d) Surge Protection. Surge protection shall be 10kV/10kA per ANSI C62.41.2. The surge protection device shall be a 3 wire device. The surge suppressor shall be NRTL listed and be in accordance with UL 1449.

(e) The minimum luminaire efficacy shall be 90 lumens per watt.

(f) Wiring. The LED array and driver components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor minimum. The use of wiring smaller than #16 AWG will require the written approval of the Commissioner. Color coding will be in a manner approved by the Commissioner. A complete wiring diagram must be displayed at an approved location on the interior of the luminaire and must include all luminaire and component identification and ratings. The wiring diagram must be provided on high quality material that will be resistant to cracking, yellowing, and fading in a luminaire environment. Quick disconnects must be provided for all components.

- (g) Control Device Receptacle and Cap.
1. Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.
 2. 7-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41.
 3. 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
 4. Receptacle Wire Leads must all be properly terminated.
 5. Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
 6. Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

GLOBE

7. (a) Appearance. The globe must conform in appearance and design to that shown on Electrical Standard Drawing Number 895.
- (b) Material. The globe must consist of a clear DR acrylic lens having a minimum cross-section of 3/32". The bottom portion of the globe must be frosted as shown on Standard Drawing 895. The lens must provide maximum resistance to ultra-violet degradation along with maximum mechanical durability.
- (c) Gaskets. Gasketing must be provided for the interface of the globe and capital to effectively provide a dustproof assembly. This proposed gasketing material must be shown to have been effective in other applications for a minimum period of five (5) years. Should the optical system also require a filter, it must be a charcoal "breathing" filter of adequate size to provide effective filtering of particle and gaseous contaminants.
- (d) Alternate Designs. Other designs providing the required photometrics and giving equal performance and structural rigidity will be considered. However, no alternates will be allowed without the express written consent of the Commissioner.
- (e) The completed luminaire must be listed by an independent, nationally recognized testing laboratory to verify that the luminaire does not present an electrical or fire hazard.

PHOTOMETRIC REQUIREMENTS

8. (a) The manufacturer must demonstrate that the luminaire shall meet or exceed the specified photometric requirements. The manufacturer must provide photometric calculations using published luminaire data as part of the submitted package. Submittal information must include computer calculations which demonstrate achievement of all listed performance requirements. Computer calculations must be performed for roadway lighting and for sidewalk/parkway lighting. The

submitted roadway lighting calculations must be done in accordance with I.E.S. RP-8-14, and must include point-by-point illuminance and luminance, as well as listings of all indicated averages and ratios. The submitted sidewalk/parkway calculations must be done in accordance with I.E.S. RP-8-14, and must include point-by-point horizontal illuminance and vertical illuminance, as well as listings of all indicated averages and ratios.

(b) Unless otherwise indicated, the light distribution will be classified as medium-cutoff-Type II or Type III (M-S-II or M-S-III), as defined in Appendix E of I.E.S. RP-8-14.

(c) Performance Requirements using this luminaire:

- 1. Roadway Illuminance:
 - Average Horizontal 1.00fc
 - Uniformity Ratio Av/Min 6:1
- 2. Roadway Luminance:
 - Average Luminance 0.7 cd/m2
 - Uniformity Ratio Av/Min 6:1
 - Uniformity Ratio Max/Min 10:1

The above requirements should be achieved using a light loss factor(LLF) of 0.7.

(d) Typical Roadway. Lighting should be designed for the specific roadway designated in the project. If there is no specific location, typical roadway values should be used. Typical values are as follows:

- 1. Right-of way 66'
- 2. Curb-to-curb 34'
- 3. Mounting height 14'
- 4. Setback 3'
- 5. Arm Length 0'
- 6. Overhang 0'
- 7. Opposite Pattern
- 8. Pole Spacing 100'
- 9. Pavement R3

TESTING

9. (a) Testing. All testing must be done on a prototype of the actual luminaire to be provided under this specification. If recent test results are available, they may be considered as meeting the testing requirements of this specification. The Commissioner or Commissioner's representative will have the final approval of which tests are adequate.
- (b) The manufacturer will be responsible for all costs associated with the specified testing, incidental to this contract.
- (c) Photometric testing must be in accordance with IES recommendations. The photometric tests must be conducted with a reference lamp and ballast. The tests, at a minimum, must yield:
- An isofootcandle chart with maximum candela and half maximum candela trace.
 - An isocandela diagram.
 - Maximum plane and maximum cone plots of candela.
 - A candlepower table (house and street side).
 - A coefficient of utilization chart.
 - A luminous flux distribution table.
- (d) The luminaire must meet the electrical and photometric requirements of IESNA LM -79.
- (e) The luminaire must meet the lumen maintenance requirements of IESNA LM -80.
- (f) The luminaire must meet the requirements of IESNA TM -21 for long term maintenance of LED light sources.
- (g) The LEDs must meet the requirements for chromaticity per ANSI C78.377.
- (h) The following applicable UL standards shall be met:
1. 8750 LED Light Sources in Lighting Products
 2. 1598 Luminaires
 3. 1012 power units other than Class 2
 4. 1310 Class 2 power units
 5. 2108 low voltage lighting systems

(i) Additional Types of Testing.

1. Interchangeability of all component parts.
2. Thermal testing in accordance with U.L. Standard 1572 or Standard 1598. The fixture must be placed in a controlled 25° Celsius environment and be energized for a minimum of 8 hours. At no time will any of the components exceed the manufacturer's recommended operating temperatures. At no time will any surface of the refractor exceed the manufacturer's recommended temperature limits.
3. Vibration testing in accordance with ANSI Standard C136.31. Upon completion of the test, all set screws, castings, and components must be secure and undamaged. The luminaire will not be energized during the test, and will not include the LED's and fuses. However, the luminaire must be fully operational after the test.
4. Moisture testing in accordance with U.L. Standard 1572 or Standard 1598. The luminaire will be subjected to a water spray from various directions for a sufficient amount of time to verify that the inside lamp compartment stays dry and that the fixture does not take on water. After the water spray the inside of the refractor must remain dry and the fixture should be demonstrated to operate properly.

PACKAGING

10. (a) Packing. Each luminaire assembly must be securely packed in a suitable carton so that it will not be damaged by shipment and/or handling.
- (b) Marking. Each carton containing a luminaire must be clearly marked on the outside in letters not less than three-eighths (3/8) inch tall with the legend: "ORNAMENTAL, GASLIGHT, LED, I.E.S. TYPE II/III". The appropriate City Commodity Code Number, the name of the manufacturer, the date of manufacture, and the contract number under which the luminaire is furnished shall also be listed.

**ELECTRICAL SPECIFICATION 1617
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
SEPTEMBER 16, 2019**

ACCESSIBLE PEDESTRIAN SIGNAL

SUBJECT

1. This specification states the requirements for an integrated accessible pedestrian signal assembly which will include a vibrotactile push-button with arrow, a speaker, a sign, and housing. This assembly will provide non-visual walk information for persons without sight or with low vision. The walk indications shall be both audible and vibrotactile. This assembly can be used for either actuated pedestrian signal crossings or for non-actuated pedestrian signal crossings.

GENERAL

2. (a) Specifications. The accessible pedestrian signal (APS) assembly must conform in detail to the requirements herein stated, and to the latest requirements of the Manual on Uniform Traffic Control Devices (MUTCD). The APS must also meet the most recent requirements of the Americans with Disabilities Act (ADA).
- (b) Acceptance. APS assemblies not conforming to this specification will not be accepted.
- (c) Bidders Submittal. Bidders must submit with their bids detailed specifications and any shop drawings that describe the physical appearance and the functionality of the APS.
- (d) Sample. One complete APS assembly of the manufacture intended to be furnished must be submitted within fifteen (15) business days upon request of the Chief Procurement Officer.
- (e) Warranty. The manufacturer must warrant the APS against defects due to design, workmanship, and material, for a period of five years from the date of acceptance by the City. If any assembly fails to properly function within this period, the manufacturer will replace the assembly, free of charge to the city, including shipping.

HOUSING

3. (a) The housing shall be cast aluminum. It shall be vandal resistant. The housing shall contain the speaker and the push-button, and be able to accommodate a 9 inch by 12 inch sign. The housing shall have a hole in the back to accommodate cable. The housing shall be mounted to a bracket with stainless steel screws.
- (b) A cast aluminum mounting bracket shall be supplied. The mounting bracket will be manufactured to be mounted onto a tubular shaped pole or post using two 3/4 inch steel bands (0.03 inches thick) or two stainless steel screws. The mounting bracket shall accept the APS housing.
- (c) The housing and bracket shall be powder coated Gloss Black with an enamel.

ELECTRICAL

4. (a) The APS shall operate on 12 volt DC.
- (b) A separate power supply shall be provided. The power supply will have its own housing and be able to be mounted in the WALK/DONT WALK signal compartment.
- (c) The power supply shall accept 120 volt ac input. There will be two inputs (WALK, DONT WALK) that will accept 89VAC to 250VAC at 120 VAC nominal, 27 watt maximum per input. Output shall be a maximum of 16VDC and 1.6 amps.
- (d) An MOV rated at 5 joules shall provide electrical protection. Each input shall be fused at 1.5 amps.
- (e) There shall be four input wires and four output wires. These wires shall be identified on the power supply: WALK, DONT WALK, NEUTRAL, and GROUND. The input wires shall be long enough to be terminated in the signal compartment. The output wires on the power supply shall have a single quick disconnect plug.
- (f) The push-button switch contacts must be normally open and must be closed when the push-button is pressed, restoring immediately to a normal open position when released. The switch must be electrically insulated from the housing. The push-button output rating shall be 36VAC/DC, 100mA.

PUSH-BUTTON

5. (a) The push-button must meet ADA requirements and the requirements of the MUTCD (Chapter 4E.11-4E.12).
- (b) The push-button must have a raised tactile arrow on its surface. The arrow must be adjustable, so that it can face in the direction of the associated crosswalk. The arrow will vibrate during the associated WALK interval.
- (c) If there is an actuated walk, pushing the button will send a request to the controller.

SOUND

6. (a) All sounds generated by the APS must meet the requirements of the MUTCD (Chapter 4E.11-4E.12).
- (b) Sound levels must be able to be manually adjusted. Sound levels must be in the 30dB to 90dB range.
- (c) The APS must include an option for automatic sound adjustment due to ambient sound levels.
- (d) The APS shall have a push-button locator "click" tone during DONT WALK and flashing DONT WALK intervals.
- (e) The APS shall have two options for the WALK interval. The APS shall generate a rapid "click" tone during the WALK interval or shall have a programmable voice message during the WALK interval.
- (f) When the push-button is pushed during the DONT WALK or flashing DONT WALK, the APS will respond with a voice message, either "wait" or another programmed voice message.

SIGN

7. (a) A 9" by 12" reflective sign that can be mounted to the housing back-plate shall be supplied.
- (b) The sign shall be an R10-2, "CROSS ONLY ON WALK (symbol) SIGNAL", an R10-3, "PUSH BUTTON FOR WALK (symbol)", or another sign as specified in the order or contract. Each sign shall contain a message in Braille meeting the requirements of the ADA (Americans with Disabilities Act).

ENVIRONMENT

8. (a) The APS shall function correctly within the temperature range of -34°C and +74°C.
- (b) The APS shall function correctly up to 100% non-condensing humidity.
- (c) The APS shall function correctly under the power conditions from Commonwealth Edison.

PACKAGING

9. (a) General. The APS must be shipped fully assembled and ready for installation. Each assembly must be individually wrapped and boxed so that the assembly is not damaged in shipment.
- (b) Labeling. Each box must be labeled in 3/8 inch high letters " ACCESSIBLE PEDESTRIAN SIGNAL". The City Commodity Code, contract number, manufacturer, and date of manufacture must be clearly labeled on the box.

**ELECTRICAL SPECIFICATION 1618
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
MAY 23, 2019**

CABLE: FLEXIBLE CORD FOR ACCESSIBLE PEDESTRIAN SIGNAL

SUBJECT

1. This specification states the requirements for an electrical cable to be used to connect a power supply located in the compartment of a WALK signal to an accessible pedestrian signal located either on the same pole or to another pole nearby.

GENERAL

2. (a) Specifications. The cable must conform in detail to the requirements herein stated, and to the applicable portions of the latest revisions of the specifications and methods of test of the following agencies:
 - (1) ASTM – American Society for Testing and Materials
 - (2) ICEA – Insulated Cable Engineers Association
 - (3) IEEE – Institute of Electrical and Electronics Engineers
 - (4) UL – Underwriters
- (b) Acceptance. Cable not conforming to this specification will not be accepted.
- (c) Bidders Submittal. Bidders must submit with their bids detailed specifications.
- (d) Sample. If requested by the Chief Procurement Officer, a three (3) foot sample of the cable intended to be provided under this specification must be sent to the attention of the Division of Electrical Operations within fifteen (15) days of receipt of such request.
- (e) Warranty. If the cables are installed within twelve (12) months of date of shipment, the manufacturer must replace any cable failing during normal and proper use within one year of the date of installation. All replacements under this warranty must be made free of charge F.O.B. delivery point of the original contract.

CABLE

3. (a) The cable shall be rated at 600 Volts.
- (b) The cable shall be classified as SOOW cord.
- (c) The conductors shall consist of uncoated annealed multiple strand copper meeting the requirements of ASTM B-174. The size of each conductor shall be No. 18AWG.
- (d) The cable shall contain four insulated conductors within a single jacket. The insulation for each conductor shall be ethylene propylene rubber (EPR), 30mils thick, or equivalent. The jacket shall be chlorinated polyethylene (CPE), 60 mils thick. Insulation and jacket shall be thermoset.
- (e) The insulation for the individual conductors shall be colored as follows: red, black, white, green. The jacket shall be black.
- (f) The cable shall meet the requirements of UL 62 for flexible cord.
- (g) The cable shall be UL listed for outdoor use and for water resistance. It shall be rated to operate in temperatures from -40°C to +90°C.

PACKAGING

4. (a) General. The cable must be delivered on sound substantial, non-returnable reels. Each reel must be marked with the manufacturer's name, footage, and any other pertinent information.

**ELECTRICAL SPECIFICATION 1619
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
DECEMBER 20, 2020**

**NEMA TS2-1 ADVANCED TRANSPORTATION CONTROLLER
AND NEMA TS2-1 SUPER P CABINET
WITH UNINTERRUPTIBLE POWER SUPPLY**

1. GENERAL REQUIREMENTS

- 1.1 This specification details the requirements for traffic signal control equipment for use in the City of Chicago. This equipment shall control traffic signal timing and sequencing at an intersection. The equipment shall include a battery back-up system which will maintain power to the signals during a power failure.
- 1.2 (Commodity contracts) If requested by the Chief Procurement Officer, within forty-five (45) business days from receipt of notice, the contractor must provide a sample to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. The sample must consist of the controller, cabinet, load switches, malfunction management unit, and all appurtenant wiring and equipment completely assembled as a working unit. If the sample is acceptable and the bidder is awarded a contract, the sample will become the property of the City with a suitable credit to the contract.
- 1.3 All tests as outlined herein must be regarded as minimum requirements. The contractor shall submit his testing procedure for approval prior to performing any testing functions. Upon successful completion of all testing, certified test reports shall be submitted for each unit. Units not successfully passing these tests or lacking proper documentation will be rejected. The manufacturer, or manufacturer's representative, shall be available for shop testing at the City's facilities.
- 1.4 Industry Standards. Equipment furnished under this specification must meet the appropriate requirements of the following standards, as required within the body of this specification:
- (1) NEMA Standard Publication No. TS2-2016
 - (2) American Association of State Highway and Transportation Officials (AASHTO)
 - (3) American Society for Testing and Materials (ASTM)

- (4) Institute of Transportation Engineers (ITE)
- (5) Manual on Uniform Traffic Control Devices (MUTCD)
- (6) National Electrical Manufacturers Association (NEMA)
- (7) Occupational Safety and Health Administration (OSHA)
- (8) Underwriters Laboratories (UL)

1.5 Standard Drawings. The Electrical Standard Drawing 962 “Load Switch and Conflict Assignment”, Electrical Standard Drawing 987A “NEMA TS2-1 Traffic Controller Cabinet Back Panel and Power Supply, 1 of 3”, Electrical Standard Drawing 987B “NEMA TS2-1 Traffic Controller Cabinet Back Panel and Power Supply, 2 of 3”, and Electrical Standard Drawing 987C “NEMA TS2-1 Traffic Controller Cabinet Back Panel and Power Supply, 3 of 3” are integral parts of this specification. The cabinet shall have bolt holes and a bolt pattern to match that shown on Electrical Standard Drawing 888A.

1.6 The manufacturer(s) shall warranty the performance and construction of the traffic signal controller and other major components to meet the requirements of this specification, and must warranty all parts, components, and appurtenances against defects in design, material, and workmanship for a period of five (5) years after written acceptance by the City. In the event of defects or failures during this period, the manufacturer(s) must repair and/or replace all defective or failed parts or appurtenances at no expense to the City. This is not meant to include labor.

1.7 The manufacturer of the controller and the manufacturer of the battery back-up system must demonstrate a knowledge of past production, or have been actively engaged in the sale and/or service of the equipment herein described, as demonstrated by a submitted list of comparable projects. The manufacturer must be a recognizable company that manufactures ATC controllers, such as Econolite, McCain, Siemens, or ORIUX (Peek Traffic).

2. CONTROLLER REQUIREMENTS

2.1 The controller must be an Advanced Transportation Controller (ATC) meeting the requirements of the specification “Advanced Transportation Controller (ATC) Standard Version 5.2b” dated June 26, 2006 and the requirements of NEMA TS2-2003. The referenced specification is a joint effort of AASTHO, NEMA, and ITE. All software necessary to make the controller operational must be included.

2.2 The controller must operate on 120 volt, 60 cycle (± 3 Hertz), single phase,

alternating current. The controller must function in the range from 89 to 135 Volts AC. The power consumed must be under 50VA.

- 2.3 Instructions. If requested, one (1) complete set of up to date instructions providing complete information on installation, adjustment, operation and maintenance, including both up to date "Logic Schematics" and "Electronic Circuit" diagrams, of these controllers, must be furnished to the Division of Electrical Operations. All information, including photos and schematics, must reference to the controller being furnished on this contract and must be a high quality, completely legible reproduction.
- 2.4 Training. If requested, the contractor shall provide training at the City's facilities. The training must be on the actual equipment provided under the contract, and must include, but not be limited to, programming all features, connecting and wiring, and troubleshooting. Training shall be structured for both field personnel and shop personnel.
- 2.5 The chassis shall be aluminum with a powder coat finish. No plastic chassis or composite chassis will be allowed. The controller must physically fit into 'SUPER P' cabinets configured for City of Chicago applications. The controller must not exceed the following dimensions: 12 inches high, 14.5 inches deep, and 15 inches wide.
- 2.6 The ATC processor shall have at least the following performance:
- (1) Clock speed - 300MHz
 - (2) Non-volatile Memory - 32MB Flash
 - (3) DRAM - 64MB
 - (4) SRAM - 1MB
 - (5) All memory and firmware must be stored in flash memory. No EPROMS will be allowed.
- 2.7 The display shall be a 16 x 40 backlit LCD using a 6 x 8 character font. Display and keypad must be permanently attached to chassis. Detachable keypads will not be allowed.
- 2.8 The controller must operate in the temperature range of -34° Celsius to +74° Celsius. The controller must operate within the relative humidity of 5% to 95%.
- 2.9 All printed circuit boards must be mounted vertically.
- 2.10 Encapsulation of 2 or more discrete components into circuit modules is

prohibited except for transient suppression circuits, resistor networks, diode arrays, solid-state switches, optical isolators and transistor arrays. All encapsulated components must be second sourced and must be of such design, fabrication, nomenclature or other identification as to be purchased from a wholesale distributor or from the component's manufacturer as a standard product. Custom encapsulated components are not allowed.

- 2.11 Obsolete components, components no longer supported by the manufacturer, components not recommended for new designs, components which have been discontinued or which the contractor should have reasonably been expected to know were discontinued, or components which the vendor/manufacturer has announced plans to discontinue at the time of the bid must not be used in the design of any subassemblies provided under this contract.
- 2.12 The controller must meet the functional and environmental requirements of NEMA TS2 2003. The use of 2070s and 170s is not allowed.
- 2.13 The controller shall communicate with the MMU, detection units, and the load bay via SDLC communications.
- 2.14 The controller shall utilize the BIU for communications.
- 2.15 Communication.
 - (1) NTCIP (National Transportation Communications for ITS Protocol).
 - a. The controller must be compliant with NTCIP Standards as outlined in NEMA TS2 – 2003 and must be tested and documented for compliance.
 - b. Global objects must be compliant to NTCIP 1201 v2.26 or later.
 - c. Actuated Signal Controller objects must be compliant to NTCIP 1202 v2.19f or later.
 - (2) Serial ports, one of which must be set as either RS-232 or RS-485.
 - (3) Ability to add an internal GPS module.
 - (4) Ethernet. The controller must be equipped with a minimum of two front panel mounted 10/100Mb Ethernet ports.
 - (5) A single port USB interface must be provided to facilitate database transfers, re-flashing of operation software and log transfer.
 - (6) The unit must be fully compatible with, and fully functional within,

the City's existing central signal system. Any additional software or hardware necessary to fully integrate the controller into the City's central signal system must be provided by the contractor and will be considered as part of the requirements of this specification.

- (7) A Windows based laptop utility software must be provided for data transfers and monitoring of controller operation.

2.16 Software operation.

- (1) The controller must have the ability to re-synch a minimum of 8 cycle lengths to an "absolute zero" reference point. It must be possible to set absolute zero by either global command or individual cycle length.
- (2) In addition to hardwire input, it must be possible to set Absolute Zero via keyboard command or via fiber optic communication.
- (3) The controller must have the ability to operate in two modes of operation, selectable by time of day:
 - a. Actuated control per NEMA TS2 – 2003.
 - b. Pretimed Interval based control per NEMA TS2 – 2003.
- (4) The controller must have the ability to transfer between actuated control and interval based control by time of day schedule.
- (5) The controller will have 32 Pre-timed plans
 - a. Each plan will allow for up to 32 timing intervals
 - b. Each plan will allow for 64 circuit outputs. Each output must be individually programmable per interval.
- (6) The controller must have 100 coordination plans.
- (7) The controller must provide 6 preempts per NEMA TS2-2003.
- (8) The controller must offer security as follows:
 - a. Two 4 digit security codes can be programmed (one for timing data, one for signal plan data), which when activated, allow data changes. These codes must automatically de-activate 10 minutes after the last user keystroke. It will be possible to re-program the security codes if the previous security code is known or has been defeated.

- b. It must not be possible to read the security code from the controller's display.
 - c. It must be possible to access the controller in the case of a lost security code through a "back door" which is provided only by the controller manufacturer. This "back door" security code must change based upon the controller's internal calendar.
- (9) The controller shall be programmed to energize the flash circuit if the MMU is removed or loses its supply voltage.

3. MALFUNCTION MANAGEMENT UNIT(MMU)

- 3.1 The cabinet assembly shall include a NEMA MMU for checking for conflicts in the signal output circuits. It must be a self-contained unit with its own power supply.
- 3.2 The MMU make and model shall be fully compatible with all other components of the cabinet assembly.
- 3.3 The cabinet assembly shall include one MMU as defined by the requirements of Section 4 of the NEMA TS2 Standard.
- 3.4 The MMU shall be a Type 16.
- 3.5 A removable programming card shall be supplied with the MMU for programming signal compatibility. The circuits for programming shall be composed of soldered jumper wires. Diode or dip switch type programming will not be acceptable. The programming card shall contain no circuitry or components other than the wire jumpers and the wire jumper soldering devices.
- 3.6 The MMU shall be programmed to put the controller in a flashing sequence upon detection of a failure or conflicting signal display. The MMU shall have a manual reset button to return the controller to normal operation after conflict circuit operation is no longer necessary.
- 3.7 A stop time control circuit shall be supplied from the MMU to force the timer unit to stop timing upon detection of a conflict.
- 3.8 The front panel of the MMU housing shall have LED indicators which will be activated when a conflict or failure occurs in accordance with Section 4 of NEMA TS2.

- 3.9 The MMU shall have a latch circuit, ensuring that if a voltage monitor failure occurs, the intersection remains in conflict until reset.
- 3.10 The MMU shall have the ability to store, in memory, a minimum of ninety-nine (99) conflict events, including date of conflict and channels conflicting.
- 3.11 MMU Assignments

Channel	Load Switch	Phase
1	1	1 Vehicle
2	2	2 Vehicle
3	3	3 Vehicle
4	4	4 Vehicle
5	5	5 Vehicle
6	6	6 Vehicle
7	7	7 Vehicle
8	8	8 Vehicle
9	9	Overlap A
10	10	Overlap B
11	11	Overlap C
12	12	Overlap D
13	13	2 Ped
14	14	4 Ped
15	15	6 Ped
16	16	8 Ped

- (1) It shall be possible for the user to change conflict assignments without unsoldering any connections.
- (2) All unused channels shall be neatly tied or terminal-mounted in such a manner that they are readily available in front of the panel. If tied, the harness wires shall be labeled. If terminal-mounted, the terminations shall be labeled.
- (3) A terminal shall be provided for the red enable feature.
- (4) A terminal shall be provided for the hook up of any unused red channels to AC.
- (5) Controller monitoring shall consist of: voltage monitor, 24VDC- I, 24VDC-II.
- (6) The output relay shall operate a sixty (60) ampere, normally open, "A" type mercury contactor without the use of an external or

“cabinet interface” relay.

4. SUPER P CABINET

- 4.1 The cabinet material shall be aluminum type 5052-H32. The enclosure thickness shall be at least 0.125 inch.
- 4.2 The cabinet shall be a P44 and dimensions shall be nominally 55.4 inches high, 57.8 inches wide, and 26.3 inches deep. The cabinet shall be of sufficient size to accommodate all equipment.
- 4.3 The cabinet shall have a rigid frame that does not flex. The cabinet shall be suitable for base mounting.
- 4.4 The top surface shall be pitched downward one inch toward the rear to draw moisture away from the cabinet door.
- 4.5 All interior seams shall be sealed with Room Temperature Vulcanizing (RTV) silicone or equivalent sealant.
- 4.6 The enclosure shall meet NEMA 3R rating requirements and shall include a UL approved label on the inside.
- 4.7 The interior of the cabinet shall be divided into two separate compartments; one will be the main compartment, and the other the UPS compartment.
- 4.8 Doors
- (1) The main door opening shall have a channel to prevent rain from entering the cabinet. The opening shall be at least 80% of the front surface.
 - (2) The main door shall be hinged on the right side. The battery compartment door shall be hinged on the left side.
 - (3) All cabinet doors shall have permanently bonded closed-cell, neoprene gasket seals. The gasket thickness shall be adequate to be compressed by the closed door to create a dustproof and weatherproof seal.
 - (4) Opening the door shall provide complete access to the cabinet interior. The door shall be embossed or have a permanently attached plaque, subject to approval, with the legend "CITY OF CHICAGO TRAFFIC CONTROL" in letters at least one (1) inch high. The main door and the battery compartment door shall have a mechanism that holds the door open at 90 degrees from the closed position in windy conditions. The door latches shall have a 3-point latching mechanism with rollers at the ends of

the latch rods.

- (5) The latch handle shall include a hasp to accommodate an optional padlock. Both the main door and the battery compartment door shall have stainless steel handles with an 8-inch shank. The handles shall be able to be padlocked. The cabinet door handle shall rotate counter-clockwise to open. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door.
- (6) All cabinet door hinges shall be one-piece, continuous piano hinges with with a one-quarter(1/4) inch removable, stainless steel pin running the entire length of the door. The internal hinge shall be attached to the cabinet with stainless steel bolts such that no rivets or bolts are exposed. The doors shall be interchangeable with any corresponding door from another cabinet of the same type from the manufacturer.
- (7) The key lock for the latch mechanism must be a cylinder lock with keys to match existing City controller cabinets. Two(2) keys shall be furnished with each cabinet.
- (8) The police panel door on the main door must be furnished with a lock for a modified Chicago police key per sample to be furnished to the supplier. This key must have a shaft of at least one and three quarter inches (1-3/4") in length. Two keys must be furnished with each cabinet. The door will have a stainless steel piano hinge and be sealed with a neoprene gasket.
- (9) A small, lockable door shall be provided on the rear of the cabinet that is sized to allow for a power cable from a temporary generator. This door shall have a stainless steel piano hinge and be sealed with a neoprene gasket. Two keys will be furnished for this door.

4.9 Ventilation

- (1) The lower section of the main cabinet door and the battery compartment door shall include a downward-louvered air vent. The vent size shall accommodate the fan air flow capacity. Louvers shall be compliant with the NEMA rod entry test for 3R ventilated enclosures. The louvered area shall have a securable space to hold a changeable air filter snugly against the inside of the cabinet door without gaps. The aluminum air filter shall be standard, commercially available item that is non-corrosive and blocks insects. For winter, each louvered section shall have a shutter that fits snugly in the opening to block snow, ice, and salt.
- (2) A screened exhaust vent shall be included in the air baffle at the top of the cabinet with a screened air outlet built into the roof overhang. The screen

openings shall not exceed 0.125-inch in diameter.

- (3) The cabinet shall be provided with at least two thermostatically-controlled ventilation fans: two fans at the top of the cabinet in the main compartment controlled by the main compartment thermostat and one fan at the top of the UPS compartment controlled by the UPS processor. Each fan assembly shall be adjustable between 55°F to 160° F. The fan plate shall be removable with the use of simple hand tools for serviceability. Each fan shall be a ball bearing type fan and shall be capable of moving air a minimum of 100 cubic feet per minute. Each fan/thermostat assembly shall be connected to the power panel.

4.10 Shelves

- (1) Cabinet shall include at least one 10-inch deep, removable shelf manufactured from 5052-H32 aluminum.
- (2) The front edge of the shelf shall include holes every 6 inches to accommodate cabling support.
- (3) Shelves shall be vertically adjustable and large enough to accept the ATC and all other shelf-mounted devices. The battery compartment shall have a minimum of three shelves. Shelves shall have sufficient strength to hold the weight of the cabinet components.

4.11 The bolt pattern shall match the pattern as shown on Standard Electrical Drawing 888A. Bolt holes shall accommodate 0.75-inch bolts. The cabinet flange for securing the anchor bolts shall protrude inward at the bottom of the cabinet.

4.12 An LED light strip with a minimum output of 1500 lumens shall be mounted in the cabinet to sufficiently illuminate the field terminals. The light shall be hard-wired to an ON/OFF toggle switch mounted on an inside panel.

4.13 Each interior wall of the cabinet shall include two vertical "C" channels to accommodate spring-mounted hardware to mount components. Each mounting rail shall extend to within 8 inches of the top and bottom of the cabinet.

4.14 Finish

- (1) All exterior surfaces of the cabinet shall be smooth. All drilled, tapped, or punched holes on the outer surface shall be filled with liquid metal and ground smooth, and slotted screw heads must be ground smooth flush with surface. Bolts extending through cabinet wall shall be round head, carriage, square shoulder type and fastened on the inside of the cabinet with a nut and necessary gaskets to ensure the weatherproofing integrity of the cabinet.

- (2) Cabinet shall be handled with care to avoid scratches.
- (3) All surfaces shall be free from weld flash. Welds shall be neat, smooth, and without irregularities.
- (4) All sharp edges present during fabrication shall be ground smooth.
- (5) The finished cabinet must be thoroughly degreased in a wash process and dried in a heated chamber. A thermosetting, ultraviolet resistant, polyester powder coat must be electrostatically applied to all cleaned and treated surfaces and cured to a hard, mar resistant finish in a heated chamber at a temperature recommended by the powder coat paint manufacturer. Exterior color must conform to Federal Standard 595 Number 17038 for gloss black, or another color as specified. Color samples must be submitted for approval prior to acceptance of cabinet. Cabinet interior must be glossy white and may be either baked enamel or thermosetting, polyester powder coat. For either process, the interior must be prepared as described above. If the baked enamel finish is used, it must be preceded by a 4-stage iron phosphate primer coating prior to painting. The final coat shall consist of a powder coat paint (TGIC or equivalent) applied with a minimum thickness of 2 mils.

4.15 A re-sealable print pouch shall be provided inside the cabinet. The pouch shall be of sufficient size to accommodate one complete set of folded cabinet prints. A minimum of two sets of complete and accurate cabinet drawings shall be supplied with each cabinet.

5. POWER SUPPLY

- 5.1 The power panel shall be located on the lower portion of the cabinet. It shall provide filtered power to the load switches and flasher(s).
- 5.2 Breakers shall be at a minimum, a thermal magnetic type, UL listed with a minimum of 10,000 amp interrupting capacity.
- 5.3 A sixty (60) ampere main breaker must be inserted in series with the line. The breaker shall supply power to the controller, MMU, signals, cabinet power supply, and auxiliary panels.
- 5.4 An un-fused terminal bus must be provided for ground side of the power supply and signal conductor commons.
- 5.5 Individual circuit breakers must be supplied for:
 - (1) AC+ lights, 50 amperes

- (2) AC+ control, 10 amperes
 - (3) power outlet supply, 15 amperes
- 5.6 The incoming line must contain lightning protection devices consisting of, but not limited to, a metal oxide varistor and gas type arrester. The gas type arrester must be on the line side of the radio interference filter.
- 5.7 A sixty (60) ampere, normally open, "A" type solid-state contactor must be supplied for opening and closing the AC supply to the signal bus. The contactor must be mounted in such a manner on the power supply panel that accidental contact does not produce a safety hazard.
- 5.8 A radio interference suppression filter rated at sixty (60) amperes minimum must be installed in line with the main power supply, after the sixty (60) ampere circuit breaker.
- 5.9 The grounded side of the power supply must be continuous throughout the controller and must be grounded to the controller cabinet in an approved manner meeting OSHA requirements.
- 5.10 The phase conductors of the signal circuits must have the same polarity as the phase side of the power supply, and the common conductor(s) must be of the same polarity as the grounded side of the power supply.
- 5.11 Power Supply
- (1) The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.
 - (2) The cabinet power supply shall provide LED indicators for the line frequency reference, 12VDC, 12VAC, and 24VDC outputs.
 - (3) The cabinet power supply shall provide jack plugs on the front panel for access to the +24VDC and +12VDC for test purposes.
- 5.12 A minimum of one 8-position neutral bus bar capable of connecting three #12 wires per position shall be provided.
- 5.13 A minimum of one 6-position ground bus bar capable of connecting three #12 wires per position shall be provided.
- 5.14 A minimum of one NEMA type 5-15R non-GFI utility power strip with a minimum of 6 outlets shall be provided. The strip shall be hard wired directly to power panel and shall not be connected to the UPS.

6. UNINTERRUPTIBLE POWER SUPPLY

- 6.1 The uninterruptible power supply shall consist of batteries which will recharge through the 120 volt electric service line. In the event of a power disruption, the unit shall automatically activate. The transfer from utility power to battery power shall not interfere with the normal operations of the traffic controller, MMU, or any other part of the traffic system. A generator port shall be provided to accept input from an external generator that can operate the traffic signals.
- 6.2 The UPS shall be the product of an established manufacturer, and suitable for the service required. The UPS manufacturer shall have been in the business for a minimum of five (5) years.
- 6.3 General Operation
- (1) The line power provided by ComEd is nominally 120 volt, single phase, 60 Hertz. The UPS system must take the line power, regulate it, and provide continuous 120 volt, single phase, 60 hertz power to the traffic system. The UPS must regulate the input line voltage within the limits specified herein.
 - (2) The input line voltage shall be transformed and rectified to charge the batteries. Under battery operation, the output from the batteries shall go through an inverter to provide the proper A.C. current to provide continuous 120 volt, single cycle, 60 Hertz power to the traffic system.
 - (3) In the event of a power loss, the system shall automatically switch to battery operation, without adversely affecting the traffic system. When power is restored, the system shall automatically switch back without adversely affecting the traffic system. In the event the UPS system fails, an automatic switch shall bypass the UPS and connect unconditioned power from ComEd directly to the traffic system. A manual bypass switch shall be provided. The system shall be capable of running on an external generator. The UPS shall allow the generator to be put in or out of the system without adversely affecting the traffic system.
 - (4) The system shall be capable of providing power for normal full timing mode, flash mode, or a combination of both. The operation shall be field programmable to activate at various times, to change operation due to changing battery capacities, and to track alarm conditions, using the touch pad or remotely using the serial or Ethernet communications interface. Programmability shall be in ASCII formats and shall not require any external or proprietary software. The DB-9 serial interface

port and the RJ45 Ethernet port shall be located on the front panel of the UPS. The UPS shall provide a minimum of 4 hours of full normal timing for a full LED controlled intersection.

- (5) In the event ComEd line voltage falls outside the high and low limits (95VAC and 130VAC should be the default values) the UPS shall transfer the load to battery power. The high and low limits shall be programmable.
- (6) The UPS shall return to line mode when the ComEd power is restored within the proper limits for a specified period of time. The limits shall be programmable. The default values shall be 105VAC and 125VAC. The time shall be programmable and shall range from 3 to 30 seconds.
- (7) The transfer time allowed, from disruption of normal utility line voltage to batteries or from batteries back to line voltage, shall be such that the traffic signal system is not disrupted. The maximum transfer time allowed shall be 60 milliseconds.

6.4 Specifications

- (1) The UPS capacity shall be a minimum of 2000VoltAmps/ 1500 watts.
- (2) The inverter shall have a minimum efficiency of 80%.
- (3) The UPS shall have an operating range of between -37°C. to +74°C.
- (4) The manual bypass switch shall be rated at 240 volts, 40 amps.
- (5) The UPS shall have a temperature- compensated battery charging system. The charging system shall compensate over a range of 2.5mV to 4 mV per degree centigrade per cell. Batteries shall not be charged when temperatures exceed 50°C. The temperature sensor shall be located in the cabinet near the batteries.
- (6) The charger shall be rated at 10 amps at 48 VDC.
- (7) When under battery operation the UPS output voltage shall be between 110 VAC and 125VAC, with a sine wave with THD less than 3% at 60 Hertz (± 3 Hz).
- (8) The UPS shall be equipped to prevent a malfunction feedback to the utility service or to the cabinet per UL 1778, Section 48 "Back-Feed Protection Test". The upstream back-feed voltage from the UPS shall be less than 1 volt AC.

- (9) The UPS shall have a lightning surge protection in compliance with IEEE/ ANSI C.62.41 for 2000 volts AC.
- (10) The UPS shall not weigh more than 50 pounds.
- (11) The UPS shall have a minimum efficiency of 95%.
- (12) The generator bypass switch shall be supplied with a 30 amp, weather-proof locking receptacle and cover plate.

6.5 Display and Functions

- (1) The UPS shall include an LCD display with programmable keypad, LED status indicators, and communications interface ports.
- (2) The UPS processor shall indicate, through the LCD display and the communications interface ports, the current battery charge status, various input/output voltages, power output, battery temperature, date, time, settings of programmable relays, events, and various other functions.
- (3) The UPS shall provide a temperature control for the cabinet fan in the battery compartment.
- (4) The UPS shall be provided with a resettable inverter event counter and a cumulative inverter timer.
- (5) The UPS shall include an event log for a minimum of 100 events. Each event shall have a date and time.
- (6) The UPS shall be capable of performing a self-test.
- (7) Password protection shall be provided.
- (8) The LED indicators shall cover the following conditions:
 - a. Alarm
 - b. Fault
 - c. Battery Mode
 - d. Line Mode
- (9) The manual UPS bypass switch shall allow the UPS to be maintained or replaced.

6.6 Batteries

- (1) Individual batteries shall be 12 volt, and must be commercially available and easily replaced.
- (2) Four 79 amp-hour batteries shall be supplied.
- (3) The batteries shall be connected in series. The wiring harness shall be color coded with quick disconnects.
- (4) Batteries shall be certified to operate over a temperature range of -25° C. to $+74^{\circ}$ C.
- (5) The batteries shall be rated for extreme temperatures, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (absorbed glass mat/valve regulated lead acid).
- (6) Maximum recharge time from protective low cut-off to 80% of full capacity shall not exceed 20 hours.
- (7) Thermostat- controlled heater strips or pads shall be supplied to keep battery operation efficient.

6.7 Relay Contacts

- (1) The UPS shall provide 6 sets of panel-mounted, potential-free, fully programmable relay contacts rated at 1 amp, 120 volt. The relays shall be numbered from C1 to C6.
- (2) Each relay shall be programmable to activate under any number of the following conditions:
 - a. ON BATTERY, relay activates when UPS switches to battery power.
 - b. LOW BATTERY, relay activates when batteries have reached a certain level of remaining capacity. This is adjustable from 0% to 100%.
 - c. TIMER, relay activates after battery power is on for a certain amount of time. This is adjustable from 0 to 8 hours.
 - d. ALARM, relay activates after a specific alarm is detected. Alarm conditions include line frequency, low output voltage, no temperature reading, overload, batteries not connected, high temperature, and low temperature.

- e. FAULT, relay activates after a specific fault is detected. Fault conditions include short circuitry, low battery voltage, high battery voltage, high internal temperature, and excessive overload.
- f. OFF, relay is not active.

7. LOAD SWITCHES

7.1 General

- (1) A panel shall be provided for mounting the load switch jacks, flash transfer relay jacks, flasher jack, auxiliary relays, time clock jacks, switches, flash change combination terminals, and terminals for field signal connections under non-interconnected operation. See Electrical Standard Drawings and 988.
- (2) Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.
- (3) the front of the load switch shall be provided with three LED indicators to show the input signal from the controller to the load switch.
- (4) Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.
- (5) The full set of load switches shall be supplied with the cabinet to allow for maximum phase utilization for which the cabinet is designed.

7.2 Each load circuit shall be capable of carrying fifteen (15) amperes continuously at a temperature of 165° F. (74° C.).

7.3 Bus feeds shall be capable of carrying fifty (50) amperes continuously at a temperature of 165° F. (74° C.).

7.4 Panel Wiring

- (1) Wiring shall be neatly laced and individual conductors shall be properly terminated. Wiring shall be insulated and properly sized for their application.
- (2) Wiring panel shall include the following:
 - a. Ten (10) ampere fuses with barrier type fuse holders shall be installed between the load switch signal output circuits and field terminals for signal light conductors. Each terminal shall be the barrier type with sufficiently long screws to accept four (4) #12AWG solid conductors. The terminals shall be located

at least two inches (2") above the bottom of the cabinet.

- b. The signal load switching device shall be a three (3) circuit, solid state, jack mounted load switch. Each load switch shall be rated for a minimum fifteen (15) ampere continuous resistive load and shall mate with an S-2412-SB panel socket. Sixteen (16) load switches shall be provided with each cabinet.
 - c. Two (2) sets of terminal blocks shall be provided between the machine logic output and the input side of the load switches. By terminating all machine logic output on one set of terminals and all load switch input to the other set, an interface is thus created by which the machine logic can be readily connected to any of the load switches by means of a jumper wire. The two (2) sets of terminal blocks shall be conveniently located in proximity to each other and shall be arranged such that, initially, each function will be factory wired directly from one set of terminals to the other without the need to crisscross wires between blocks.
- (3) Each panel shall be equipped with sixteen (16) load switch jacks for a minimum of forty-eight (48) signal circuits.
 - (4) All unused signal circuits shall be neatly tied or terminated. If tied, the harness wire must be labeled. If terminated, each termination must be identified.

7.5 All field terminals shall be suitably identified, subject to approval.

8. FLASHERS

8.1 General

- (1) The flasher shall be a solid state device, with no contact points or moving parts, producing between 50 and 60 flashes per minute with a 40 to 50 percent duty cycle. The flasher mechanism shall be mounted on a type P-406-SB plug which will mate with an S-406-SB socket on the controller panel. The flasher shall utilize zero-point switching, with turn-on at the zero voltage point (± 5 degrees) of the power line sinusoid.
- (2) The flasher shall conform to the requirements of Section 6.3 of the NEMA TS2 Standard.
- (3) Flashing of field circuits for the purpose of intersection flash shall be

accomplished by the cabinet flasher.

- (4) The flasher shall be rated at 15 amperes, double pole.
- (5) All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.
- (6) The coil of the flash transfer relay shall be de-energized for flash operation.
- (7) The full set of relays shall be provided with the cabinet to allow for maximum phase utilization for which the cabinet is designed.

8.2 A panel shall be provided with one (1) terminal wired to the flasher and marked "FL". The panel shall be equipped with terminals to provide or omit flashing of all red and yellow outputs.

8.3 Flashers shall provide two (2) output circuits to permit alternate flashing of signal phases and shall carry a minimum of twenty (20) amperes per circuit at 120 volts. The flasher shall operate continuously so that flashing power will be available at the field terminal marked "FL". The flasher wiring shall divide the loads imposed on the two (2) circuit flasher alternately on each phase.

8.4 A manual flash switch shall be included to provide flashing indication for all circuits. The flash change combination terminals shall allow the selection of flashing either yellow or red on the main and/or cross streets, or complete omission of the flashing feature if required.

9. POLICE PANEL

9.1 Each controller shall be provided with an auto-off-flash switch. In the "AUTO" position the signals shall be on and the controller timing unit shall run normally. In the "OFF" position the signals will be OFF and the controller timing unit will continue to run and the MMU shall not conflict or require reset. In the "FLASH" position the signals shall flash and the controller timing unit shall continue to run. The auto-off- flash switch shall be located on the side of the police switch panel that faces outward when the police door is open.

9.2 Each controller shall have an auto-hand switch on the back side of the police switch panel. This switch shall be so arranged that the switch can be physically rotated 180 degrees to provide usage after opening the police panel door. It must be so mounted that the act of rotation does not affect the police switch panel. Switch terminals shall not be exposed on either position. The auto-hand switch shall provide a means of manually timing the signals by use of a separate, momentary contact, hand switch. Operation of the timer by manual control shall provide the same color sequence as an automatic operation with no momentary

undesirable indications appearing. Manual control shall be possible with the door of the cabinet closed. The hand switch required for manual control shall only be supplied when specified in the contract. It shall be of an approved weatherproof construction with a six (6) foot, retractable, flexible, extension cord to allow connection to the appropriate terminals on the panel of the controller. It shall be possible to manually step through a vehicle clearance interval.

9.3 A two point terminal block shall be mounted on the back side of the police switch panel and the hand control circuit terminated on this block. This will be for installation of a hand control cord by others, as required.

9.4 Adequate room shall be provided in the police panel section to store the manual switch and retractable cord.

10. RELAYS

10.1 Eight (8) double pole, double throw, flash transfer relays shall be furnished with each controller. These relays shall be jack mounted into an S-408-SB, or equivalent, socket mounted on the controller panel.

10.2 Each contact arm shall have over travel on the front and back contacts and be independent of any other contact arms. No adjustment of contact pressure or wipe shall be necessary. Load capability shall be a minimum of fifteen (15) amperes per contact continuously and thirty (30) amperes for one (1) minute. Contacts shall be of coin or fine silver or an approved alternate.

10.3 A suitable dust cover shall be provided for each relay.

10.4 All relays shall meet their approved specified requirements and shall have contacts which cannot be opened by unusual vibrations, shock, or momentary voltage excursions of up to 30%. All relays, other than the flash and bus relay, shall be mounted on a molded base with eleven (11) or eight (8) pins for jack mounting to their respective panel or sub-base, and shall be electrically interchangeable with those presently used by the City.

11. FIBER-OPTIC COMMUNICATIONS

11.1 Only if fiber-optic cabling is required in the cabinet for communications, a fiber-optic distribution enclosure shall be provided meeting the following requirements:

(1) The fiber-optic distribution enclosure shall be approved by the City. "ST" type terminals, suitably labeled, shall be provided for the connection of field fibers and the Ethernet switch.

(2) Fiber-optic jumpers (i.e., optical patch cords) shall be provided for

connecting the fiber ports on the fiber-optic distribution enclosure to the small form pluggable (SFP) fiber transceiver module on the Ethernet switch. The factory-installed connectors on the jumpers shall match the mating ports on both ends of the connection. The jumpers must be six-foot long in controller cabinets and neatly secured in such a manner that the minimum bending radius is greater than ten (10) times the diameter of the cable and the cables exert no strain on the connectors. Each jumper shall have a minimum tensile strength of 50 lbs.

- 11.2 Only if fiber-optic cabling is required in the cabinet for communications, then a hardened managed Ethernet switch shall be provided in the cabinet in accordance with the Ethernet switch requirements of MANAGED ETHERNET SWITCH FOR TRAFFIC SIGNALS specification.

12. RAILROAD INTERCONNECT

- 12.1 The railroad preemption shall meet the requirements of the ICC (Illinois Commerce Commission) and the requirements of IDOT (Illinois Department of Transportation).
- 12.2 The railroad preemption shall meet all the requirements of the Illinois Department of Transportation's Standard Specifications for Road and Bridge Construction, adopted April 1, 2016. It shall meet all the requirements of Article 1073.01 (c) (2) and Article 1074.03 (a) (5) e.
- 12.3 The railroad preemption shall meet all the requirements of the Illinois Commerce Commission, as stated herein.
- (1) The railroad preempt relays and the City traffic cabinet in general shall be able to be wired as indicated in IDOT's Standard 857006-01 "SUPERVISED RAILROAD INTERCONNECT CIRCUIT". A failure in the interconnection circuit will result in activation of a supervisory failure alarm.
 - (2) The Remote Flash input to the controller must be inverted from normal NEMA logic. Instead of grounding the input to Logic Ground (0 volts DC) to activate, the Remote Flash will be normally grounded and will be activated when the input is in the Logic 1 (+24 volts DC) state. This will preclude the installation of a controller without the proper railroad software and a normal controller with standard (non-railroad) software will not be able to run the traffic signals.
 - (3) All critical components to railroad preemption such as relays and harnesses shall utilize the 24 VOLT DC monitor voltage to form a series loop. Removal of any component will result in the traffic

signals entering a flashing red condition. The 24 VOLT latch in the Management Malfunction Unit will be programmed, requiring manual reset if a failure in the series loop occurs.

- (4) Like the supervisory interconnection circuit monitors the integrity of the interconnect cable, this feature monitors the integrity of the controller railroad preemption input and associated wiring within the traffic controller cabinet. This will utilize a secondary railroad preemption input that is normally active (on) when no demand for railroad preemption is present. When a demand for railroad preemption is received, the normal railroad preemptor input is applied and the secondary input is dropped. If both inputs are either simultaneously on or simultaneously off for a time period of more than one (1) second, the controller will recognize this as an input failure. When a failure occurs, the traffic controller shall be configured to provide a track clearance interval followed by a flashing red condition. This occurrence shall set a preempt input alarm and also will require a manual reset of the controller.
- (5) Any demand for railroad preemption received at any point in the normal sequence, the emergency vehicle preemption sequence, a bus preemption sequence, or any other form of low priority preemption, or a previously called for railroad preemption sequence will result in the traffic controller providing a track clearance green indication within a “maximum time to track clearance green “ (usually 8 seconds depending upon site specific criteria) and will provide a full track clearance green time interval after the preemption demand was received. The controller software shall have the capability to restart the railroad preemption sequence providing a full track clearance green interval from any point within the railroad preemption sequence from the start of track clear green through the entire dwell/hold interval(s) including any exit yellow and red clearance intervals, if the demand for preemption drops and is reapplied. The number of times the controller is able to react to successive demands for railroad preemption must not be limited. This shall be a software based routine that does not require any user programming and must be designed into the software.
- (6) Preemptor number 1 is typically assigned to a supervisory failure in the interconnection circuit and preemptor 2 is typically assigned to a normal railroad preemption demand. Preemptor 1 must have priority over preemptor 2. Preemptor 2 must have priority over all other forms of preemption.
- (7) In order to compensate for noisy or intermittent calls, the controller shall have a programmable delay timing parameter for railroad

preemptors, programmed at 1 second. Any demands for railroad preemption lasting less than this time will be ignored. This will apply to any subsequent demands for railroad preemption that may occur while the controller is still within the railroad preemption sequence from a prior demand.

- (8) The controller shall have the capability to configure the railroad preemptors as non-locking calls. If a demand for preemption is placed for a duration of less than 1second (as programmed in the delay timer), the call will not lock and the controller will not initiate the preemption sequence. Furthermore, if an initial demand for preemption is dropped prematurely while the preemption sequence is still timing, the non-locking feature will allow the controller to re-service another demand for preemption.
- (9) The controller shall have a separate minimum green timing parameter, programmed at 1 second, that replaces normal controller phase minimum green times when entering railroad preemption. When a demand for preemption is applied, any active phase(s) must terminate immediately or after they have been active for 1 second if the demand occurs at the start of the phase(s). If any indications that are part of the track clearance green are active when the demand for railroad preemption is placed, those indications will not terminate until after the track clearance green interval is completed.
- (10) The controller shall have the capability to display a programmable phase(s) and rest in that phase(s) until the demand for railroad preemption is released. The controller shall also have the option to cycle between a set of programmable phases that don't conflict with the railroad crossing, or rest in an all-red steady state until the demand is released. The necessity for cycling during the hold interval or the use of an all-red steady state is determined by an assessment of the specific site. The controller shall have a timing parameter that will provide a minimum hold/dwell time, even if the demand for preemption is dropped prematurely. The controller shall be able to re-service any subsequent demands for preemption during this minimum hold/dwell time.
- (11) The controller shall have a timing parameter that will extend the hold/dwell interval for a programmed time after the demand for railroad preemption has been released. The controller shall be able to re-service any subsequent demands for preemption during this extension time.
- (12) When pre-signals are present in advance of a railroad crossing, during normal operation the pre-signal green indications terminate a

programmable time (timed overlap) prior to the indications at the intersection. The duration of the timed overlap should not be reduced when leaving normal operation to service other forms of preemption, such as emergency vehicle or bus preemption. If a demand for railroad preemption occurs during the timed overlap portion of the normal sequence, the overlap timer shall terminate and the track clear green interval shall begin immediately, after the pre-signal yellow and red vehicle clearance intervals are completed.

- (13) Capabilities to remotely monitor the traffic controller shall be provided, including the capability to monitor the operation of the controller, upload logs/events, and to verify the integrity of the database. In addition, the controller shall have the ability to automatically report alarms, such as preempt1 activation, preemptor input failure, automatic flash, CRC failure, 24 volt failure, and other defined alarms. The controller shall have the ability to prevent the remote download of changes to the critical data protected by the railroad preemption security feature.
- (14) Blank-out Signs. If these signs are used for railroad preemption, they should activate immediately with the activation of the railroad interconnect circuit. They should deactivate immediately with the deactivation of the interconnect circuit, not after the controller exits the railroad preemption sequence. Whenever the traffic signals are in flashing red operation, cabinet circuitry must be such that the signs will remain operational if the interconnect circuit activates due to railroad warning device activation.

12.4 A CRC module with all connections, a USB memory device, software, and any other firmware necessary to make the CRC fully functional will be provided if so designated.

- (1) A 16 bit CRC (cyclical redundancy check) module shall be provided. The module will connect to the ATC controller using unused I/O pins. Reassignment of unused inputs on the NEMA 'A', 'B', and 'C' connector I/O pins or connection to a proprietary 'D' module's input pins will be acceptable. The final CRC value for the specific intersection requirements will be set on the module for that intersection. Removing the CRC module during normal operation of the intersection, or mismatching the values in the database and the CRC, will result in a fault condition and put the intersection in flash mode.
- (2) Software
 - a. The controller software/firmware shall provide the logic and

control facilities to fully implement CRC error detection. All the data elements (objects) required for the implementation will be contained in a proprietary data block. The software will provide a mechanism to “display” the final CRC value to be set on the CRC module.

- b. A USB memory device shall be utilized to ‘lock’ or ‘unlock’ the database. When the USB device is inserted into the controller, the controller will display a menu that will include a utility to ‘unlock’ the database. The USB device shall contain a file structure that will allow access to the protected areas of the database. Once ‘unlocked’, the database can be edited through normal user interfaces. While the database is ‘unlocked’, the controller will drop the voltage/fault monitor signal to the conflict monitor to keep the intersection in flash. The CRC comparison check will be disabled during this period.
- c. After all the changes to the database are completed, the user will use a utility on the USB to ‘lock’ the database. After the database is ‘locked’, another utility will allow the calculated CRC to be displayed. This can be used to configure the CRC module. After the CRC is connected and the USB is removed from the controller, the voltage/fault monitor signal to the conflict monitor will be enabled. A restart will be required to restart the controller.
- d. Once the CRC module has been set (programmed), and the database has been locked, the controller can resume normal operation. The controller firmware shall validate the stored CRC against the CRC module’s value at least once per second.

13. WIRING

- 13.1 All electrical conductors shall be stranded copper, with a minimum of nineteen (19) strands per conductor, and a concentrically applied 90° C. insulation with a 600 VAC rating. Wiring from the fuse block to the first distribution point, and to the controller bus, must be No. 10 AWG. Signal circuit wire must be No. 14 AWG. The wires shall be provided with lugs or other approved terminal fittings for attachment to binding posts. All wiring between various parts of the controller shall be neatly cabled. All wiring and terminal blocks shall be tested for possible short circuits and resistance to ground by a high voltage dielectric test at 1,200 VAC. A wiring harness of adequate length shall be provided to the timing device to allow the timer to be placed on top of the cabinet when required.

- 13.2 All VAC connections to load switches, flasher, and flash transfer relays shall be soldered. All VAC connections on back of terminals shall be soldered.
- 13.3 All VDC connections on back of terminals, and load switches shall be soldered or connected with pre-approved terminations. All VDC connections to load switches are to be soldered or connected in a manner pre-approved by the City of Chicago's Division of Electrical Operations.
- 13.4 All wiring, 14 AWG and smaller, shall conform to MIL W 16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation and rated to 105° C. All 12 AWG and larger wire shall have UL listed THHN/THWN 90° C, 600V, 0.020 inches thick PVC insulation.
- 13.5 All Terminals and Facilities configurations shall be provided with wiring assignments consistent with NEMA TS2 specifications.
- 13.6 All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.
- 13.7 All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.
- 13.8 The grounding system in the cabinet shall be divided into two separate circuits: AC Neutral and Earth Ground. These ground circuits shall be connected together at a single point in accordance with NEMA TS2.
- 13.9 All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

14. TESTING

14.1 General

- (1) The testing on the controllers must be done as described herein. Environmental testing must be done at the manufacturer's facilities or at an independent laboratory, and must be certified by the manufacturer or the independent laboratory. Functional testing will be done at the City's facilities. All controllers provided under the contract must be tested as stipulated under "Functional Burn-In Testing" and "Physical Inspection" at the manufacturer's facilities.
- (2) If a controller is ordered for a specific location, the manufacturer shall program and test the controller at the factory. The manufacturer's representative shall fully support further testing the controller at the City's facilities. Each assembly shall be delivered with a signed document detailing the cabinet final tests performed.

- 14.2 One controller, unless previously approved, shall be tested, at the manufacturer's expense, in accordance with Section 2 of NEMA TS2. All of the tests listed must be performed with all data properly recorded and certified. If the manufacturer changes the design, fabrication or components of a previously tested and approved controller, then a sample of the controller containing the new design, fabrication or components must be retested at the manufacturer's expense. Any NEMA environmental test references to minimum recall must include but not be limited to: All sixty-four (64) output circuits must be programmed in a sequence to simulate the normal functioning of the entire controller cabinet assembly
- 14.3 The manufacturer of the controller shall perform, at his manufacturing facilities, a one hundred (100) hour burn-in test on every controller, and appurtenant devices. This test period must be certified by the manufacturer with supportive documentation and must include the device serial number, dates and times of test periods, and results. Any failed, or nonconforming components, must be replaced at this time. After each of the components has passed the burn-in test, they may be used in the assembly of the complete controller unit. Each completed unit must be subjected to the seventy-two (72) hour function test as described in this specification. The "burn in" requirement must include a test that uses all sixty-four (64) output circuits in "solid" burn as well as 1 pps and 5 pps for each circuit. All thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval. The documentation for a test program to simulate the normal functioning of the controller phasing must be supplied. A copy of the test program must be approved by the City of Chicago, Division of Electrical Operations prior to testing. This certification is in addition to any other documentation and/or testing required by these specifications.
- 14.4 In addition to the NEMA environmental test and the "burn-in" requirements stated above, satisfactory performance of the traffic signal cabinet and its equipment shall be demonstrated. The manufacturer must submit five (5) copies of his proposed "Test Procedure Document" for approval with the sample requested above. The test procedure must consist of two (2) sections; physical inspection and functional testing. If the test procedure is judged by the Commissioner or his duly authorized representative to be incomplete, inadequate or otherwise deficient, the contractor must revise and resubmit his "test procedure document" until it is approved. No contract can be awarded until the "test procedure document" has been approved. Functional testing must include, but not be limited to, phasing for multiple legged intersections, bridge and railroad pre-empts, flash operation, actuation, and any combinations of these features. Controllers designed to function without railroad pre-empts must be shown to function without the presence of a railroad interconnect. It shall be demonstrated that the sample controller(s) function with the City's central signal system. Any failure must be addressed by the manufacturer within the time frame allotted.

- 14.5 UPS. Testing of the equipment shall verify that the operation meets the requirements of this specification. All equipment shall be shown to operate correctly, including the rectifier, charger, inverter, batteries, and control unit. The UPS shall be connected to a dummy load at the factory and tested for performance under various conditions of line voltage and frequency, varying loads, temperature range, and humidity range. The automatic switching must be successfully demonstrated; losing line power and restoration of line power must not adversely affect the operation of the traffic signals. Use of the manual bypass switch must be successfully demonstrated. A generator shall be connected to the unit and successfully operate the system without interruption. The batteries must be shown to be able to operate the traffic signals for the specified time. The batteries must be shown to be able to be recharged in the specified time between failures. The control unit, including the LCD display and the RS-232 interface, must be shown to function according to this specification. All reports and event monitoring must be successfully demonstrated. Programming functions must also be shown to work properly.
- 14.6 Physical Inspection. The "physical inspection" portion of the test procedure document shall require the manufacturer to perform a physical inspection of workmanship and specification compliance for each traffic signal controller assembly. The inspection must be done using a detailed check list defining items to be inspected and criteria for acceptance. The inspection shall include, but not be limited to, the following items:
- (1) Hardware installation
 - (2) Assembly mounting
 - (3) Dimensions
 - (4) Presence of specified devices and materials
 - (5) Presence of required documents
 - (6) Labeling and required serial numbers
 - (7) Wiring including routing, covering, gauge, length, and soldering of terminations
 - (8) Arrangement of equipment for safety and ease of calibration reprogramming troubleshooting and maintenance
 - (9) Condition of cabinet body and finish
 - (10) Condition and installation of doors, panels, gaskets and ventilation

- (11) High voltage test of insulation resistance to ground, with wires installed in cabinet and equipment disconnected

14.7 Functional Testing. The "functional testing" portion of the Test Procedure shall require the manufacturer to perform a complete room-temperature functional test of each complete traffic signal controller assembly for a minimum of seventy-two (72) hours. This test must be designed to concurrently check integrated hardware systems e.g., from simulated input to load switch output including MMU and time base coordinator. All interface/controller interconnections must be tested. All load switch and interconnect relay positions must be tested, regardless of the number of load switches and interconnect relays. The functions tested shall include, but not be limited to, the following:

- (1) Flash logic and operation (color, phases)
- (2) Conflict monitor logic and operation
- (3) Police panel switch operation
- (4) Auxiliary panel switches (including fans)
- (5) Interface panel
- (6) Time switch operation
- (7) Load switches (with a continuous ten (10) ampere load on each signal circuit)
- (8) Outputs
- (9) Power interruptions of less than 500 ms
- (10) Power interruptions of more than 1.0 second
- (11) Generator Hook-up

15. VEHICLE DETECTION

- 15.1 Vehicle detection racks shall support the number of channels and detection card types needed for the control at the designated signalized intersection. Either 2-channel or 4-channel detector cards shall be provided for the rack. The cabinet shall be capable of up to 64 unique detection inputs.
- 15.2 Detector rack BIU mounting shall be an integral part of the detector rack.
- 15.3 All BIU rack connectors shall have jumper address pins corresponding to the

requirements of the TS2 specification. The jumpers may be moved to change the address of any individual rack. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.

- 15.4 A ground bus terminal shall be provided to provide a termination for the field wiring to be grounded.
- 15.5 Each detector rack shall be powered by the cabinet power supply and connected to the power bus assembly.
- 15.6 Bus Interface Unit (BIU)
- (1) BIUs shall meet the requirements of Section 8 of the NEMA TS2 Standard.
 - (2) BIUs shall include power on, transmit and valid data indicators. All indicators shall be LEDs.

16 SHIPMENT AND DELIVERY

- 16.1 Packaging. All equipment shall be shipped so as to prevent any damage due to shipping and handling. Cabinets shall be shipped on individual pallets. Each cabinet must be individually wrapped and protected so that it can be handled without damage to the cabinet or its finish. All packing should be clearly labeled indicating the contents.
- 15.2 Delivery. All equipment shall be delivered to the Division of Electrical Operations at 2451 S. Ashland Avenue, unless otherwise directed.

**ELECTRICAL SPECIFICATION 1620
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
MARCH 23, 2022**

**FIELD CABINET INTEGRATION EQUIPMENT AND DETECTION
PROCESSOR WITH VIDEO CAMERA**

1. SUBJECT

This specification states the requirements for video camera and integration equipment to enhance the technological functions at a signalized intersection that does not have a City fiber network connection. The set of equipment shall include a hemispherical video detection camera and integration device for video detection processing, video streaming, Ethernet networking, and cellular communications. The technology enhancement equipment shall collectively interface with the existing or proposed traffic signal controllers and cabinets, enable remote monitoring and control of the signal operations, support continuous data collection and signal performance monitoring, provide vehicle actuation, enable Web-based real-time and recorded video from the intersection, provide local area network connectivity for equipment in the cabinet, interface with the City's central signal system, and provide forward compatibility with future systems. The integration device and video detection processor shall be physically located in a traffic signal control cabinet. The camera shall be mounted to a City pole or extension arm with a mounting bracket specifically manufactured for that purpose.

2. GENERAL

2.1 Specifications. The intersection technology equipment shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following:

Electronic Industries Alliance (EIA)
Federal Communications Commission (FCC)
National Electrical Manufacturers Association (NEMA)
National Transportation Communications for ITS Protocol (NTCIP)
Restriction of Hazardous Substances (RoHS)
Telecommunications Industry Association (TIA)
Underwriters Laboratories (UL)

- 2.2 Acceptance. Intersection enhancement equipment not conforming to this specification will not be accepted. The equipment shall be approved by the selected wireless carrier for use on their network.
- 2.3 Sample. If requested by the Chief Procurement Officer, a sample of the technology enhancement equipment intended to be provided under this specification, shall be submitted to the Division of Electrical Operations within fifteen (15) business days after receipt of the request. The samples shall be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.
- 2.4 Compatibility
1. Traffic signal controller. The technology enhancement equipment must be compatible with the City's traffic control equipment and the City's communications equipment.
 2. Future technology. The technology enhancement equipment shall be forward compatible to support technologies through the integrated standard Layer 2 network interface including adaptive traffic signal controls.
- 2.5 Documentation. All equipment shall include the manufacturer's installation and operations manuals in hardcopy and electronic PDF formats. Contractor shall provide documentation of exact equipment model and serial numbers in hardcopy and electronic PDF formats.
- 2.6 Warranty. The manufacturer shall warrant the technology enhancement equipment against defects in material and workmanship for a period of three (3) years from the date of the City's final acceptance. The manufacturer's local distributor shall provide a replacement of any failed technology enhancement equipment at no cost to the City.
- 2.7 Support
1. Support shall include software updates and phone support, Monday through Friday, 7:00 AM to 7:00 PM, for the duration of the warranty period.
 2. Equipment shall have ability to receive Over-The-Air (OTA) upgrades for enhancements to capabilities and security.
- 2.8 License
1. The technology enhancement equipment shall include licensed software use and full maintenance and support services for the software for a minimum period of 10 years from the date of the

- City's official receipt for commodity contracts or from the date of City's final written acceptance for construction contracts.
2. The software license shall be fully transferable to CDOT. Transfer shall be completed upon purchase for commodity contracts and prior to City's final written acceptance for construction contracts.
 3. The software license provided by the vendor shall be subject to the City of Chicago Data Protection Requirements for Contractors, Vendors and Third Parties. A copy of this document is provided in the Appendix.
 4. In no event shall the software license include an obligation by the licensee to indemnify the licensor.
 5. Software license shall allow a minimum of 100 concurrent users for any client based or cloud services.
 6. Written evidence of the transfer shall be certified by an authorized representative of the software vendor and provided to the City.
 7. The software license shall grant the City full use of the Web-based software including access to the data collected by the technology enhancement equipment and all data analytic tools of the Web portal software. The capabilities of the software may be enhanced but shall not be reduced.

3. ENVIRONMENTAL

- 3.1 All technology enhancement equipment inside the traffic signal cabinet, including the SIM card, shall be manufacturer-hardened to withstand the elements and fully operate in the field without a dependency on external environmental conditioning equipment.
- 3.2 The technology enhancement equipment shall meet the environmental and operating requirements of the NEMA TS2 standard for controller units, including temperature, humidity, shock, vibration, and voltage. Testing shall comply with NEMA TS2 2.2.7 through 2.2.11.
 1. Operating temperature: -30° F to 165° F.
 2. Storage temperature: -30° F to 165° F.
 3. Operating relative humidity: 5% to 95% non-condensing.

4. INTEGRATION DEVICE

- 4.1 General.
 1. Provide multiple backhaul communications options including hardwired Ethernet and cellular communications backhaul.
 2. Provide local network Ethernet, serial, or I/O connectivity for field devices at the signalized intersection.
 3. Provide an "always-on" connection, without dialing.

4. Support local and remote management access
5. Support Virtual Private Network (VPN) connections
6. Communicate with an NTCIP compliant controller over Ethernet providing auto-negotiation to 10/100 Mbps, half or full duplex.
7. SIM card shall have a static IP address assigned by City, and shall be provisioned on the City's cellular provider's (currently Verizon) private network for City of Chicago.
8. Support direct communication between City systems and the devices connected to the integration device (and through an interface hardware adapter for legacy controllers) for remote monitoring and control.
9. Provide all required components, including power supply, cables, mounting hardware, and all accessories required to make the system fully operational in accordance with these specifications.
10. Provide data buffering of all telemetry and alert data for at least 12 minutes of communications loss at least 5 seconds of power loss.
11. Support vertical and horizontal installation.
12. Shall support the collection and transmission of telemetry data, video data, alert data, and vehicle identification data to the server via the communications network.
13. Include light-emitting diode (LED) indicators for health heartbeat, network connectivity, and device status.

4.2 Integrated Layer 2 Ethernet switch.

1. Minimum six Gigabit Ethernet ports (RJ-45) including one WAN port and minimum three PoE+ ports (802.3af and 802.3at compliant).
2. Support Transmission Control Protocol (TCP)/IP and User Datagram Protocol (UDP).
3. For each RJ-45 port, include a 6-foot Category 6 network cable that is Electronic Industries Alliance (EIA) / Telecommunications Industry Association (TIA)-568-A compliant.
4. One non-PoE+ port shall be used for the traffic signal controller, one PoE+ port shall be used for the video camera, and the remaining ports shall remain unused and reserved for the City's approved other uses.
5. Each port shall have auto-resetting in-line surge protection, compliant with IEC 61000-4-5 Class 4.

4.3 Connection ports

1. Minimum two serial ports (EIA RS-232).
2. Minimum one Universal Serial Bus (USB-A) port (USB 2.0 or higher).

3. Minimum one general purpose input/output (I/O) port with four signal pins, 0~30V, 200 mA, sinking, digital input.
4. Minimum one NEMA-rated I/O port for detector actuation (24)
5. Minimum one NEMA-rated I/O port for signal priority control (8)
6. Minimum one SDLC port

4.4 Data storage

1. Solid State Drive (SSD)
2. Minimum 240 GB
3. SATA III compliant
4. Support Self-Monitoring, Analysis, and Reporting Technology (SMART) command feature set
5. Rugged. 1500 G/0.5ms shock-resistance, 5~800 Hz at 5G peak vibration-resistance

4.5 Wireless communications

1. Frequency band and cellular network interface shall be fully compatible with the City's cellular data service provider.
2. Shall support 4G LTE cellular connectivity with MiMo and diversity (Bands 2, 4, 5, 12, 13, 14, 66, 71), UMTS/HSPA+ and GSM/GPRS/EDGE with peak downlink of 150 Mbps and peak uplink of 50Mbps.
3. Shall support 802.11 a/b/g/n with MiMo and Diversity antennas with security of at least 64/128 bits WEP, WPA, WPA2.
4. Shall support GPS for location service.

4.6 NTCIP controller interface

1. Communicate with an NTCIP compliant controller over Ethernet providing auto-negotiation to 10/100 Mbps, half or full duplex
2. Provide an ethernet cable for interfacing with NEMA TS2 type A1N, A2N, P1N, or P2N controllers.
3. Ethernet cable shall meet NEMA operating temperature specification -30 °F to 165 °F and be shielded with a UL-certified jacket.
4. Communicate to the controller over TCP/IP
5. Communicate over SNMP v1, v2c, and v3 protocols
6. Communicate over STMP NTCIP protocols reading all objects defined in NTCIP 1201 and 1202 supported by the controller
7. Acquire and record phase, channel, detector, pedestrian detector, pre-emption, alarm and overlap statuses at a frequency of no less than 10 times per second including whether a phase is next or has a call for service on it

8. Read and distinguish information from all detector, pedestrian detection and pre-emption devices wired into the cabinet
9. Detect failure of a detector, pedestrian detector or pre-emption device in either always high or always low mode based on user configuration.
10. Detect all controller-defined failures of a detector defined in NTCIP-1202::ASC.vehicleDetectorAlarms
11. Detect all detector-defined failures of a detector defined in NTCIP-1202::ASC.vehicleDetectorReportedAlarms
12. Detect the free mode status of the controller
13. Read coordination information including cycle and sync status and current and future coordination plan parameters when provided by controller
14. Distinguish between minimum green, extension, maximum, green rest, yellow change, red clearance and red rest intervals of a phase.
15. Identify flash status, stop time, external start, power restart, low battery, a serviceable call exists and has not been serviced for two cycles, or SDLC response fault.
16. Measure the existing sequence selected
17. Read the phase table, sequence table, channel table, and overlap table
18. Re-synch controller clock
19. Place a call on a phase if a detector is in fault
20. Run the traffic controller in free mode through force, hold, and omit directions
21. Set the current timing plan dial, split, or offset
22. Set coordination plan parameters including splits, offsets, and cycle length
23. Set phase table parameters.
24. Capture and report controller faults based on controller reported flash status reasons of 'other', 'automatic', 'localManual', 'faultMonitor', 'mmu', 'startup', and 'preempt'

4.7 SDLC controller interface

1. Provide all necessary cabling to connect to a cabinet's existing Port 1/SDLC bus
2. Read terminal and facility input & outputs at a frequency of at least 10 times per second
3. Read channel state at a frequency of at least 10 times per second
4. Acquire MMU fault status including conflict, red failure and clearance failure
5. Read information from all detectors wired into the cabinet supporting up to 100 millisecond resolution between detection events
6. Detect detector failure in either always high or always low mode

7. Support capturing and reporting controller faults based on MMU status bits of 'in conflict', 'red failure', 'diagnostic failure', 'in failure state', and 'local flash'
8. Function as multiple SDLC detector racks for actuation

4.8

Video processor

1. The integration device shall include real-time multimodal (vehicle, cyclist, pedestrian) video detection.
2. Support Real Time Streaming Protocol (RTSP).
3. Support live video streaming through remote network access. The live video shall be accessible from a browser and/or through third-party software used by the operating agency.
4. The cameras system at each intersection should Shall locally record camera video streams continuously at the intersection and store recordings for at least 14 days.
5. Shall allow the locally stored video recordings at the intersection to be recalled, downloaded, and viewed remotely for up to 14 days.
6. Detection accuracy shall be 90% for each lane at the intersection in clear weather conditions for any 1-hour period and 95% for any 24-hour period of real-time video processing.
7. Shall include a display showing status information of signal phases, detection channels, cameras, SDLC bus, and operational state.
8. Shall support multimodal detection and counting
 - a. Process simultaneous feeds from multiple intersection video cameras
 - b. Process at least 150 detection zones at intersection
 - c. Allow irregular polygon shaped zones
 - d. Support conditional detection based on directional movement of object
 - e. Differentiate between vehicle and cyclist at stop bar detection
 - f. Support conditional stop bar detection based on object type
 - g. Auto adjust settings in response to viewing conditions for improved detection accuracy
 - h. Support approach and departure detection zones
 - i. Support automated OTA software updates
 - j. Process turning movement count data for all visible movements at the intersection at all times
 - k. Classify in real-time all detected objects passing through an intersection including bicycles, light vehicles, single-unit trucks, articulated trucks, and buses
 - l. Process crosswalk movement count data for pedestrians
 - m. Track objects for video analytics applications
 - n. Auto-validate detection accuracy for each configured presence zone in the intersection

- o. Distinguish between lanes for all vehicle movements
- p. Count large groups of pedestrians
- 9. Actuation.
 - a. Support the option of actuation via SDLC or direct wiring into traffic cabinet
 - b. Support 64 actuation outputs over SDLC
 - c. Support 16 actuation outputs over general purpose I/O direct wiring with constant-call fail active capability
 - d. Support 8 actuation outputs over general purpose I/O without constant-call fail active capability
 - e. Support multiple detection zones per lane in any combination of pulse or presence configuration
 - f. Support constant detection channel call output when no video signal detected (1 second response time).
 - g. Support automatically switching individual detection zones into alternate detection mode when poor visibility is detected
 - h. Support delay and extend functionality per detection zone
 - i. Support local and remote manual override of detection to force actuated channels into constant call
 - j. Support virtual actuation channels for signal performance measures without actuating controller channels

4.9 Device data access

- 1. Support data access by third-party devices via TCP/IP
- 2. Provide local live data access via an open standard interface for third-party device integration
 - a. Signal indication status change on each channel
 - b. Detector status change on each channel
 - c. Preemption status change on each channel
 - d. Active timing plan change for NTCIP controllers
 - e. Video detection object presence
 - f. Movement data for detected objects
- 3. Provide updated status with 100 millisecond resolution.

5. **VIDEO CAMERA**

5.1 Hemispherical (fisheye) lens shall provide an ultra-wide, 360-degree, fixed field of view of all approaches of a signalized intersection.

- 1. 180-degrees horizontal
- 2. 180-degrees vertical

5.2 4K video resolution.

5.3 Shall support at least 9 megapixel (MP) capture

- 5.4 Shall support configuration in both spherical “fisheye” configuration, and rectangular “quad view”
- 5.5 Support a minimum of 10 concurrent video streams
- 5.6 Shall support pan, tilt, and zoom of the video feed by users
- 5.7 Camera shall be powered over Ethernet cable (PoE) in compliance with IEEE 802.3af
- 5.8 Shall provide H.264 and MJPEG image compression
- 5.9 Shall support RTSP streaming and H.265 compression
- 5.10 Shall support integration of RTSP video streams into third-party video management systems
- 5.11 Shall be rated to IP66 (NEMA 4X compliant)
- 5.12 Shall include an electronic de-humidification device for use in various weather conditions
- 5.13 Shall include a lens defrost function
- 5.14 The camera shall be fully compatible with the video processor and be provided by the same manufacturer. The camera quality and performance shall support the detection requirements of the video processor.
- 5.15 The camera shall provide full visibility of the intersection as required to achieve the performance requirements of this special provision.
- 5.16 Shall include Cat-5e / 6 surge protection capable of being mounted to the sidewall mounting channel of the traffic signal controller cabinet for protection of the camera and video processor. The surge must not interfere or degrade the quality of the video signals on the line.
- 5.17 Shall be compatible with in-line Ethernet repeater for cable runs exceeding standard Ethernet distance.
- 5.18 Mounting hardware.
 - 1. Support vertical and horizontal mounting
 - 2. Constructed of aluminum or stainless steel
 - 3. Compatible for securing a minimum 6-foot extension mast, 1.5-inch diameter

4. Shall be shipped fully assembled within secured package and ready to attach to pole or extension arm
5. A hole for cable of a minimum of 1" shall be located where the bracket shall be attached to City infrastructure. Bracket shall allow for banding to City mast arm.
6. Shall meet the structural requirements of ASSTHO's Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Edition. The entire assembly shall be able to withstand wind gusts up to 150 MPH.

6. ANTENNA

- 6.1 The low-profile, omnidirectional external antenna rated for outdoor use shall be fully compatible with the integration device and shall provide optimal signal reception at each site as recommended by the equipment manufacturer.
- 6.2 Antenna shall be able to be easily mounted to cabinet. Antenna housing shall require only one penetration in the mounting surface to route all internal antenna cabling. The antenna shall be an environmentally hardened, vandal-resistant antenna that protrudes no more than 1-1/2 inch from the cabinet. A watertight sealing bushing shall be included to prevent cable fraying and the ingress of water into the cabinet. All mounting hardware shall be included.
- 6.3 For the cellular modem integrated in the integration device, the antenna housing shall have multiple antennas inside with one threaded opening for all cabling and shall support:
 1. Global Positioning System (GPS) (qty: 1)
 2. 3G/LTE MIMO (qty: 2)
 3. 2.4GHz/5GHz WiFi MIMO (qty: 2)
- 6.4 Shall include antenna cables with required manufacturer-terminated connectors for full compatibility with corresponding ports on the integration device.
- 6.5 Shall have labeled antenna terminations for easy installation.
- 6.6 Shall not exceed 1-1/2 inch in height.
- 6.7 Shall be IP67 rated and include a water-tight seal made of a closed cell rubber type foam and medium-firm acrylic adhesive with bonding features including a high initial adhesion and excellent high/low temperature holding power with excellent peel strength.

7. POWER

Technology enhancement equipment inside the traffic signal controller cabinet shall meet the following power requirements.

- 7.1 Include compatible UL-certified power supply and connections as recommended by the technology enhancement equipment manufacturer.
- 7.2 Provide galvanic isolation between earth ground and logical ground.
- 7.3 Shall support power source via NEMA 5-15R or direct-wire terminal block.
- 7.4 Shall include power backup to maintain device operation for at least 5 seconds of brownout. System shall shutdown safely with power loss.
- 7.5 Shall include a separate circuit breaker of sufficient amperage rating (minimum 10 amperes) for powering the technology enhancement equipment inside the cabinet. Breaker shall be at a minimum, a thermal magnetic type, UL listed with a minimum of 10,000 amp interrupting capacity.

8. SOFTWARE

- 8.1 Web-based management client software shall be included by the equipment manufacturer with Graphical User Interface (GUI) and secured through Secure Sockets Layer (SSL) encryption.
- 8.2 Shall provide access to field data from the integration device and provide all functions from a single software platform with a single sign-on.
- 8.3 Shall support an unlimited number of concurrent logins by authenticated users.
- 8.4 Shall be fully accessible via desktop, tablet, and mobile products on Chrome, Edge and Safari.
- 8.5 Shall support the full set of software features without interfering with the traffic signal controller to communicate with third-party software used by the operating agency.
- 8.6 System server
 - 1. Professional cloud server hosting facility with fault-tolerant redundancy, automated load-balancing, and scalability to meet the service levels specified herein.

2. Storage of all telemetry, alert, and vehicle data with no age limit.
3. Polling, storage, and support for at least 3,000 signal controllers
4. Performance of at least 95% uptime

8.7 Security features

1. User login through credentials and OAuth protocol
2. Authentication and encryption with public key infrastructure (PKI) and Datagram/Transport Layer Security (DTLS/TLS1.0+) protocol
3. Account verification through email
4. Secure password reset
5. Administrative management of user profiles and customizable privileges for users internal and external to operating agency
6. Secure Virtual Private Network (VPN) connection
7. HTTPS/SSL communication to the server from the public Internet

8.8 Signal equipment monitoring

1. Shall support live display of all telemetry data with latency not to exceed 1 second with at least LTE connectivity.
2. Shall support historical display for at least 3 months of all telemetry data on-demand with load latency not to exceed 1 second.
3. Shall support a viewing mode in which all telemetry data is displayed overlaid onto a diagram of the intersection.
4. Shall support a viewing mode in which all telemetry data is displayed in a timing diagram format in which interval length is displayed in seconds for each signal phase.
5. Shall support display of environmental weather conditions, including precipitation and temperature, as part of live and historical viewing of telemetry data.
6. Shall provide networking support for secure monitoring by operating agency's third-party software of equipment connected via serial communications
7. Shall provide reporting on signal telemetry, detector, and alert data.

8.9 Data reports and Automated Traffic Signal Performance Measures (ATSPM) on metrics enabled by monitored detection implemented at intersection

1. Secure remote access to dashboard for traffic count data
2. Available data in at least 15-minute intervals
3. Summary charts and trend reporting with user-selectable parameters
 - a. Turning movement counts

- b. Vehicle type
 - c. Percentiles
 - d. Historical date range selection
 - e. Delay per vehicle and per approach
 - f. Approach volume and speed
 - g. Red light runners
 - h. Arrivals on green
 - i. Arrivals on red
 - j. Split failures
 - k. Platoon ratios
 - l. Pedestrian actuations
 - m. Pedestrian delay
 - n. Detector count and duration
 - o. Queue length
 - p. Queue spillback
 - q. Intersection level of service
 - r. Total cost
 - s. CO₂ emissions
 - t. Travel time
 - u. Purdue phase termination, split failures, adjustment optimization, and predicted coordination diagrams
4. Exportable data summary formats, including Portable Document Format (pdf), MS Excel (xlsx), and Comma-Separated Values (csv)

8.10 Video viewing

- 1. Access from Web browsers to live video streams without third-party plugins and additional software installation
- 2. Access from tablet Web browsers with HTTP Live Streaming (HLS)
- 3. Support a minimum of 300 total simultaneous video streams among all cameras
- 4. Allows users to virtually pan, tilt, and zoom the video feed
- 5. Support live video streaming of any third-party camera connected over Ethernet to the integration device that supports non-proprietary codecs and RTSP streaming
- 6. Support live video streaming with an initial load time of no more than 10 seconds
- 7. Support live video streaming with a latency of no more than 10 seconds at a frame rate of at least 15 fps
- 8. Support at least 10 concurrent video streams from a single camera to be viewed in multiple browsers
- 9. Allow users to recall, download, and view intersection video recorded and stored at the intersection for up to 14 days

- 8.11 Video detection configuration
1. Web-based user interface for configuration of detection zones
 2. Configuration of rectangular and irregular polygon shaped zones and pulse or presence detection zones
 3. Secure remote configuration of system without additional connectivity costs
 4. Full configuration history for remote changes
 5. Local roadside configuration of all detection zones
- 8.12 External data interface
1. Support external data access by shared open protocol or documented network-based Application Programming Interface (API)
 - a. Turning movement count data in minimum 15-minute intervals
 - b. Crosswalk bi-directional pedestrian counts in minimum 15-minute intervals
 - c. Intersection information including geographic coordinates
 - d. Active alert data
 2. Open data interface format including JSON and XML
 3. Support administrative management and security of data interface
 4. Provide API documentation and testing support
 5. Secure access to all stored multimodal count data
- 8.13 Management functions
1. Signal assessment information on signal operations and maintenance, signal configuration, signal performance, input data quality, and alert volume
 2. Condition detection and alerting
 - a. Power outage
 - b. Signal flash operation
 - c. Digital I/O signals
 - d. Detector failure
 - e. Preemption failure
 - f. Controller failure
 - g. Support
 3. Issue reporting with prioritization, acknowledgement, comment, assignment, resolution, recipients, and user-customizable SMS text and email alerting functions
 4. Viewing of information in tabular and geographic format with user-selectable filtering
 5. Data query by date and time
 6. Record retention for at least 5 years

7. Exportable data formats, including MS Excel (xlsx) and Comma-Separated Values (csv)
8. Asset management features
 - a. Create geographical placeholders for intersections without a device installed
 - b. Record cabinet equipment inventory information for each intersection
 - c. Upload and store reference files (up to 1 GB) with each node in the network
 - d. View all asset information and uploaded reference files

8.14 Cellular communications

1. Fully communicate with the integration device over 4G LTE cellular data service and local network of the operating agency
2. Provide at least 1 GB per month per location for 4G LTE cellular data usage, pooled collectively among all monitored intersections of the operating agency
3. Support failover from 4G to 3G with incremental fallback
4. Provide cellular signal strength readings with field unit to support integration device deployment (RSSI or Received Signal Strength Indicator for 3G, CDMA/UTMS/, and RSRP for Reference Signal Received Power for 4G LTE)
5. Provide cellular signal quality readings with field unit to support integration device deployment (ECIO or Energy to Interference Ratio for 3G, CDMA/UMTS/, RSRQ or Reference Signal Received Quality for 4G LTE, and SINR or Signal to Interference-plus-Noise-Ratio for 4G LTE)

9. **SHIPPING**

All technology enhancement equipment and hardware shall be packed to provide protection during shipping. Instructions must be included in each package. Packages shall be labeled indicating contents and shall include the manufacturer and model numbers.

**ELECTRICAL SPECIFICATION 1621
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
DECEMBER 20, 2020**

MANAGED ETHERNET SWITCH FOR TRAFFIC SIGNALS

1. SUBJECT

This specification states the requirements for a managed Ethernet switch to be used to connect various traffic signal devices at an intersection and prioritize and control communications between these devices. The switch shall be programmable (managed). The switch shall be physically located in a traffic signal control cabinet.

2. GENERAL

2.1 Specifications. The switch shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following organizations:

Institute of Electrical and Electronics Engineers (IEEE)
International Electromechanical Commission (IEC)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)

2.2 Acceptance. An Ethernet switch not conforming to this specification will not be accepted.

2.3 Sample. If requested by the Chief Procurement Officer, a sample of the switch intended to be provided under this specification, shall be submitted to the Division of Electrical Operations within fifteen (15) business days after receipt of the request.

2.4 Warranty. The manufacturer shall warrant the Ethernet switch against defects in material and workmanship for a period of five (5) years after City acceptance. The warranty shall include software updates and phone support, Monday through Friday, 7:00 AM to 7:00 PM. The manufacturer's local distributor shall provide a replacement of any failed switch at no cost to the City.

3. ENVIRONMENTAL

- 3.1 The Ethernet switch shall be suitable for installation in an outdoor cabinet without the need for special environmental conditioning equipment.
- 3.2 The Ethernet switch shall be an environmentally hardened switch compliant with IEEE 802.3af and IEEE 802.3at (10/100/1000 Mbps).
- 3.3 The Ethernet switch shall be capable of operating over an ambient temperature range of -40°C to +75°C without the use of external or internal cooling fans in accordance with IEC 60068-2-1 and IEC 60068-2-2.
- 3.4 The Ethernet switch shall be capable of operating properly in relative humidity conditions of up to 95% non-condensing at 55°C in accordance with IEC 60068-2-30.
- 3.5 The Ethernet switch shall meet the environmental requirements of traffic control equipment in accordance with NEMA TS2 (2003) Section 2: Environmental Requirements, including NEMA TS2 2003 Section 2.2.8.
- 3.6 The manufacturer shall provide written evidence of independent testing verifying performance in compliance with these requirements.
- 3.7 The Ethernet switch shall be capable of operating properly when exposed to radiated electric fields of up to 10V/m continuously and magnetic fields of up to 40A/m continuously.
- 3.8 The Ethernet switch shall comply with the Electromagnetic Interference (EMI) immunity requirements given in IEC 61850-3 and IEEE 1613 and with the FCC Paragraph 15 Class A requirements.
- 3.9 The Ethernet switch shall pass the minimum Electromagnetic Compatibility (EMC) immunity requirements of EN61800-3, the IEC standard for adjustable speed electrical power drive systems.
- 3.10 The Ethernet switch shall comply with the electrical safety requirements for IT equipment of UL 60950.
- 3.11 The Ethernet switch shall comply with the atmospheric, vibration, shock, and bump requirements outlined in Table 1. The compliance shall be demonstrated by type withstands tests (i.e. type tests) as outlined in the table and summarized in a Type Test Report per the test report requirements of each of the standards given in the table.

TABLE 1. Environmental Tests

Test	Description		Test Level	Severity
IEC 60068-2-1	Cold Temp	Test Ad	-40°C, 16 hours	N/A
IEC 60068-2-2	Dry Heat	Test Bd	+85°C, 16 hours	N/A
IEC 60068-2-30	Humidity	Test Db	95% non-condensing, 55°C, 6 cycles	N/A
IEC 60255-21-1	Vibration		2g @ 10-150Hz	Class 2
IEC 60255-21-2	Shock		30g @ 11ms	Class 2

4. **PORT REQUIREMENTS**

4.1 The Ethernet switch shall have a minimum of:

1. 8 - 10/100/1000Base TX ports. Four of these ports shall be POE+.
2. 3 - 10/1000Base FX small form pluggable (SFP) ports

4.2 All fiber optic link ports shall be capable of multimode or single mode.

4.3 The Ethernet switch shall support the following requirements and options:

1. 10/100/1000Base TX POE ports:
 - a. RJ45 connectors
 - b. Cable type: Category 5, unshielded twisted pair (CAT5 UTP), or better
 - c. Segment length: 100m
 - d. Auto-negotiation support (10/100Mbps) (IEEE 802.3)
 - e. Auto MDI/MDIX crossover capability
 - f. TVS (transient voltage suppression) between Line \pm , Line \pm ground, to protect the circuitry

- g. Full duplex operation (IEEE 802.3x)
- 2. SFP modules shall be either single mode or multimode, as required.
 - a. Multimode:
 - 1. LC connectors
 - 2. 2 fiber
 - 3. Optical Characteristics: 1300/1310/850 nm
 - 4. Supports 62.5/125 μ m multimode fiber
 - 5. Optical power budget: minimum 34.5dB @ 1310nm
 - 6. Full duplex operation (IEEE 802.3x)
 - 7. Cable distance: 2km
 - b. Single Mode:
 - 1. LC connectors
 - 2. 2 fiber
 - 3. Optical Characteristics: 1310/1550 nm
 - 4. Supports 9/125 μ m single mode fiber
 - 5. Optical power budget: minimum 34.5dB @ 1310nm
 - 6. Full duplex operation (IEEE 802.3x)
 - 7. Cable distance: 40km

5. **NETWORK REQUIREMENTS**

- 5.1 The Ethernet switch shall support automatic address learning of up to 8000 MAC addresses.
- 5.2 The Ethernet switch shall support the following advanced layer 2 functions:
 - 1. IEEE 802.1Q VLAN, with support for up to 256 VLANs
 - 2. IEEE 802.1 p priority queuing
 - 3. IEEE 802.1w rapid spanning tree protocol (RSTP)
 - 4. IEEE 802.1Q-2005 MSTP (formerly 802.1s)
 - 5. IEEE 802.1Q-VLAN tagging
 - 6. IEEE 802.3x flow control

7. IEEE 802.3ad-Link Aggregation Control Protocol (LACP)
8. IGMPv3 multicast groups, 128 for each VLAN
9. Port Rate Limiting (user defined)
10. Configuration via test file which can be modified through standard text editor
11. DHCP Option 82
12. 20 Gbps full duplex bandwidth12 - 10/100/1000Base TX ports

5.3

The Ethernet switch shall provide the following network management functions:

1. SNMPv1, SNMPv2c, SNMPv3
2. RMON
3. GVRP
4. Port Mirroring
5. 802.1x port security
6. SSL – Secure Socket Layer
7. SSH – Secure Shell
8. TACACS+
9. TFTP
10. Network Time Protocol (NTP)
11. Simple Network Time Protocol (SNTP)
12. Management via web or Telnet
13. Tracing operation of protocols including but not be limited to the following: STP, MAC, IGMP

6. PROGRAMMABLE CRITICAL FAILURE RELAY

6.1 The Ethernet switch shall provide a programmable critical failure out relay that may be configured to activate upon critical error detection such as loss of link or detection of critical system errors.

6.2 The programmable critical failure out relay function shall be user enabled and programmable.

6.3 The output contacts shall be available in a Form-C configuration .

7. POWER SUPPLY

7.1 The Ethernet switch shall be supplied with provisions for operation at the following power supply inputs, 85 to 264 VAC (50/60Hz).

7.2 The power supply shall be internal to the Ethernet switch and shall have isolation.

7.3 A power cord of not less than 5 feet in length shall be supplied.

7.4 The Ethernet switch shall require no more than 27W of power with allowed increases for POE+ ports.

8. MOUNTING REQUIREMENTS

The Ethernet switch shall provide options for DIN Rail mounting or panel mounting via brackets. All mounting hardware shall be included.

9. SHIPPING

Each Ethernet switch and each SFP module shall be individually wrapped and boxed so that the items are not damaged in shipment. Each box must be labeled indicating the contents. The manufacturer and model numbers must be prominently displayed.

**ELECTRICAL SPECIFICATION 1622
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
DECEMBER 20, 2020**

CELLULAR MODEM FOR TRAFFIC SIGNALS

1. SUBJECT

This specification states the requirements for a cellular modem to be used as a wireless cellular two-way communication link between the traffic signal controller, video detection camera, and other traffic devices at an intersection and a remote computer or computers. The cellular modem will allow monitoring of the intersection controller, real time video, traffic counts, etc. Remote programming of the modem, the controller, video detection, and other traffic equipment shall also be provided. The modem shall be physically located in a traffic signal control cabinet.

2. GENERAL

2.1 Specifications. The modem shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following organizations:

Institute of Electrical and Electronics Engineers (IEEE)
International Electromechanical Commission (IEC)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)

2.2 Acceptance. The modem model shall be approved by the selected wireless carrier for use on their network. A modem not conforming to this specification will not be accepted.

2.3 Sample. If requested by the Chief Procurement Officer, a sample of the modem intended to be provided under this specification, shall be submitted to the Division of Electrical Operations within fifteen (15) business days after receipt of the request.

2.4 Warranty. The manufacturer shall warrant the modem against defects in material and workmanship for a period of five (5) years after City

acceptance. The manufacturer shall provide a replacement of any failed modem at no cost to the City.

2.5 Support.

1. Support shall include software updates and phone support, Monday through Friday, 7:00 AM to 7:00 PM, for the duration of the warranty period.

2.6 License.

1. The modem shall include licensed software use and full maintenance and support services for the software for a minimum period of 10 years from the date of the City's official receipt for commodity contracts or from the date of City's final written acceptance for construction contracts.
2. The software license shall be fully transferable to CDOT. Transfer shall be completed upon purchase for commodity contracts and prior to City's final written acceptance for construction contracts.
3. The software license provided by the vendor shall be subject to the City of Chicago Data Protection Requirements for Contractors, Vendors and Third Parties. A copy of this document is provided in the Appendix.
4. In no event shall the software license include an obligation by the licensee to indemnify the licensor.
5. Written evidence of the transfer shall be certified by an authorized representative of the software vendor and provided to the City.
6. The software license shall grant the City full use of the Web-based software including access to the data collected by the modem. The capabilities of the software may be enhanced but shall not be reduced.

2.7 Documentation. The modem shall include the manufacturer's installation and operations manuals in hardcopy and electronic PDF formats.

3. GENERAL FUNCTIONS

3.1 Support Virtual Private Network (VPN) connections

3.2 Support firewall capabilities, such as, Internet Protocol (IP) block/allow listings

3.3 Provide an "always-on" connection, without dialing

3.4 Support local and remote management

- 3.5 Domain name addressable
- 3.6 Port Filtering
- 3.7 Generic Routing Encapsulation (GRE) Tunneling
- 3.8 IP Filtering
- 3.9 Media Access Control (MAC) Address Filtering
- 3.10 SIM card shall have a static IP address assigned by DoIT, and shall be provisioned on the City's cellular provider's (currently Verizon) private network.

4. PORT REQUIREMENTS

- 4.1 Modem transceiver shall support full duplex operation.
- 4.2 The modem shall be static IP addressable.
- 4.3 Frequency Band and Cellular Network Interface.
 - 1. Fourth Generation (4G) Long Term Evolution (LTE) models:
 - a. Tri-band support for 700/1900/2100 megahertz (MHz)
 - b. Backward compatible with: evolved High Speed Packet Access (HSPA+), High Speed Packet Access (HSPA), Enhanced Data-rates for GSM Evolution (EDGE), and General Packet Radio Service (GPRS).
 - c. LTE auto-fallback to GSM / HSPA.
 - 2. 3G HSPA+ models:
 - a. Tri-band support for 850/1900/2100 MHz or quad-band support for 850/900/1800/1900 MHz
 - b. Backward compatible with: HSPA, universal mobile telecommunications system (UMTS), EDGE, GPRS, and Global System for Mobile communications (GSM).

5. ETHERNET INTERFACES

- 5.1 Support Transmission Control Protocol (TCP)/IP and User Datagram Protocol (UDP)/IP.
- 5.2 A minimum of two registered Jacks (RJ)-45, IEEE 802.3 standard 10 Base-T Ethernet port for 3G cellular modems and 100 Base-TX Ethernet ports for 4G modems.
- 5.3 For each RJ-45 port, include a pre-terminated 6-foot Category 6 network cable that is Electronic Industries Alliance (EIA)/Telecommunications Industry Association (TIA)-568-A compliant.

6. ANTENNA

- 6.1 Omnidirectional external antenna rated for outdoor use and fully compatible with the modem in accordance with manufacturer specifications.
- 6.2 Antenna shall be vandal resistant and low profile.
- 6.3 Antenna shall be able to be easily mounted to cabinet. All mounting hardware shall be included.
- 6.4 50-Ohm Sub Miniature version A (SMA) male connector.
- 6.5 Include a 9-foot coax antenna cable(s) with required pre-terminated adapters (SMA) per the manufacturer's recommendation.
- 6.6 Minimum Antenna gain of 2 decibels relative (dBi).
- 6.7 2 antenna elements with operating Frequencies of 698-896 and 1700-2700 MHz.

7. POWER SUPPLY

Include compatible power supply and connections as recommended by the modem manufacturer.

8. MOUNTING REQUIREMENTS

Include mounting hardware to securely mount the modem in the cabinet.

9. ENVIRONMENTAL

- 9.1 Operating temperature for the modem and all associated field components

shall be -22° F to 158° F.

- 9.2 Storage temperature for the modem and all associated field components shall be -22° F to 158° F.
- 9.3 The modem and all associated field components shall operate in relative humidity of 5 percent to 95 percent non-condensing.

10. MANAGEMENT, SECURITY AND DIAGNOSTICS

- 10.1 Support real-time 2-way communications for remote management and shall include management software by the modem manufacturer.
- 10.2 Light-emitting diode (LED) indicators for Ethernet, power, cellular link/activity and signal strength.
- 10.3 Support signals for Transmit Data (TXD), Receive Data (RXD), Request To Send (RTS), Clear To Send (CTS), Data Terminal Ready (DTR), Data Set Ready (DSR), Data Carrier Detect (DCD) and hardware and software flow control.
- 10.4 Compatibility with Hypertext Transfer Protocol (HTTP)/HTTP Secure (HTTPS), Dynamic Host Communications Protocol (DHCP), Simple Network Management Protocol (SNMP) v2 or v3, Simple Mail Transfer Protocol (SMTP), Secure Socket Layer (SSL), Secure Shell (SSH)-2.
- 10.5 Web-based Graphical User Interface (GUI).
- 10.6 Command Line Interface (CLI) access via TELNET connection.
- 10.7 SNMP Management Information Base (MIB)-II and SNMP Traps.

11. SHIPPING

Each cellular modem, antenna, power supply, and cables shall be packed so as to provide protection in shipping. Packing shall be labeled indicating contents and shall include the manufacturer and model numbers.

**ELECTRICAL SPECIFICATION 1623
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
DECEMBER 20, 2020**

HEMISPHERICAL VIDEO DETECTION CAMERA SYSTEM

SUBJECT

1. This specification states the requirements for a hemispherical video camera system to be used to detect vehicular traffic at a signalized intersection. The camera system shall also provide real-time video of the signalized intersection. The camera system shall be used for vehicle tracking and counting as well as intersection actuation. The camera will be mounted to a traffic signal arm or a luminaire arm with a mounting bracket specifically manufactured for that purpose.

GENERAL

2. (a) This specification shall include the camera, the video processor, the camera mount, a surge protection panel, and associated software.

(b) Sample. If requested, one camera, one processor, and one mount of the manufacture proposed to be furnished shall be submitted along with specification sheets within fifteen (15) business days upon request of the Chief Procurement Officer. The sample shall be delivered to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608.

(c) Warranty. The manufacturer shall warrant the camera, processor and mount to meet the requirements of this specification, and shall warrant all components against defective design, material and workmanship for a period of three (3) years from date of acceptance by the City. In the event that defects or failures occur during the warranty period, the manufacturer must repair and/or replace all defective materials, which shall include shipping, at no expense to the City. This warranty must be evidenced by a letter or certificate of warranty submitted to the City at the time final acceptance is made.

(d) Support. Support shall include software updates and phone support, Monday through Friday, 7:00 AM to 7:00 PM, for the duration of the warranty period.

(e) Compatibility. The camera and processor must be compatible with the City's traffic control equipment and the City's communications equipment.

(f) The manufacturer's installation and operations manuals shall be supplied.

CAMERA

3.

(a) Lens

1. 360-degree fixed field of view of all approaches of a signalized intersection, fixed focus
2. horizon to horizon, 400 feet in each direction
3. 180° horizontal, 175° vertical

(b) Must be fully automatic to adjust for lighting conditions. Must produce useful information from luminance levels of .1 to 10,000 lux

(c) Housing

1. aluminum
2. powder coated white
3. ingress protection IP68
4. dimensions: less than 12" in diameter; less than 10" in height
5. weigh less than 10 pounds
6. waterproof disconnect for cable

(d) Power

1. 12 or 24 volt dc
2. 5 watts (50 watts with heater)
3. power over ethernet (POE)

(e) Environment

1. operating temperature: -34° C to +74° C
2. humidity: 0 to 95% non-condensing
3. vibration: ANSI C136.31 Section 5

(f) Digital image sensor: 5MP CMOS (5 megapixel complementary metal-oxide semiconductor)

- (g) Resolution: 2560 pixels by 1920 pixels
- (h) video output: MJPEG (Motion Joint Photographic Experts Group)
- (i) connectivity: CAT 6 cable
- (j) heater is thermostatically controlled
- (k) FCC Class A

PROCESSOR

- 4. (a) Housing
 - 1. aluminum
 - 2. shelf mounted
 - 3. dimensions: maximum 10"x12"x3"
 - 4. LED front panel for status indicators
- (b) Power
 - 1. for 2 cameras with heaters (100 watts)
 - 2. 120 volt ac input (will operate between 89v to 135v)
 - 3. 12/24 volt dc output to each camera
- (c) Environment
 - 1. operating temperature: -34° C to +74° C
 - 2. humidity: 0-95% non-condensing
 - 3. NEMA TS2 for transient voltage, temperature and voltage, vibration, and shock
- (d) Video
 - 1. output: MJPEG
 - 2. color
 - 3. resolution: 1920p
 - 4. frame rate:30fps
 - 5. support snapshot capture of video stream
 - 6. Hypertext Transfer Protocol (HTTP) accessible images
 - 7. support live video streaming through remote network access through a Web browser and through the city's existing video management system
 - 8. minimum 20 concurrent video streams per camera
 - 9. support real time streaming protocol (RTSP) or H.264

- (e) 2 camera input
- (f) FCC Part 15, subpart B, Class A
- (g) connectivity: WAN (wide area network) port
- (h) communications: TCP/IP
- (i) USB 3.0 ports (4)
- (j) Ethernet ports
- (k) detector I/O: TS1, TS2, or ITS interface
- (l) outputs: 24 optically isolated outputs, SDLC interface conforming to TS2 specs
- (m) programmable up to 64 detectors
- (n) 4 processing cores of 2.8 GHz
- (o) 3GB RAM, 32GB onboard storage

SOFTWARE

- 5. (a) Detection
 - 1. detection zones must be sensitive to the direction of travel
 - 2. detection accuracy shall be 90% for each lane at the intersection in clear weather conditions for any 1-hour period and 95% for any 24-hour period of real-time video processing
 - 3. detect approaching/departing vehicles in programmed detection zones, which may include multiple lanes, single lanes, and turning lanes in real time
 - 4. minimum of 64 user defined zones of detection (per camera). User defined polygons imposed on video image that can be redefined at any time by using a mouse or keyboard
 - 5. Minimum of 24 detector zones of output
 - 6. real time vehicle detection (within 500 milliseconds of vehicle arrival)
- (b) User

1. administrative management of users and customized user privileges
2. web based with graphical user interface (GUI) and encryption
3. user authentication through login credentials.
4. multiple logins (1000 minimum)

(c) Web

1. web based with graphical user interface (GUI) with encryption
2. access from web browsers to live video without third-party plug-ins
3. real time live stream visuals of intersection
4. open data interface format including JSON and XML (Java-script Object Notation and Extensible Markup Language).
5. all features and programming available over web portal, including detection zone configuration

(d) Data

1. data collection -access to current and historical data
2. exportable data summary formats
3. user selectable summary tables and graphs
4. support external data access by shared open protocol or documented network-based application programming interface (API)
5. support administrative management and security of data interface (DATA)

(e) License.

1. The camera and processor shall include licensed software use and full maintenance and support services for the software for a minimum period of 10 years from the date of the City's official receipt for commodity contracts or from the date of City's final written acceptance for construction contracts.
2. The software license shall be fully transferable to CDOT. Transfer shall be completed upon purchase for commodity contracts and prior to City's final written acceptance for construction contracts.
3. The software license provided by the vendor shall be subject to the City of Chicago Data Protection

Requirements for Contractors, Vendors and Third Parties.
A copy of this document is provided in the Appendix.

4. In no event shall the software license include an obligation by the licensee to indemnify the licensor.
5. Software license shall allow a minimum of 100 concurrent users for any client based or cloud services.
6. Written evidence of the transfer shall be certified by an authorized representative of the software vendor and provided to the City.
7. The software license shall grant the City full use of the Web-based software including access to the data collected by the camera and processor and all data analytic tools of the Web portal software. The capabilities of the software may be enhanced but shall not be reduced.

CAMERA MOUNT

6.
 - (a) shall consist of an aluminum arm with a 90 degree elbow
 - (b) horizontal portion of arm shall be at least 20" long. vertical portion of arm shall be able to extend to 7'.
 - (c) horizontal end of arm shall have attachment for fish-eye camera
 - (d) vertical portion of arm shall be supplied with mounting bracket that can be banded to a luminaire mast arm
 - (e) A hole for cable of a minimum of 1" shall be located where the bracket will be attached to the arm
 - (f) entire assembly shall meet the structural requirements of ASSTHO's Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Edition. The entire assembly shall be able to withstand wind gusts up to 150 MPH.

SURGE PROTECTION

7. Provide an interface panel capable of being mounted to the sidewall of a controller cabinet for protection of the processor and camera. The panel must consist of, at a minimum, CAT5e surge protection.

SHIPPING

8.
 - (a) Each camera, each processor, and each surge protection panel shall be packed in a container or containers so that the contents will not be damaged in shipping or handling. Instructions must be included in each

container. The mounting arm shall also be protected for shipping and handling.

- (b) Each package shall be clearly labeled as to the contents.

**ELECTRICAL SPECIFICATION 1623
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
NOVEMBER 10, 2019**

RADAR SPEED SIGN, VARIABLE MESSAGE

1. SUBJECT

This specification states the requirements for a radar speed sign that shall display the immediate speed of an approaching vehicle. The speed of the approaching vehicle is determined by radar. This specification shall include the sign, the radar, the power supply, and any software. The sign is intended to be displayed on a permanent installation.

2. GENERAL

2.1 Specifications. The sign shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following organizations:

Manual on Uniform Traffic Control Devices (MUTCD)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)

2.2 Acceptance. Any sign not conforming to this specification will not be accepted.

2.3 Sample. If requested by the Chief Procurement Officer, a sample of the sign intended to be provided under this specification, shall be submitted to the Division of Electrical Operations within fifteen (15) business days after receipt of the request.

2.4 Warranty. The manufacturer shall warrant the sign against defects in material and workmanship for a period of two (2) years after City acceptance. If the sign comes with batteries, the warranty on the batteries shall be one (1) year. The manufacturer shall provide a replacement of any failed sign (or battery) at no cost to the City.

3. DISPLAY

- 3.1 The size of the lettering and numbers, as well as the colors, and format of the display shall meet the requirements of the latest edition of the MUTCD, as detailed in Chapter 2 "SIGNS" and Chapter 2L "CHANGEABLE MESSAGE SIGNS".
- 3.2 The display shall contain only electronic letters and numbers. There shall be no permanent letters and numbers in the display.
- 3.3 The display shall be programmable to display either miles per hour or kilometers per hour.
- 3.4 Two lines of text with variable message
- 3.5 Light sensor for automatic brightness adjustment
- 3.6 LEDs
1. 1200 minimum, yellow
 2. Luminous intensity per LED: 5680-8200 mcd
- 3.7 Digits: 18 inches high by 10 inches wide
Variable message matrix: 12.5 inches high by 24 inches wide

4. HOUSING

- 4.1 Housing shall be approximately 31 inches wide by 42 inches tall, and 5 inches deep. Total weight without batteries not to exceed 55 pounds. No separate housing for batteries (if batteries are required).
- 4.2 Access by front or rear door. Door shall be hinged on one side and securely closed with screws or clamps on the other side.
- 4.3 Body of housing shall be powder coated gray. Front of housing shall be powder coated yellow with black stripe outlining frame.
- 4.4 12 gauge aluminum or thicker
- 4.5 Weatherproof, NEMA 4X-12, IP65 compliant
- 4.6 Non-sealed and ventilated
- 4.7 Mounting brackets to accommodate 3/4" stainless steel banding
- 4.8 UV protected polycarbonate sheet over display area.

5. POWER

5.1 The unit shall be equipped to be hard wired for 240 volt operation or be equipped for solar power.

5.2 240 volt:

1. Nominal 240 VAC input for power supply to provide 12VDC for LEDs and circuit boards
2. Hardwired
3. 10 amp fusing

5.3 Solar:

1. Solar panel (85w) to provide 12VDC for sign and circuit boards
2. Crystalline solar cells
3. Laminate: Glass/EVA/TPT/or TPE
4. Front side: high-transmission 3.2mm tempered glass
5. Back side: TPT/TPE
6. Frame: clear anodized aluminum
7. Junction box for cable
8. Batteries: two 12 volt 18amp/hour AGM; provides up to 14 days of back-up operation when fully charged
9. Side of pole mount for panel, bracket or banding
10. Max surface area: 40" X 26" for northern latitudes
11. Charge controller: manages flow of energy to batteries
12. Low battery cut-off feature

6. ENVIRONMENT

6.1 Operating temperature: -40° C to +85°C

6.2 Humidity: 5 to 95 % non-condensing

6.3 Vibration: ANSI C136.31 for luminaires

7. RADAR

7.1 Internal radar: Doppler (FCC Part 15 compliant)

7.2 RF output: 5 milli-watts maximum

7.3 Frequency-center: 24.125 Ghz +/-25Mhz

7.4 Pick-up distance: 1200 feet

- 7.5 Beam angle: 12° +/-2°
- 7.6 Beam polarization: linear
- 7.7 Speed detection range: 5-127 MPH

8. PROGRAMMING

8.1 Manufacturer shall include all necessary software.

8.2 Display settings:

1. Stealth mode: speed not displayed but data is collected
2. Display minimum speed/ Display maximum speed
3. Digit flashing: digits flash above selected speed
4. Message flashing: message flashes above selected speed
5. 4 standard messages: SPEED LIMIT, YOUR SPEED, SLOW DOWN, TOO FAST
6. 4 custom message slots

8.3 Data Collection:

1. Total vehicle count
2. Total speed violations
3. Average vehicle count in selected period
4. Average number of violations in selected period
5. Average speed in selected period
6. Data stored for up to 12 months
7. Store data for up to 1 million vehicles

8.4 Data Reports:

1. Data collected and stored at location
2. Download data via Bluetooth
3. Summary reports
4. Period comparison reports
5. Reports can be printed directly or exported into CSV format, Excel, Adobe Acrobat PDF or HTML.

9. COMMUNICATIONS

9.1 Bluetooth 4.0 for local downloading and programming

9.2 Licensed software using the Cloud for data storage and allowing for remote programming and data collection.

10. SHIPPING

10.1 General. The sign must be shipped fully assembled and ready for installation. Each assembly must be individually wrapped and boxed so that the assembly is not damaged in shipment. If batteries are required, they shall be supplied with the sign. If a solar panel is required it shall be packaged so as not to be subject to damage in shipping or handling.

10.2 Labeling. Each box must be labeled in 3/8 inch high letters " RADAR SPEED SIGN" and/or "SOLAR PANEL FOR RADAR SPEED SIGN". The City Commodity Code, contract number, manufacturer, and date of manufacture must be clearly labeled on the box.

ROADWAY SMART LIGHTING CONTROL
ACCESS POINT

I. SUBJECT

This specification states the requirement for smart lighting access point. The City of Chicago's smart lighting management system interfaces with an itron mesh network, that provides communication through individual external and internal nodes positioned on lighting fixtures. The itron access point shall provide the central link between endpoint devices such as external, internal nodes located on lighting fixtures and network control and monitoring center. It is a two-way wireless communication between nodes and cellular communications to the City's data center. The itron access point runs on infrastructure hardware for positioning throughout the mesh network with multiple paths to each node that services.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C12.20, "Operating Vibration and Shock Standard"
- ANSI C12.20, "Humidity, Operating Temperature Standard, and Electromagnetic Susceptibility Standard"
- ANSI C12.20, "Surge Withstand Capability, Electrostatic Discharge and Electrical Fast Transients Standard"

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE 802.15.4g, "IEEE standard for local and metropolitan area networks--Part 15.4: Low-Rate wireless personal area networks (LR-WPANs) Amendment3: Physical layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks. Based on Wi-SUN Communications System"

United States National Institute of Standards and Technology (NIST)

- Federal Information Processing Standards (FIPS) PUB 197, "Advanced Encryption Standard"

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

- ISO/IEC 18033-3, “Information Technology-Security Techniques-Encryption Algorithms-Part 3: Block ciphers”
- IEC 61000-4-6, “Conducted Immunity”
- IEC 61000-4-8, “Magnetic Immunity”
- IEC 61000-4-11, “Voltage Dips and Interrupts”
- IEC 60950-1, IEC 60950-22, “Safety Standard for Information Technology Equipment”

Federal Communications Commission (FCC)

- FCC Part 15.247, “Operating within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz”

Radio Standards Specifications (RSS)

- RSS-247, “Digital Transmission Systems, Frequency Hopping Systems and License-Exempt Local Area Network Devices”

European Telecommunications Standards Institute (ETSI)

- ETSI EN 303 204, “Fixed Short-Range Devices in Data Networks; radio equipment to be used in the 870 MHz to 876 MHz frequency range with power levels ranging up to 500mW; Harmonized Standard for access to the radio spectrum”

- B. Information Required. Each bidder shall submit with their proposal the following information relative to the access point proposed to furnish.
- i. Manufacturer’s catalog description, including manufacturer's name and catalog ordering numbers.
 - ii. Specification sheets.
 - iii. Any other information as required herein.
- C. Assembly. Each access point shall be delivered completely assembled, wired, and ready for installation.
- D. Warranty. The manufacturer shall warrant each access point against any defects due to design or workmanship developing within a period of five (5) years after the access point have been accepted by the City. This will be interpreted particularly to mean failure of any component impairing the proper operation of the unit. Any access point developing defects within this period shall be replaced by the manufacturer at their sole expense and without cost to the City.
- E. Sample. If so requested, a sample of the access point of the manufacturer intended to be furnished under this contract must be submitted to the Division of Electrical Operations within fifteen (15) days upon receipt of a request from the Chief Procurement Officer.
- F. The manufacturer shall be ISO 9001 certified for quality management in the manufacturing field.

- G. Access point shall be FCC compliant for non-electrical interference.
- H. Compliance. The Access Point shall conform in detail to the requirements herein stated, and to the standards herein cited, of which the latest revisions shall govern.

III. HOUSING

- A. Housing shall be white Aluminum. The housing is required to be impact resistant.
- B. Cellular housing shall be 9.5" L x 10" W x 5.2" H, and weigh 5.1 lbs.
- C. Ethernet housing shall be 9" L x 8" W x 4" H, and weigh 4 lbs.
- D. Housing shall provide a lighting-pole mounting bracket kit.

IV. ENVIRONMENTAL

- A. The Access point shall operate within the temperature range of -40°C to +85°C (-40°F to +185°F)
- B. The Access point shall have an ingress protection of IP65.

V. ELECTRICAL

- A. The access point must function properly within the existing City lighting circuits and the power distribution system as provided by ComEd. Existing conditions shall not adversely affect the access point, nor keep them from performing properly.
- B. Power consumption shall be less than 7.0 Watts for Ethernet and 8.0 Watts for Ethernet with battery back-up.
- C. Power consumption shall be less than 12.5 Watts for cellular and 13.5 Watts for cellular for battery back-up.
- D. The access point must be stable and reliable over the range of 96 to 250 Volts AC, at 50/60 cycles.
- E. Its battery backup option shall provide a greater than 8-hour operation.

VI. COMMUNICATIONS

- A. The access point shall operate at the frequency of 902-928 MHz.
- B. The access point must have a transmitter output of 30 decibel-milli-watts (dBm) with an output impedance of 50 ohms.
- C. Access point shall have a receiver sensitivity of -97 dBm for 1% PER.
- D. Access point must have a wireless branch networking through cellular, ethernet and satellite.

VII. TRANSCEIVER

- A. Access point must function under 2.4 GHz HAN Transceiver, with a frequency of 2.4GHz in an ISM Band.
- B. It must have a Data Rate of 100 Kbps – 1Mbps Frequency-hopping spread spectrum (FHSS).
- C. Access point shall have a receiver sensitivity of -97 dBm for 1% PER.

VIII. PHYSICAL INTERFACES

- A. Access point shall have an N Type, Female antenna
- B. It must have an OMNI NAN antenna with gain not to exceed 3.6dBi on 2.4GHz and 3.0 decibel relative to isotropic (dBi) om 900 MHZ.
- C. It will also have a Mobile Mark antenna RMM-UMB-1S-WHT-7.

IX. PROTOCOLS AND SECURITY

- A. Access point shall have an Internet Protocol Version 6 (IPv6)
- B. Access Point must have a Secure Hash Algorithm 256-bit (SHA-256) RSA-1024 and/or ECC 256.
- C. Its Encryption shall be Advanced Encryption Standard (AES)-128 or AES-256.

X. MEMORY

32 MB/32 MB Flash/RAM

XI. PACKAGING

- A. Carton. Each Access Point shall be individually packed in a carton of adequate strength and properly secured and protected to prevent damage to the unit during shipment, handling, and storage. A master carton shall contain multiple units, each in individual cartons.
- B. Marking. Each carton shall be clearly marked on the outside with the legend "ROADWAY LIGHTING CONTROL ACCESS POINT" (or similar as appropriate), with the number of units in the carton: volt-ampere, load rating, voltage, manufacturer's name and catalogue number, and shipping or manufacturing date.

**ROADWAY SMART LIGHTING CONTROL
FIELD SERVICE UNIT**

I. SUBJECT

This specification states the requirement for smart lighting Field Service Unit (FSU). The portable field device or communication tester shall use Radio Frequency (RF) to communicate with network devices such as fixtures nodes to troubleshoot and determine how well the fixture is responding to dimming or to turn it on-off. The City of Chicago's smart lighting management system interfaces with an itron mesh network, that provides communication through individual external or internal nodes positioned on lighting fixtures to the City's network control and monitoring center.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C12.20, "Humidity, Operating Temperature Standard, and Electromagnetic Susceptibility Standard"
- ANSI C12.20, "Surge Withstand Capability, Electrostatic Discharge and Electrical Fast Transients Standard"

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE 802.15.4g, "IEEE standard for local and metropolitan area networks--Part 15.4: Low-Rate wireless personal area networks (LR-WPANs) Amendment3: Physical layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks. Based on Wi-SUN Communications System"

United States National Institute of Standards and Technology (NIST)

- Federal Information Processing Standards (FIPS) PUB 197, "Advanced Encryption Standard"

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

- ISO/IEC 18033-3, “Information Technology-Security Techniques-Encryption Algorithms-Part 3: Block ciphers”
- IEC 61000-4-6, “Conducted Immunity”
- IEC 61000-4-8, “Magnetic Immunity”
- IEC 61000-4-11, “Voltage Dips and Interrupts”
- IEC 60950-1, IEC 60950-22, “Safety Standard for Information Technology Equipment”

Federal Communications Commission (FCC)

- FCC Part 15.247, “Operating within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz”

Radio Standards Specifications (RSS)

- RSS-247, “Digital Transmission Systems, Frequency Hopping Systems and License-Exempt Local Area Network Devices”

European Telecommunications Standards Institute (ETSI)

- ETSI EN 303 204, “Fixed Short-Range Devices in Data Networks; radio equipment to be used in the 870 MHz to 876 MHz frequency range with power levels ranging up to 500mW; Harmonized Standard for access to the radio spectrum”

- B. Information Required. Each bidder shall submit with their proposal the following information relative to the Field Service Unit proposed to furnish.
- i. Manufacturer’s catalog description, including manufacturer's name and catalog ordering numbers.
 - ii. Specification sheets.
 - iii. Any other information as required herein.
- C. Assembly. Each field service unit shall be delivered completely assembled, wired, and ready for installation.
- D. Warranty. The manufacturer shall warrant each field service unit against any defects due to design or workmanship developing within a period of five (5) years after the field service unit have been accepted by the City. This will be interpreted particularly to mean failure of any component impairing the proper operation of the unit. Any field service unit developing defects within this period shall be replaced by the manufacturer at their sole expense and without cost to the City.
- E. Sample. If so requested, a sample of the field service unit of the manufacturer intended to be furnished under this contract must be submitted to the Division of Electrical Operations within fifteen (15) days upon receipt of a request from the Chief Procurement Officer.
- F. The manufacturer shall be ISO 9001 certified for quality management in the manufacturing field.

- G. Field service unit shall be FCC compliant for non-electrical interference.
- H. Compliance. The field service unit shall conform in detail to the requirements herein stated, and to the standards herein cited, of which the latest revisions shall govern.

III. HOUSING

- A. Housing shall be Aluminum. The housing is required to be impact resistant.
- B. Housing shall be 4.94" L x 2.71" W x 1.27" H.

IV. ENVIRONMENTAL

- A. The field service unit shall operate within the temperature range of -30°C to +60°C (-22°F to +140°F)

V. ELECTRICAL

- A. The field service unit must function properly within the existing City lighting circuits and the power distribution system as provided by ComEd. Existing conditions shall not adversely affect the access point, nor keep them from performing properly.
- B. The field service unit must have an external power supply of 110-240 VAC, at 50/60 cycles.

VI. NAN COMMUNICATIONS

- A. The field service unit shall have a Data Rate of 100 to 2400 Kbps
- B. The field service unit shall operate at the frequency of 902-928 MHz.
- C. The field service unit must have a Spread Spectrum technology of Frequency-Hopping spread spectrum (FHSS) with an output impedance of 50 ohms.
- D. Field service unit shall have a Modulation with Frequency-shift keying or Orthogonal frequency-division multiplexing (FSK or OFDM) – adaptive gear shifting.
- E. Field service unit must have a transmitter output of 900MHz – 1W, 870 MHz – 500mW ERP with an output impedance of 50 ohms.

VII. HAN COMMUNICATIONS

- A. The field service unit must function under 2.4 GHz HAN receiver, with a frequency of 2.4GHz in an ISM Band.
- B. It must have a Data Rate of 250 Kbps.
- C. The field service unit shall have a receiver sensitivity of -97 dBm for 1% PER.

VIII. PROTOCOLS AND SECURITY

- A. Field service unit shall have ZigBee Smart Energy Profile 1.1
- B. The field service unit shall have an Internet Protocol Version 6 (IPv6)
- C. The field service unit must have a Secure Hash Algorithm 256-bit (SHA-256) RSA-1024 and/or ECC 256.
- D. Its Encryption shall be Advanced Encryption Standard (AES)-128 or AES-256.

IX. PACKAGING

- A. Carton. Each field service unit shall be individually packed in a carton of adequate strength and properly secured and protected to prevent damage to the unit during shipment, handling, and storage. A master carton shall contain multiple units, each in individual cartons.
- B. Marking. Each carton shall be clearly marked on the outside with the legend "ROADWAY SMART LIGHTING CONTROL FIELD SERVICE UNIT" (or similar as appropriate), with the number of units in the carton: volt-ampere, load rating, voltage, manufacturer's name and catalogue number, and shipping or manufacturing date.

**ELECTRICAL SPECIFICATION 1626
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
APRIL 25, 2021**

**ROADWAY SMART LIGHTING CONTROL
RELAY**

I. SUBJECT

This specification states the requirement for smart lighting Relay. The City of Chicago's smart lighting management system interfaces with an itron mesh network, that provides communication through individual external and internal nodes positioned on lighting fixtures. The itron relay accessories shall provide a repeating action that will extend the range of the mesh network. It will provide reliability and redundancy communications to the City's data center. The itron relay accessories shall run on infrastructure hardware to quickly identify anomalies and optimize grid operations even to the grid endpoints.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C12.20, "Operating Vibration and Shock Standard"
- ANSI C12.20, "Humidity, Operating Temperature Standard, and Electromagnetic Susceptibility Standard"
- ANSI C12.20, "Surge Withstand Capability, Electrostatic Discharge and Electrical Fast Transients Standard"

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE 802.15.4g, "IEEE standard for local and metropolitan area networks--Part 15.4: Low-Rate wireless personal area networks (LR-WPANs) Amendment3: Physical layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks. Based on Wi-SUN Communications System"

United States National Institute of Standards and Technology (NIST)

- Federal Information Processing Standards (FIPS) PUB 197, "Advanced Encryption Standard"

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

- ISO/IEC 18033-3, “Information Technology-Security Techniques-Encryption Algorithms-Part 3: Block ciphers”
- IEC 61000-4-6, “Conducted Immunity”
- IEC 61000-4-8, “Magnetic Immunity”
- IEC 61000-4-11, “Voltage Dips and Interrupts”
- IEC 60950-1, IEC 60950-22, “Safety Standard for Information Technology Equipment”

Federal Communications Commission (FCC)

- FCC Part 15.247, “Operating within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz”

Radio Standards Specifications (RSS)

- RSS-247, “Digital Transmission Systems, Frequency Hopping Systems and License-Exempt Local Area Network Devices”

European Telecommunications Standards Institute (ETSI)

- ETSI EN 303 204, “Fixed Short-Range Devices in Data Networks; radio equipment to be used in the 870 MHz to 876 MHz frequency range with power levels ranging up to 500mW; Harmonized Standard for access to the radio spectrum”

- B. Information Required. Each bidder shall submit with their proposal the following information relative to the relay proposed to furnish.
- i. Manufacturer’s catalog description, including manufacturer's name and catalog ordering numbers.
 - ii. Specification sheets.
 - iii. Any other information as required herein.
- C. Assembly. Each relay accessory shall be delivered completely assembled, wired, and ready for installation.
- D. Warranty. The manufacturer shall warrant each relay accessory against any defects due to design or workmanship developing within a period of five (5) years after the relay accessory have been accepted by the City. This will be interpreted particularly to mean failure of any component impairing the proper operation of the unit. Any relay accessory developing defects within this period shall be replaced by the manufacturer at their sole expense and without cost to the City.
- E. Sample. If so requested, a sample of the relay accessory of the manufacturer intended to be furnished under this contract must be submitted to the Division of Electrical Operations within fifteen (15) days upon receipt of a request from the Chief Procurement Officer.
- F. The manufacturer shall be ISO 9001 certified for quality management in the manufacturing field.

- G. Relay accessory shall be FCC compliant for non-electrical interference.
- H. Compliance. The relay accessory shall conform in detail to the requirements herein stated, and to the standards herein cited, of which the latest revisions shall govern.

III. HOUSING

- A. Housing shall be white Aluminum. The housing is required to be impact resistant.
- B. Housing shall be 13.8” L x 8.32” W x 3.62” H, and weigh 8.1 lbs.
- C. Housing shall provide a lighting-pole mounting bracket kit.

IV. ENVIRONMENTAL

- A. The relay accessory shall operate within the temperature range of -40°C to +85°C (-40°F to +185°F)
- B. The Access point shall have an ingress protection of IP65.

V. ELECTRICAL

- A. The relay accessory must function properly within the existing City lighting circuits and the power distribution system as provided by ComEd. Existing conditions shall not adversely affect the access point, nor keep them from performing properly.
- B. Power consumption shall be less than 8.8 Watts and less than 14.8 W with battery back-up.
- C. The relay accessory must be stable and reliable over the range of 96 to 277 Volts AC, at 50/60 cycles.
- D. Its battery backup option shall provide a greater than 8-hour operation.

VI. COMMUNICATIONS

- A. The relay accessory shall operate at the frequency of 902-928 MHz.
- B. The relay accessory must have a transmitter output of 900 MHz – 1W, 870 MHz – 500 mW ERP with an output impedance of 50 ohms.
- C. Relay accessory shall have a Data rate of 100 to 2400 kbps.
- D. Relay accessory must have a Spread Spectrum technology of Frequency-Hopping spread spectrum (FHSS) with an output impedance of 50 ohms.
- E. Relay accessory shall have a Modulation with Frequency-shift keying or Orthogonal frequency-division multiplexing (FSK or OFDM) – adaptive gear shifting.

VII. PHYSICAL INTERFACES

- A. Relay accessory shall have an N Type, Female antenna
- B. Relay accessory shall have a 50 ohm termination for a 2.4GHz radio antenna.

VIII. PROTOCOLS AND SECURITY

- A. Relay accessory shall have an Internet Protocol Version 6 (IPv6)
- B. Relay accessory must have a Secure Hash Algorithm 256-bit (SHA-256) RSA-1024 and/or ECC 256.
- C. Its Encryption shall be Advanced Encryption Standard (AES)-128 or AES-256.

IX. MEMORY

32 MB/32 MB Flash/RAM

X. PACKAGING

- A. Carton. Each Relay accessory shall be individually packed in a carton of adequate strength and properly secured and protected to prevent damage to the unit during shipment, handling, and storage. A master carton shall contain multiple units, each in individual cartons.
- B. Marking. Each carton shall be clearly marked on the outside with the legend "ROADWAY SMART LIGHTING CONTROL RELAY" (or similar as appropriate), with the number of units in the carton: volt-ampere, load rating, voltage, manufacturer's name and catalogue number, and shipping or manufacturing date.

LUMINAIRE SPECIFICATION FOR RESIDENTIAL STREETS-SINGLE SIDED

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) residential street lighting luminaires. The specified LED luminaires will be used on Chicago residential streets single-sided system. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
- ANSI C136.31-2015, “American National Standard for Roadway and

Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form

2. Product Data Sheets.

a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).

b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.

c) LED light source data sheet

d) Surge protection device data sheet

3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.

b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.

- ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
- TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

III. CONSTRUCTION

A. Weight and Area

The net weight of these luminaires must not be more than 24 pounds. The effective projected area (EPA) must not exceed 0.57 square feet.

B. Housing

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Refractor

The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

D. Mounting Provisions

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

E. Access Door-Panel

An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

F. Hardware

All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment to the mast arm, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

G. Finish.

The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness to resist corrosion. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

H. Ingress Protection.

1. The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.
2. The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

I. General Luminaire Requirements

1. The luminaire must be rated to operate between -40° to +50° Celsius.
2. The luminaire must have the option of adding a house side shield. The shield should be designed to be easily installed in the field. The house side shield must be composed of a sturdy material capable of withstanding vibrations and weather conditions. The shield must cut off light trespass at approximately one mounting height behind the pole.
3. The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver
4. The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the 0-10 VDC Node as per Section III-I-3-h) . This information will be transmitted through the networked Lighting Management control system.

J. Electrical Components

1. LED Optical Arrays
 - a) The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible

location.

- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 20\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- g) Electrical Transient Immunity.
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Basic 6kV/3kA (120 Strikes) and the Enhanced (10 kV / 5 kA) combination wave

test level.

- Transient Immunity Testing Requirements
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
 - If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

4. Wiring.

- a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.
- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.

5. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision

for proper positioning of the control device.

- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
 - c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
 - d) Receptacle Wire Leads must all be properly terminated.
 - e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
 - f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.
6. Component Mounting.
- All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.
To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).
2. Lumen Maintenance.
 - a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
 - b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.
 - (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
 - (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
 - (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.
3. Color Attributes
 - a) Color Rendering Index (CRI) shall be no less than 70.
 - b) Nominal Correlated Color Temperature (CCT) shall be 3000K as

defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

- Legacy Residential Streets - single-sided pattern pole spacing.

a) Performance Requirements:

Roadway Luminance:

Average Luminance	1.5 cd/m ²
Uniformity Ratio Av/Min	6:1
Uniformity Ratio Max/Min	10:1
Max Veiling Luminance	0.4

Sidewalks for single-sided pattern:

Default AVG Horizontal Illuminance	0.5
AVG MIN Uniformity Ratio	4:1

Light Trespass Limits:

Vertical Illuminance	0.1 < X < 0.5
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

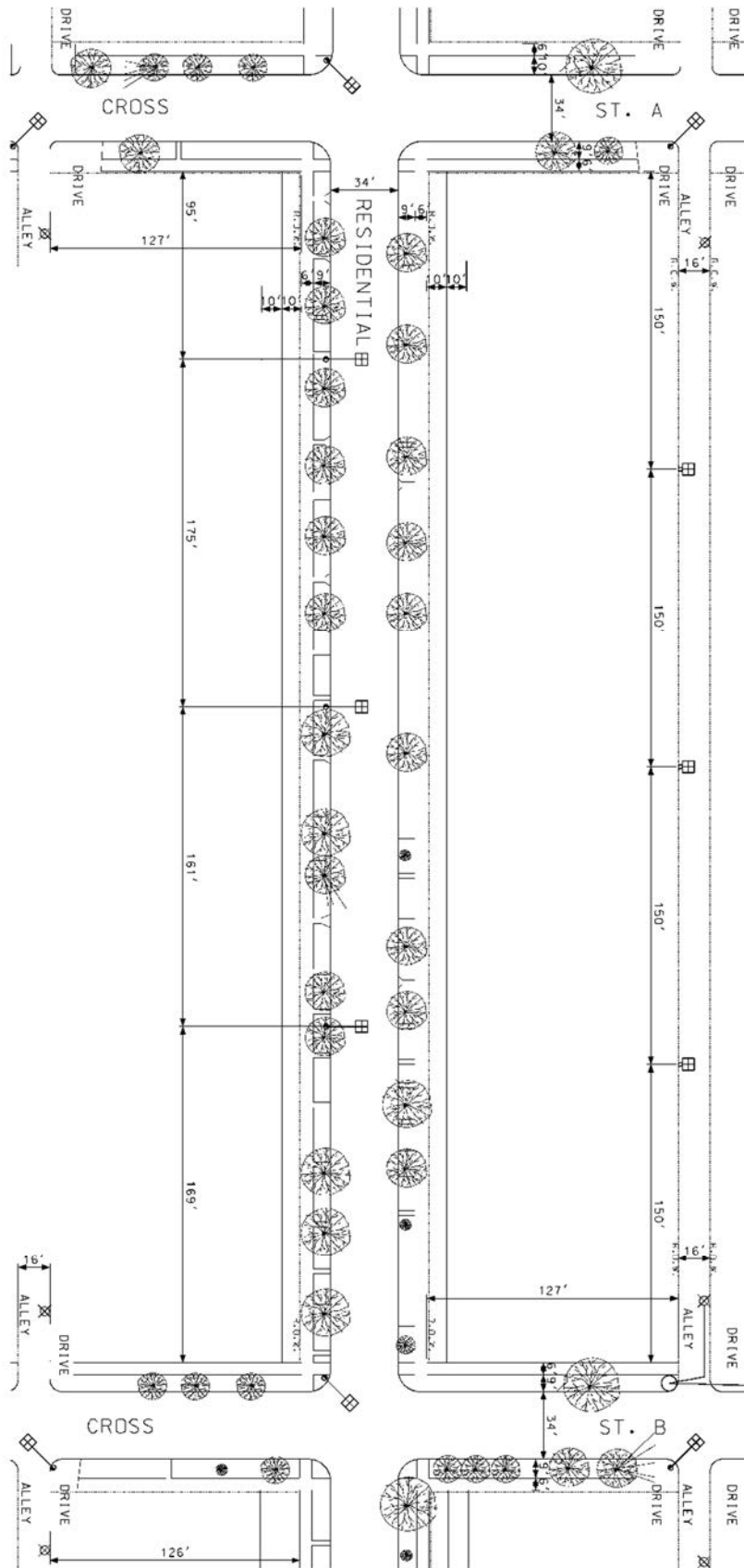
Right-of-way	66'
Curb-to-curb	34'
Mounting height	22' for single-sided
Setback	2' for single-sided
Arm length	15' for single-sided

Single Sided Pattern:

Pole Spacing	175'
Pavement	R3

See ATTACHMENT A for residential street single-sided layout.

ATTACHMENT A – Residential Street Single-sided Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Residential Single-sided Pattern		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power— maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

LUMINAIRE SPECIFICATION FOR RESIDENTIAL STREETS-STAGGERED

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) residential street lighting luminaires. The specified LED luminaires will be used on Chicago residential streets staggered system. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
- ANSI C136.31-2015, “American National Standard for Roadway and

Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form

2. Product Data Sheets.

a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).

b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.

c) LED light source data sheet

d) Surge protection device data sheet

3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.

b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.

c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.

d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.

- ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
- TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

III. CONSTRUCTION

A. Weight and Area

The net weight of these luminaires must not be more than 16 pounds. The effective projected area (EPA) must not exceed 0.50 square feet.

B. Housing

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Refractor

The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

D. Mounting Provisions

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

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- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
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Uniformity Ratio Max/Min	10:1
Max Veiling Luminance	0.4

Sidewalks for staggered pattern:

Default AVG Horizontal Illuminance	0.5
AVG MIN Uniformity Ratio	4:1

Light Trespass Limits:

Vertical Illuminance	0.1 < X < 0.5
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

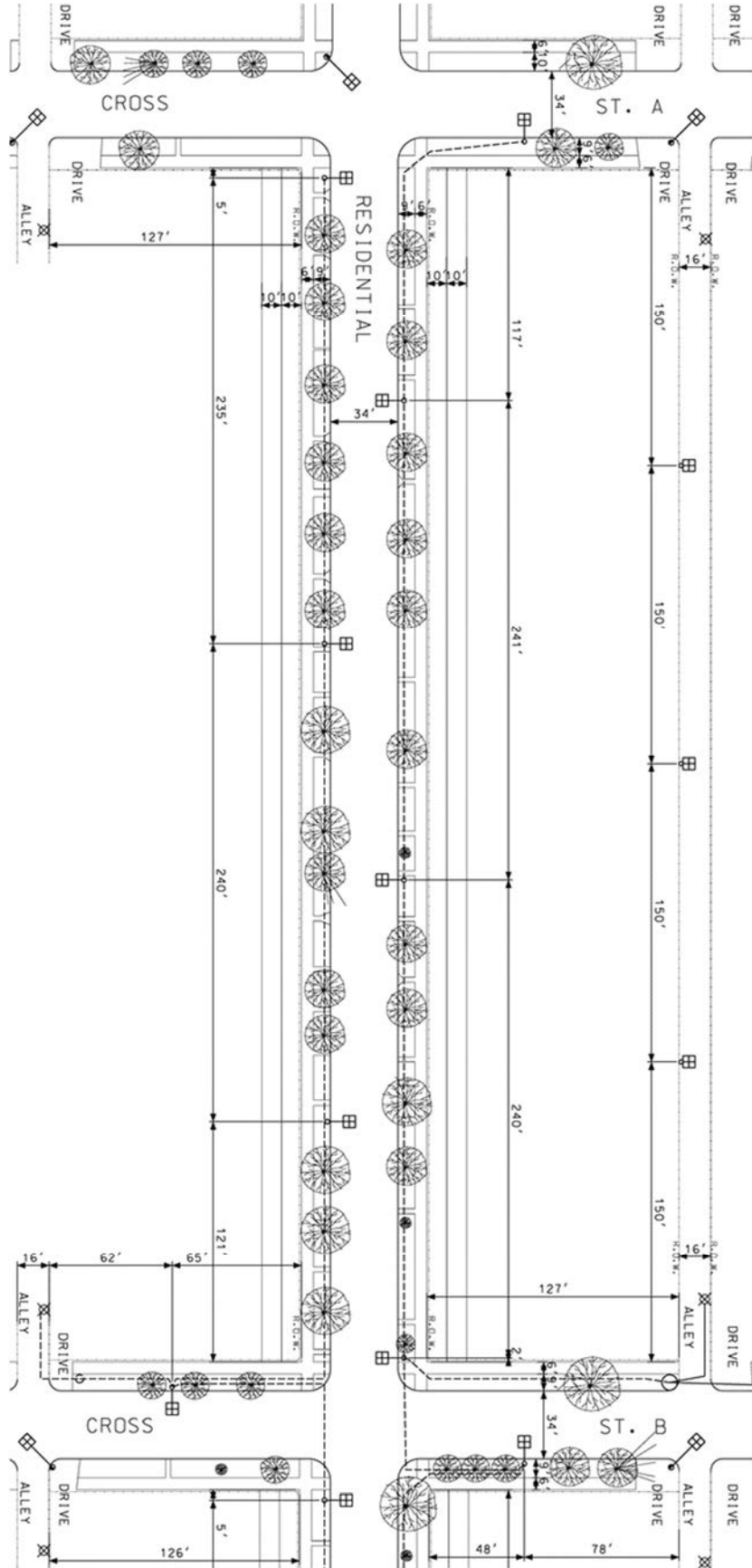
Right-of-way	66'
Curb-to-curb	34'
Mounting height	18'
Setback	3'
Arm length	8'

Staggered Pattern:

Pole Spacing	220'
Pavement	R3

See ATTACHMENT A for residential street staggered layout.

ATTACHMENT A – Residential Street Staggered Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Residential Staggered Pattern		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial		lumens	
Luminaire input power—initial		watts	
Luminaire input power— maintained		watts	
Luminaire input voltage- nominal range		volts	
LED drive current - initial		milliamps	
LED drive current - maintained		milliamps	
CCT (correlated color temperature)		kelvin	
CRI (color rendering index)			
EPA (effective projected area) - nominal		sq. ft.	
Luminaire Weight - nominal		lbs.	
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life		years	
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31		<input type="checkbox"/> Level 2	
Luminaire warranty period		years	
IES LM-80 test duration		hours	IES LM-80-15 report
LED lumen maintenance at 36,000 hours		%	TM-21 calculator
Max. LED case temperature		degrees Celsius	ISTMT report

LUMINAIRE SPECIFICATION FOR RESIDENTIAL STREETS SINGLE-SIDED-NARROW

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) residential street lighting luminaires. The specified LED luminaires will be used on Chicago residential streets single-sided narrow system. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”

- ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Vibration”
- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment–Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form
2. Product Data Sheets.
 - a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
 - b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
 - c) LED light source data sheet
 - d) Surge protection device data sheet
3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

 - a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.
 - b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.
 - c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.
 - d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.
 - ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
 - TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

III. CONSTRUCTION

A. Weight and Area

The net weight of these luminaires must not be more than 16 pounds. The effective projected area (EPA) must not exceed 0.50 square feet.

B. Housing

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Refractor

The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

D. Mounting Provisions

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

E. Access Door-Panel

An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

F. Hardware

All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment to the mast arm, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

G. Finish.

The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness to resist corrosion. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

H. Ingress Protection.

1. The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.
2. The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

I. General Luminaire Requirements

1. The luminaire must be rated to operate between -40° to +50° Celsius.
2. The luminaire must have the option of adding a house side shield. The shield should be designed to be easily installed in the field. The house side shield must be composed of a sturdy material capable of withstanding vibrations and weather conditions. The shield must cut off light trespass at approximately one mounting height behind the pole.
3. The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver
4. The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the 0-10 VDC Node as per Section III-I-3-h) . This information will be transmitted through the networked Lighting Management control system.

J. Electrical Components

1. LED Optical Arrays
 - a) The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible

location.

- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 20\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- g) Electrical Transient Immunity.
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Basic 6kV/3kA (120 Strikes) and the Enhanced (10 kV / 5 kA) combination wave

test level.

- Transient Immunity Testing Requirements
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
 - If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

4. Wiring.

- a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.
- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.

5. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision

for proper positioning of the control device.

- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
 - c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
 - d) Receptacle Wire Leads must all be properly terminated.
 - e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
 - f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.
6. Component Mounting.
- All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.
To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).
2. Lumen Maintenance.
 - a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
 - b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.
 - (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
 - (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
 - (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.
3. Color Attributes
 - a) Color Rendering Index (CRI) shall be no less than 70.
 - b) Nominal Correlated Color Temperature (CCT) shall be 3000K as

defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

- Legacy Residential Streets – Single-sided pole spacing.

a) Performance Requirements:

Roadway Luminance:

Average Luminance	1.5 cd/m ²
Uniformity Ratio Av/Min	6:1
Uniformity Ratio Max/Min	10:1
Max Veiling Luminance	0.4

Sidewalks for staggered pattern:

Default AVG Horizontal Illuminance	0.5
AVG MIN Uniformity Ratio	4:1

Light Trespass Limits:

Vertical Illuminance	0.1 < X < 0.5
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

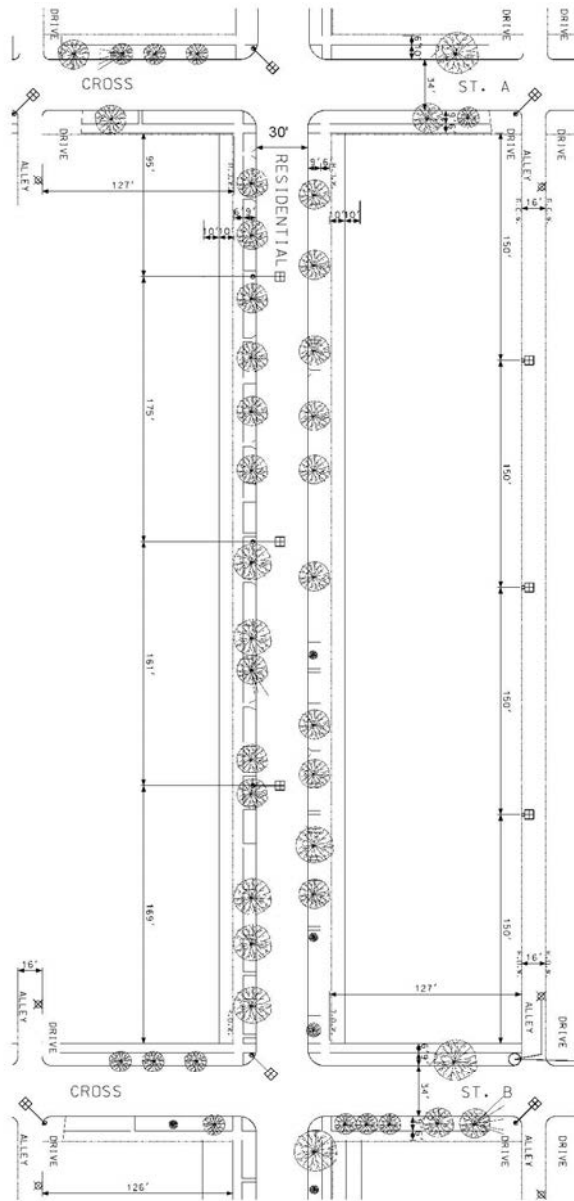
Right-of-way	66'
Curb-to-curb	30'
Mounting height	22'
Setback	2'
Arm length	15'

Staggered Pattern:

Pole Spacing	175'
Pavement	R3

See ATTACHMENT A for residential street single-sided Narrow layout.

ATTACHMENT A – Residential Street Single-sided Narrow Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Residential Single-side Narrow Pattern		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power— maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

LUMINAIRE SPECIFICATION FOR ARTERIAL STREETS-SINGLE SIDED

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) arterial street lighting luminaires. The specified LED luminaires will be used on Chicago arterial streets single-sided system. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
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- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
- ANSI C136.31-2015, “American National Standard for Roadway and

Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

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- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form
2. Product Data Sheets.
 - a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
 - b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
 - c) LED light source data sheet
 - d) Surge protection device data sheet - if applicable
3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

 - a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.
 - b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.
 - c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.
 - d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.
 - ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
 - TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

III. CONSTRUCTION

A. Weight and Area

The net weight of these luminaires must not be more than 16 pounds. The effective projected area (EPA) must not exceed 0.50 square feet.

B. Housing

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Refractor

The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

D. Mounting Provisions

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

E. Access Door-Panel

An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

F. Hardware

All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment to the mast arm, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

G. Finish.

The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness to resist corrosion. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

H. Ingress Protection.

1. The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.
2. The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

I. General Luminaire Requirements

1. The luminaire must be rated to operate between -40° to +50° Celsius.
2. The luminaire must have the option of adding a house side shield. The shield should be designed to be easily installed in the field. The house side shield must be composed of a sturdy material capable of withstanding vibrations and weather conditions. The shield must cut off light trespass at approximately one mounting height behind the pole.
3. The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver
4. The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the 0-10 VDC Node as per Section III-I-3-h) . This information will be transmitted through the networked Lighting Management control system.

J. Electrical Components

1. LED Optical Arrays
 - a) The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible

location.

- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 20\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- g) Electrical Transient Immunity.
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Basic 6kV/3kA (120

Strikes) and the Enhanced (10 kV / 5 kA) combination wave test level.

- Transient Immunity Testing Requirements
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
 - If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

4. Wiring.

a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class

of insulation and must be #16 AWG conductor at a minimum.

- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.

5. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.
- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
- c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
- d) Receptacle Wire Leads must all be properly terminated.
- e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
- f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

6. Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.

To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).

2. Lumen Maintenance.

- a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
- b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values,

i.e. $LLF = LLD \times LDD \times LAT$.

- (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
- (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
- (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

3. Color Attributes

- a) Color Rendering Index (CRI) shall be no less than 70.
- b) Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

- Legacy Arterial Streets - single-sided pattern pole spacing.

a) Performance Requirements:

Roadway Luminance:

Average Luminance	1.7 cd/m ²
Uniformity Ratio Av/Min	3:1
Uniformity Ratio Max/Min	5:1
Max Veiling Luminance	0.3

Sidewalks for single-sided arterial:

Default AVG Horizontal Illuminance	0.5
AVG MIN Uniformity Ratio	4:1

Light Trespass Limits:

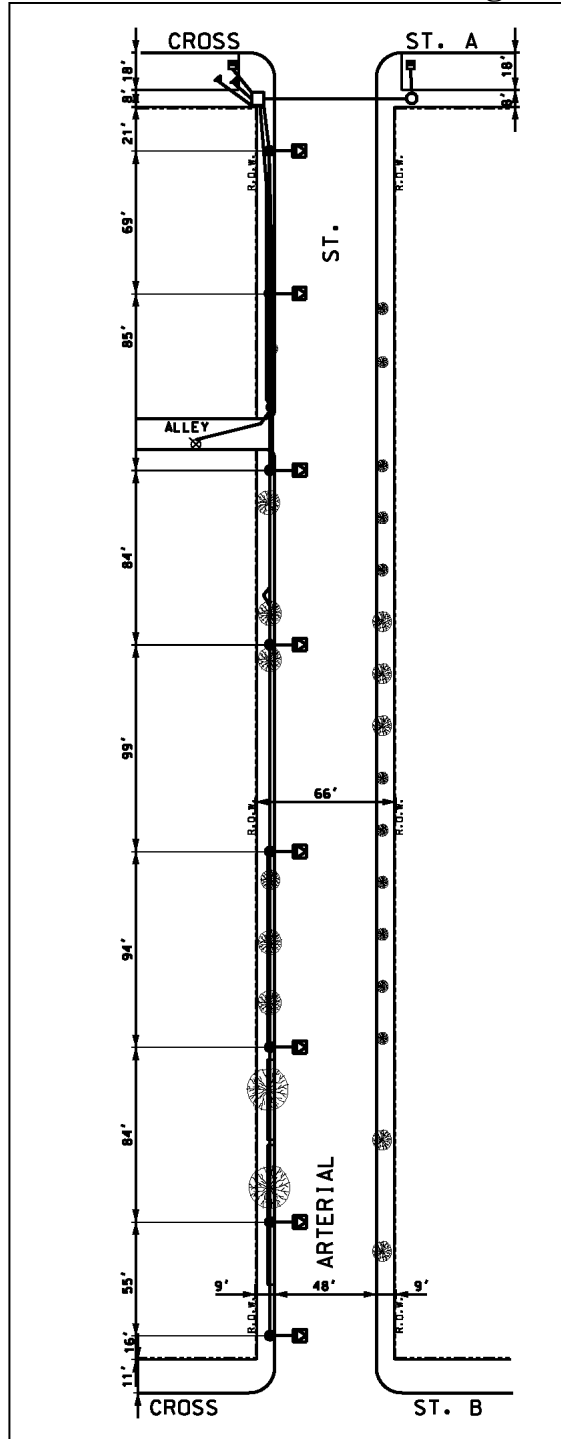
Vertical Illuminance	$0.1 < X < 0.5$
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

Right-of-way	66'
Curb-to-curb	48'
Mounting height	33'
Setback	3'
Arm length	8'
Single-sided Pattern:	
Pole Spacing	90'

See ATTACHMENT A for Arterial street single-sided layout.

ATTACHMENT A – Arterial Street Single-sided Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Arterial Single-sided Pattern		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power— maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

LUMINAIRE SPECIFICATION FOR ARTERIAL STREETS-STAGGERED

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) arterial street lighting luminaires. The specified LED luminaires will be used on Chicago arterial streets staggered system. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
- ANSI C136.31-2015, “American National Standard for Roadway and

Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form
2. Product Data Sheets.
 - a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
 - b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
 - c) LED light source data sheet
 - d) Surge protection device data sheet - if applicable
3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

 - a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.
 - b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.
 - c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.
 - d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.
 - ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
 - TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
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 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

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The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

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The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

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- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

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- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 20\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
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 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

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- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
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- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
- c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
- d) Receptacle Wire Leads must all be properly terminated.
- e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
- f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

6. Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.

To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).

2. Lumen Maintenance.

- a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
- b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values,

i.e. $LLF = LLD \times LDD \times LAT$.

- (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
- (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
- (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

3. Color Attributes

- a) Color Rendering Index (CRI) shall be no less than 70.
- b) Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

- Arterial Streets - Staggered pattern pole spacing.

a) Performance Requirements:

Roadway Luminance:

Average Luminance	1.7 cd/m ²
Uniformity Ratio Av/Min	3:1
Uniformity Ratio Max/Min	5:1
Max Veiling Luminance	0.3

Sidewalks for Staggered arterial:

Default AVG Horizontal Illuminance	0.5
AVG MIN Uniformity Ratio	4:1

Light Trespass Limits:

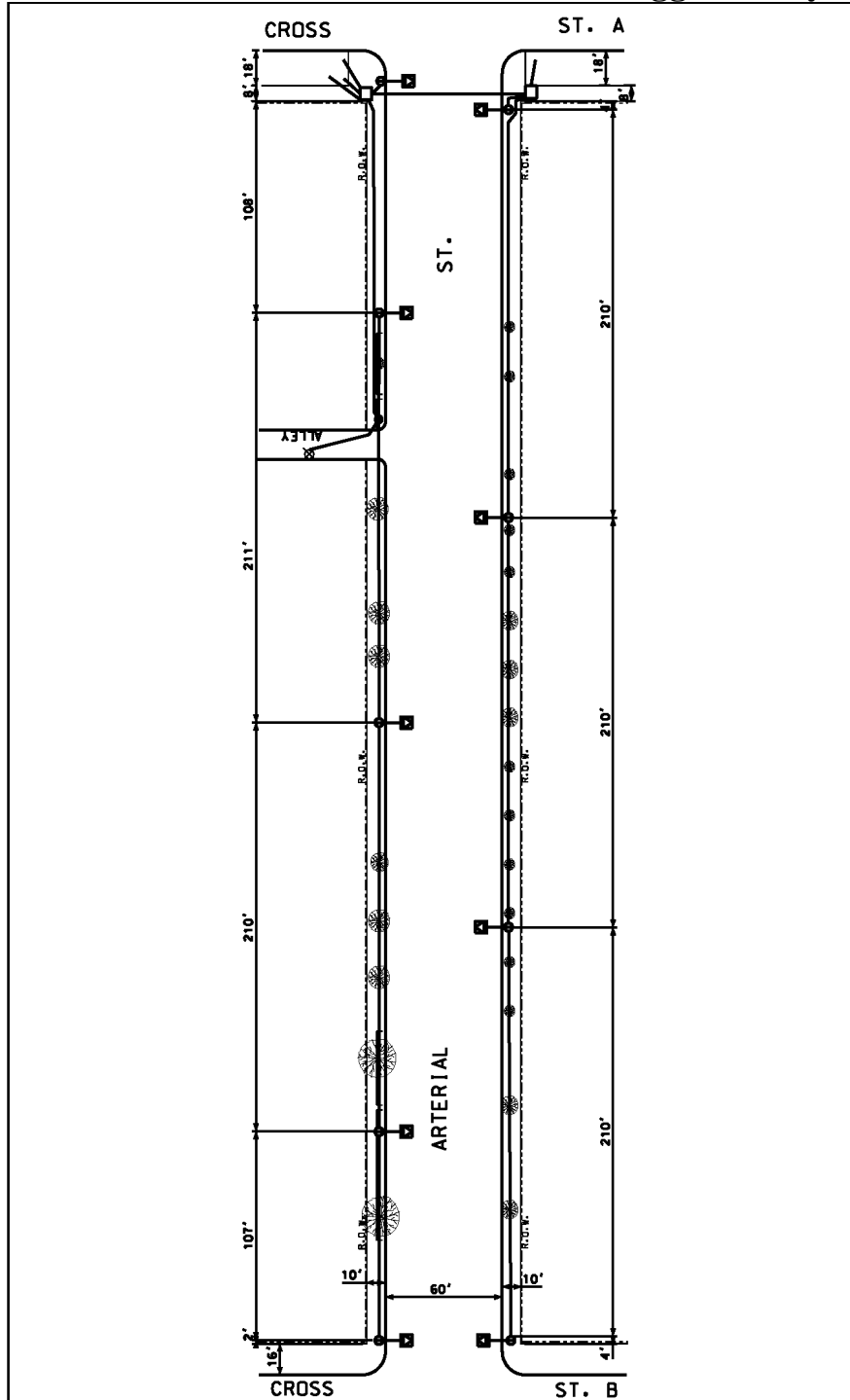
Vertical Illuminance	$0.1 < X < 0.5$
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

Right-of-way	80'
Curb-to-curb	60'
Mounting height	33'
Setback	3'
Arm length	12'
Staggered Pattern:	
Pole Spacing	220'

See ATTACHMENT A for Arterial street staggered layout.

ATTACHMENT A – Arterial Street Staggered Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Arterial Staggered Pattern		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial		lumens	
Luminaire input power—initial		watts	
Luminaire input power— maintained		watts	
Luminaire input voltage- nominal range		volts	
LED drive current - initial		milliamps	
LED drive current - maintained		milliamps	
CCT (correlated color temperature)		kelvin	
CRI (color rendering index)			
EPA (effective projected area) - nominal		sq. ft.	
Luminaire Weight - nominal		lbs.	
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life		years	
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31		<input type="checkbox"/> Level 2	
Luminaire warranty period		years	
IES LM-80 test duration		hours	IES LM-80-15 report
LED lumen maintenance at 36,000 hours		%	TM-21 calculator
Max. LED case temperature		degrees Celsius	ISTMT report

LUMINAIRE SPECIFICATION FOR ARTERIAL STREETS - OPPOSITE

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) arterial street lighting luminaires. The specified LED luminaires will be used on Chicago arterial streets opposite system. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
- ANSI C136.31-2015, “American National Standard for Roadway and

Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form
2. Product Data Sheets.
 - a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
 - b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
 - c) LED light source data sheet
 - d) Surge protection device data sheet - if applicable
3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

 - a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.
 - b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.
 - c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.
 - d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.
 - ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
 - TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

III. CONSTRUCTION

A. Weight and Area

The net weight of these luminaires must not be more than 16 pounds. The effective projected area (EPA) must not exceed 0.50 square feet.

B. Housing

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Refractor

The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

D. Mounting Provisions

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

E. Access Door-Panel

An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

F. Hardware

All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment to the mast arm, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

G. Finish.

The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness to resist corrosion. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

H. Ingress Protection.

1. The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.
2. The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

I. General Luminaire Requirements

1. The luminaire must be rated to operate between -40° to +50° Celsius.
2. The luminaire must have the option of adding a house side shield. The shield should be designed to be easily installed in the field. The house side shield must be composed of a sturdy material capable of withstanding vibrations and weather conditions. The shield must cut off light trespass at approximately one mounting height behind the pole.
3. The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver
4. The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the 0-10 VDC Node as per Section III-I-3-h) . This information will be transmitted through the networked Lighting Management control system.

J. Electrical Components

1. LED Optical Arrays
 - a) The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible

location.

- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 20\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- g) Electrical Transient Immunity.
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Basic 6kV/3kA (120

Strikes) and the Enhanced (10 kV / 5 kA) combination wave test level.

- Transient Immunity Testing Requirements
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
 - If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

4. Wiring.

a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class

of insulation and must be #16 AWG conductor at a minimum.

- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.

5. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision for proper positioning of the control device.
- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
- c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
- d) Receptacle Wire Leads must all be properly terminated.
- e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
- f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.

6. Component Mounting.

All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.

To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).

2. Lumen Maintenance.

- a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
- b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values,

i.e. $LLF = LLD \times LDD \times LAT$.

- (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
- (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
- (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.

3. Color Attributes

- a) Color Rendering Index (CRI) shall be no less than 70.
- b) Nominal Correlated Color Temperature (CCT) shall be 3000K as defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

- Arterial Streets - Opposite pattern pole spacing.

a) Performance Requirements:

Roadway Luminance:

Average Luminance	1.7 cd/m ²
Uniformity Ratio Av/Min	3:1
Uniformity Ratio Max/Min	5:1
Max Veiling Luminance	0.3

Sidewalks for Opposite arterial:

Default AVG Horizontal Illuminance	0.5
AVG MIN Uniformity Ratio	4:1

Light Trespass Limits:

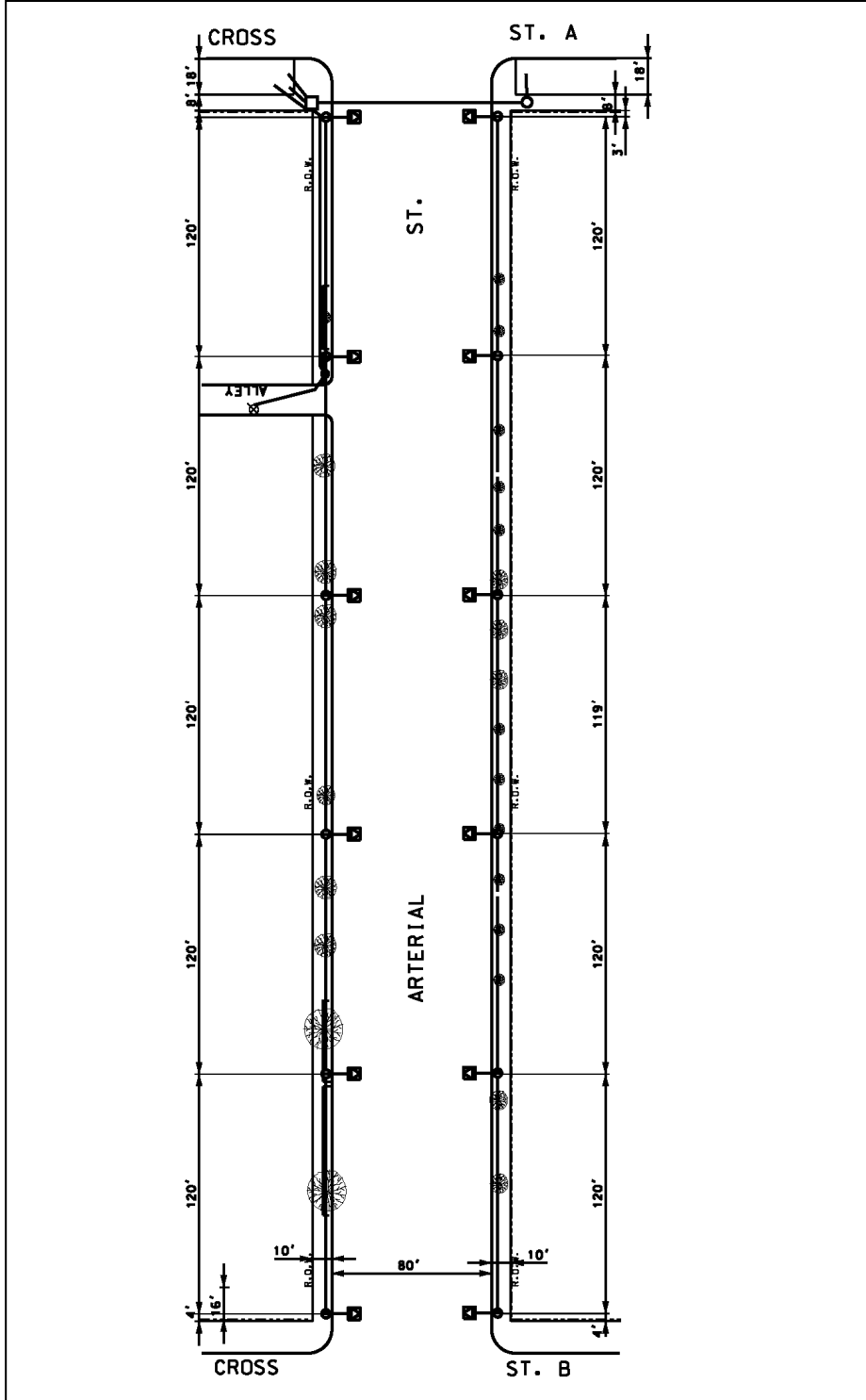
Vertical Illuminance	≤ 0.30
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

Right-of-way	100'
Curb-to-curb	80'
Mounting height	33'
Setback	3'
Arm length	12'
Opposite Pattern:	
Pole Spacing	120'

See ATTACHMENT A for Arterial street opposite layout.

ATTACHMENT A – Arterial Street Opposite Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Arterial Opposite Pattern		
<i>Product Information Description</i>	<i>Product Data (Summary)</i>		<i>Submittal Reference Document</i>
Luminaire Designation			
Luminaire Manufacturer			
Luminaire Model Number			
Luminous Flux – initial	lumens		
Luminaire input power—initial	watts		
Luminaire input power— maintained	watts		
Luminaire input voltage- nominal range	volts		
LED drive current - initial	milliamps		
LED drive current - maintained	milliamps		
CCT (correlated color temperature)	kelvin		
CRI (color rendering index)			
EPA (effective projected area) - nominal	sq. ft.		
Luminaire Weight - nominal	lbs.		
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin		
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC		
LED driver- rated life	years		
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2		
Luminaire warranty period	years		
IES LM-80 test duration	hours		IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%		TM-21 calculator
Max. LED case temperature	degrees Celsius		ISTMT report

LUMINAIRE SPECIFICATION FOR ALLEYS

I. SUBJECT

A. This specification states the requirements for non-ornamental Light Emitting Diode (LED) Alley lighting luminaires. The specified LED luminaires will be used on Chicago Alleys. The LED luminaires will be integrated into a centralized lighting management system. The luminaire manufacturer must demonstrate at least a ten year history of manufacturing LED residential street luminaires by providing a list of prior projects with project description, date, location, quantities and reference contact information. The manufacturer must also demonstrate the capacity to supply the quantities required for the contract in a timely manner.

II. GENERAL

A. References

American National Standards Institute (ANSI)

- ANSI C78.377-2015, “American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products”
- ANSI C82.77-10-2014, “American National Standard for Lighting Equipment—Harmonic Emission Limits—Related Power Quality Requirements”
- ANSI C136.2-2015, “American National Standard for Roadway and Area Lighting Equipment—Dielectric Withstand and Electrical Transient Immunity Requirements”
- ANSI C136.10-2010, “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Control Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
- ANSI C136.15-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Field Identification”
- ANSI C136.22-2004 (R2009, R2014), “American National Standard for Roadway and Area Lighting Equipment—Internal Labeling of Luminaires”
- ANSI C136.25-2013, “American National Standard for Roadway and Area Lighting Equipment—Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures”
- ANSI C136.30-2015, “American National Standard for Roadway and Area Lighting Equipment—Pole Vibration”
- ANSI C136.31-2015, “American National Standard for Roadway and Area Lighting Equipment—Luminaire Vibration”

- ANSI C136.37-2011, “American National Standard for Solid State Light Sources Used in Roadway and Area Lighting”
- ANSI C136.41-2013, “American National Standard for Roadway and Area Lighting Equipment–Dimming Control Between an External Locking Type Control and Ballast or Driver”
- ASTM B85/B85M-14, “Standard Specification for Aluminum-Alloy Die Castings”
- ASTM B117-16, “Standard Practice for Operating Salt Spray (Fog) Apparatus”
- ASTM D523-14, “Standard Test Method for Specular Gloss”
- ASTM D1654-08, “Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments”
- ASTM G154-12a, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

Illuminating Engineering Society of North America (IES)

- ANSI/IES LM-63-02, “Standard File Format for Electronic Transfer of Photometric Data”
- IES LM-79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”
- ANSI/IES LM-80-15, “IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules”
- ANSI/IES RP-8-14, “Roadway Lighting”
- IES TM-21-11 (with Addendum B), “Projecting Long Term Lumen Maintenance of LED Light Sources”

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE Std 1789-2015, “IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers”

International Electrotechnical Commission (IEC)

- IEC 60929:2011 (with Amendment 1), “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”

Underwriters Laboratories (UL)

- ANSI/UL 1598 (3rd Edition), “Luminaires”

B. Submittal Requirements:

The Contractor must submit the following information pertaining to each specified luminaire type within fifteen (15) days of request:

1. Completed ATTACHMENT B – Submittal Form
2. Product Data Sheets.
 - a) Luminaire data sheets – including summary product description, dimensioned outline drawings, and nominal characteristics including but not limited to: initial luminous flux (lumens), input power (watts), input voltage range (volts), LED drive current (milliamps), correlated color temperature (kelvins), color rendering index, effective projected area (square feet) and weight (pounds).
 - b) LED Driver data sheet – including information described in LED Driver Requirements Section III-I-3.
 - c) LED light source data sheet
 - d) Surge protection device data sheet
3. Photometric Performance Data

The manufacturer must provide photometric calculations, as part of each luminaire's submittal package, that demonstrate the luminaire's photometric performance will meet or exceed the photometric requirements listed in this specification. The submitted lighting calculations must include point-by-point illuminance, luminance and veiling luminance data, as well as listings of all indicated averages and ratios. Photometric reports must include the following information and be in accordance with the standards listed below:

 - a) IES LM-79-08 photometric report that includes measured values for initial luminous flux, input power, correlated color temperature, and color rendering index.
 - b) ANSI/IES LM-63-02 electronic format photometric file that corresponds to the LM-79 report.
 - c) LM-63 photometric calculations that demonstrate compliance with the illumination requirements specified herein using the LM-63 file. Calculation grids and observer locations not specified herein must be in accordance with ANSI/IES RP-8-14.
 - d) IES TM-21-11 calculations that derive the lumen maintenance (lamp lumen depreciation or LLD) factor applied to photometric calculations specified herein.
 - ANSI/IES LM-80-15 and in-situ temperature measurement testing (ISTMT) reports containing data used in TM-21 calculations must also be submitted.
 - TM-21 calculations must apply to the maximum LED case temperature from ISTMT, shall not extrapolate beyond six times

the duration of available LM-80 test data, and must be submitted in the spreadsheet format of the ENERGY STAR TM-21 calculator (https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd).

LM-79, ISTMT, and LM-80 reports must correspond directly to submitted luminaires, and must be produced by test laboratories that satisfy the Testing Laboratory Requirements of the DesignLights Consortium (www.designlights.org/content/QPL/ProductSubmit/LabTesting).

ISTMT must be conducted in accordance with the DesignLights Consortium Manufacturer's Guide (<https://www.designlights.org/content/qpl/productssubmit>).

ISTMT shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.

4. Safety Certification - file number indicating compliance with UL 1598. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).
 5. Vibration Testing - the luminaire must comply with ANSI C136.31 at Vibration Test Level 2 (3.0 G).
 6. Product Samples - at least two samples of each luminaire that the contractor proposes to use must be submitted to the City. All samples must be representative production units and be supplied at no cost to the City.
- C. Assembly.
- Each luminaire must be delivered completely assembled, wired, and ready for installation.
- D. Warranty.
- The luminaire manufacturer must warrant the performance and construction of luminaires to meet the requirements of this specification, and must warrant all parts, components and appurtenances against defects due to design, workmanship or material developing within a period of ten (10) years from the date of acceptance by the City.
- The inability of a luminaire to be dimmed will constitute a luminaire failure.
 - Failure of 10% or more of the LED light sources (packages or arrays/modules) in a luminaire will constitute a luminaire failure.
 - The warranty must apply for application on all of the City's existing electrical systems, both grounded and ungrounded.
 - During the warranty period the City may, from time to time, test a random sampling of 10-20 luminaires for verification of light output per IES LM-

79 and to test dimming functionality for a given luminaire population. The percentage of luminaires not performing as required in the random sampling will be applied to the total population quantity to determine the number of new luminaire replacements that must be delivered to the City by the manufacturer, without expense to the City.

III. CONSTRUCTION

A. Weight and Area

The net weight of these luminaires must not be more than 8.5 pounds. The effective projected area (EPA) must not exceed 0.30 square feet.

B. Housing

The preferred luminaire housing material is die-cast aluminum alloy meeting ASTM Specification A380. Alternate materials may be considered. The housing must enclose the mounting hardware, LED arrays, control receptacle, terminal board, and electronic driver. The housing must include a surface to facilitate leveling with a spirit level. The housing must have integral heat sink characteristics, such that all enclosed components will operate within their designed operating temperatures under expected service conditions. No external or removable heat shields or heat sinks; are permitted. The housing must be designed to encourage water shedding. The housing must be designed to minimize dirt and bug accumulation on the optic surface.

C. Refractor.

The refractor shall be crystal clear, heat-resistant, tempered safety glass, well annealed, homogeneous, and free from imperfections and striations. It must be flat.

D. Mounting Provisions.

The luminaire must include a heavy gauge slip fitter clamping assembly suitable for secure attachment over the end of a two (2) inch 2" IP (2.375" OD) steel pipe with an approved means of clamping it firmly in mounting bracket. The slip fitter mounting clamp must contain an approved shield around the pipe entrance to block the entry of birds.

E. Access Door-Panel.

An access door panel allowing access to the terminal strip and LED driver must be provided. A die-cast aluminum door-panel composed of aluminum alloy A380 is preferred; alternate materials may be considered. The door-panel must be hinged to the luminaire housing and suitably latched and fastened at the closing end. It must be made to be removed easily. The hinge and fastening devices must be captive parts which will not become disengaged from the door panel.

F. Hardware.

All machine screws, locknuts, pins and set screws necessary to make a firm assembly, and for its secure attachment to the mast arm, must be furnished in place. All hardware must be of stainless steel, zinc plated steel, copper silicon alloy or other non-corrosive metal, and where necessary must be suitably plated to prevent electrolytic action by contact with dissimilar metals.

G. Finish.

The luminaire must have a polyester powder coat with a minimum 2.0 mil thickness to resist corrosion. Surface texture and paint quality will be subject to approval. Color must be as specified in the order. A paint chip must be submitted as a sample upon request. The finish must exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117. The coating must exhibit no greater than 30% reduction of gloss per ASTM D523 after 500 hours of QUV testing at ASTM G154 Cycle 6.

H. Ingress Protection.

1. The luminaire electric compartment housing must have an ingress protection rating of IP54 or better as described in ANSI C136.25-2013). The optical system must have a minimum rating of IP 66.
2. The luminaire must be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Laboratory (NRTL) and have a safety certification and file number indicating compliance with UL 1598.

I. General Luminaire Requirements

1. The luminaire must be rated to operate between -40° to +50° Celsius.
2. The luminaire must have the option of adding a house side shield. The shield should be designed to be easily installed in the field. The house side shield must be composed of a sturdy material capable of withstanding vibrations and weather conditions. The shield must cut off light trespass at approximately one mounting height behind the pole.
3. The luminaire must meet the requirements of ANSI C136.22 for internal labeling. A bar code with pertinent information for warranty and maintenance must be attached to the inside of the housing. A separate bar code label must be on the driver
4. The luminaire must be able to provide pertinent product information, for warranty and maintenance purposes, in a digital format that is compliant with the 0-10 VDC Node as per Section III-I-3-h) . This information will be transmitted through the networked Lighting Management control system.

J. Electrical Components

1. LED Optical Arrays
 - a) The LED arrays must be properly secured at the factory and must not require field adjustment for optimum photometric performance.
2. Terminal Block
 - a) A terminal block of high grade molded plastic of the barrier or safety type must be mounted within the housing in a readily accessible

location.

- b) Terminal block wiring; all necessary terminals, pre-wired to all luminaire components, must be provided.
- c) Terminal block terminals must have copper plated or brass plated, clamp-type pressure connectors of an approved type for "line" connections, to accommodate wire sizes from #12 to #8 A.W.G.
- d) Terminal block terminals for internal component connections must be either the screw-clamp or quick disconnect type.

3. LED Driver:

- a) Voltage. The electronic driver must operate at an input voltage range of between 120 and 277 volts, 60 Hertz. It must automatically sense the input voltage and adjust the output accordingly. The City uses nominal input voltages of 120, 208, and 240 for street lighting. When operated at any supply voltage between 80 percent and 110 percent of its rated supply voltage and at rated input frequency, a driver shall provide current and/or voltage regulation that equals or exceeds the values specified by the manufacturer.
- b) Electrical Safety. Luminaires must operate at or below the Low-Risk Level, as defined in Figure 18 of IEEE 1789-2015. This requirement must be satisfied across the dimming range.
- c) Power Factor (PF). The power factor of the driver over the design range of input voltages specified above must be in accordance to ANSI C82.77-2014. PF must be ≥ 0.9 .
- d) Total Harmonic Distortion (THD). The driver input current must have specified THD in accordance to ANSI C82.77-2014. THD must be $\leq 20\%$.
- e) Thermal Protection. The driver must be thermally protected to shut off when operating temperatures reach unacceptable levels.
- f) Electromagnetic Interference. Luminaire must comply with the FCC radiation emission limits for Class B digital devices given at 47 CFR 15.109.
- g) Electrical Transient Immunity.
 - Dielectric Withstand Testing - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for dielectric withstand, using the DC test level and configuration.
 - Electrical Transient Immunity - luminaire must meet the performance requirements specified in ANSI C136.2-2015 for electrical transient immunity, using the Basic 6kV/3kA (120 Strikes) and the Enhanced (10 kV / 5 kA) combination wave

test level.

- Transient Immunity Testing Requirements
 - During electrical transient immunity testing, the device under test (DUT) must: be connected to the power source through a series coupler/decoupler network (CDN), using a two-wire (hot or hot/neutral) connection between both the power supply and CDN input and the CDN output and DUT.
 - If AC mains is used to power the DUT, the input waveform must be characterized and documented both before and after electrical transient immunity testing, with the DUT operating at rated full output.
 - For Pre-Test DUT Characterization, the diagnostic measurements shall, at a minimum, include the following: real power, input current (RMS; Root-Means-Square), power factor, and current distortion factor (THD-I Total Harmonic Distortion) when operating at rated full output.
 - Manufacturer must indicate on submittal form whether failure of the electrical transient immunity system can possibly result in disconnect of power to luminaire.

h) Dimming Capability. The driver must be capable of dimming. The dimming range must be 10% to 100% of full output. The digital lighting interface used for dimming must be 0-10 VDC as per the requirements of ANSI C136.41-2013. There must be a minimum of 100 dimming steps between the top and bottom of the dimming range.

4. Wiring.

- a) All components must be completely factory wired with non-fading, color coded leads. These leads must be insulated with an approved class of insulation and must be #16 AWG conductor at a minimum.
- b) All wires within a single circuit path must be of the same size.
- c) No wire-nut splicing will be allowed.
- d) No unnecessary splices will be allowed.
- e) Quick disconnects must be provided for all components.
- f) All wires must be properly terminated.

5. Control Device Receptacle and Cap.

- a) Twist-lock Receptacle for a control device that meets ANSI C136.41 must be mounted in the top of the housing with provision

for proper positioning of the control device.

- b) 5-pin Receptacle. The luminaire control receptacle must be fully prewired and compliant with ANSI C136.41-2013.
 - c) 3-prong Shorting Cap that meets ANSI C136.10 must be provided.
 - d) Receptacle Wire Leads must all be properly terminated.
 - e) Receptacle repositioning. The receptacle must be able to be repositioned without the use of tools.
 - f) Control Devices Not Included in LED Specifications. Whereas specifications for control receptacles are included, specifications for control devices are not. The control device performance requirements are part of the lighting management system specifications in the Smart Lighting Project Technology specifications.
6. Component Mounting.
- All electrical components must be securely mounted in such manner that individual components can be easily maintained or replaced. Permanent straps or tie-wraps will not be permitted. The entire assembly should be easily disconnected and removed for replacement.

IV. PHOTOMETRIC REQUIREMENTS

1. Light Pollution.
To limit light pollution, the submitted luminaires must not emit any light above the horizon (0 lumens at angles $\geq 90^\circ$ from luminaire nadir).
2. Lumen Maintenance.
 - a) LED arrays must deliver a minimum of 90% of initial lumen output at 36,000 hours of operation.
 - b) Light Loss Factor (LLF) < 1.0. Calculations for maintained values, i.e. $LLF = LLD \times LDD \times LAT$.
 - (1) Lamp Lumen Depreciation (LLD) calculated at 60,000 hours as per Section II-B-3-d above,
 - (2) Luminaire Dirt Depreciation (LDD) ≤ 0.90 , and
 - (3) Luminaire Ambient Temperature (LAT) ≤ 0.96

Luminaires with less than 10,000 hours of available LM-80 test data may be submitted for consideration but must be clearly indicated as such.
3. Color Attributes
 - a) Color Rendering Index (CRI) shall be no less than 70.
 - b) Nominal Correlated Color Temperature (CCT) shall be 3000K as

defined by ANSI C78.377 and described below:

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
3000	2870 to 3220	-0.006 to 0.006

4. City of Chicago Typical Lighting Contexts

- Alleys – Single-sided pole spacing.

a) Performance Requirements:

Alley Luminance:

Average Luminance	.95 cd/m ²
Uniformity Ratio Av/Min	6:1
Uniformity Ratio Max/Min	10:1
Max Veiling Luminance	0.4

Light Trespass Limits:

Vertical Illuminance	≤0.30
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(b) The photometrics shall be run for the specific requirements. If the luminaires are to be obtained for no specific project, the luminaires must meet the performance requirements for the following physical conditions:

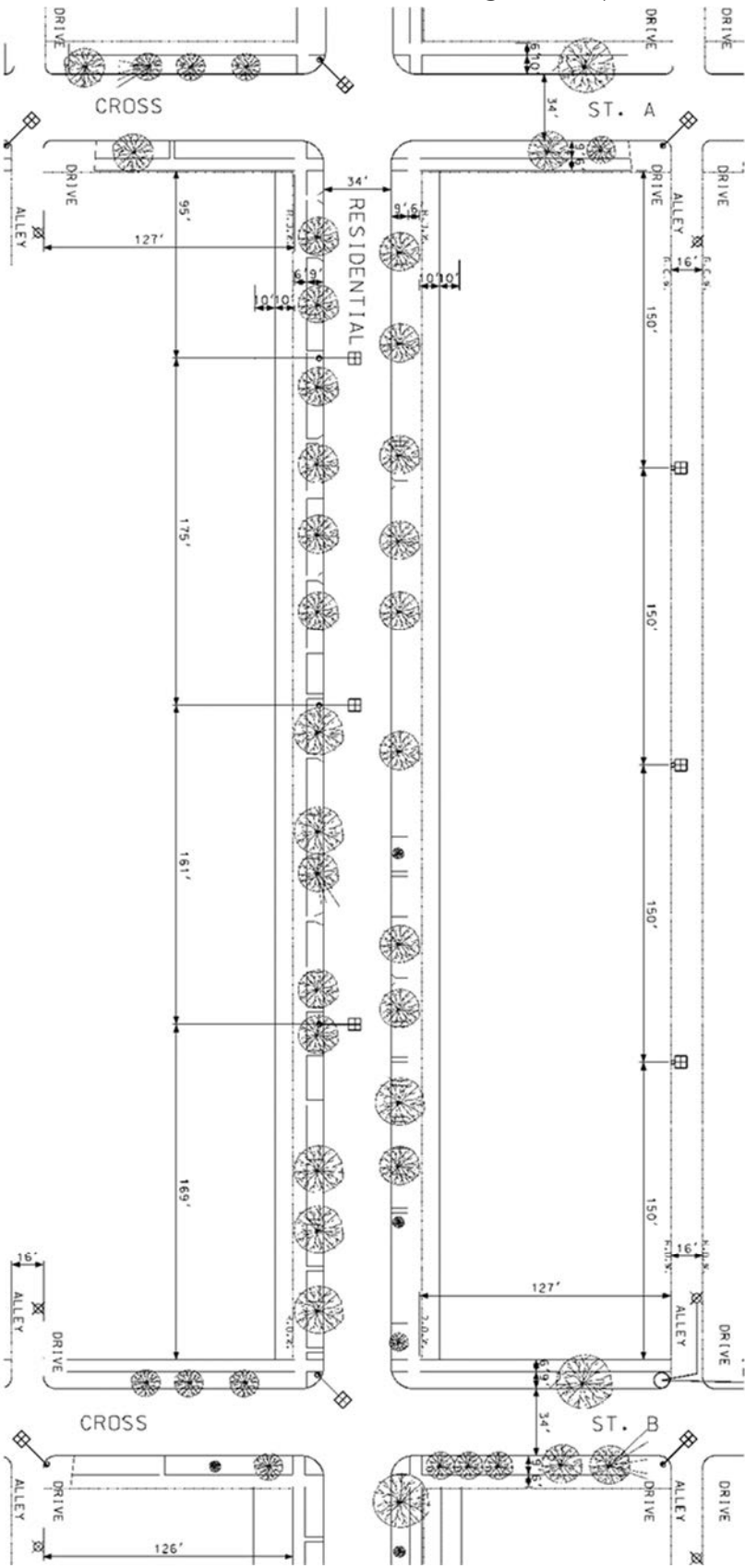
Right-of-way	16'
Curb-to-curb	16'
Mounting height	22'
Arm length	1'

Staggered Pattern:

Pole Spacing	150'
Pavement	R3

See ATTACHMENT A for Alley layout.

ATTACHMENT A – Alley Layout



ATTACHMENT B - Product Submittal Form

Lighting Context	Alley Pattern			
<i>Product Information Description</i>	<i>Product Data (Summary)</i>			<i>Submittal Reference Document</i>
Luminaire Designation				
Luminaire Manufacturer				
Luminaire Model Number				
Luminous Flux – initial	lumens			
Luminaire input power—initial	watts			
Luminaire input power—maintained	watts			
Luminaire input voltage- nominal range	volts			
LED drive current - initial	milliamps			
LED drive current - maintained	milliamps			
CCT (correlated color temperature)	kelvin			
CRI (color rendering index)				
EPA (effective projected area) - nominal	sq. ft.			
Luminaire Weight - nominal	lbs.			
Control Interface	<input type="checkbox"/> ANSI C136.41, 7-pin			
LED Driver – dimming capability	<input type="checkbox"/> Dimmable, 0-10 VDC			
LED driver- rated life	years			
Electrical transient immunity ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV/3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV/10kA)	
Vibration Test-ANSI C136.31	<input type="checkbox"/> Level 2			
Luminaire warranty period	years			
IES LM-80 test duration	hours			IES LM-80-15 report
LED lumen maintenance at 36,000 hours	%			TM-21 calculator
Max. LED case temperature	degrees Celsius			ISTMT report

**ELECTRICAL SPECIFICATION 1634
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
NOVEMBER 10, 2019**

RADAR SPEED SIGN, VARIABLE MESSAGE

1. SUBJECT

This specification states the requirements for a radar speed sign that shall display the immediate speed of an approaching vehicle. The speed of the approaching vehicle is determined by radar. This specification shall include the sign, the radar, the power supply, and any software. The sign is intended to be displayed on a permanent installation.

2. GENERAL

2.1 Specifications. The sign shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following organizations:

Manual on Uniform Traffic Control Devices (MUTCD)
National Electrical Manufacturers Association (NEMA)
Underwriters Laboratories (UL)

2.2 Acceptance. Any sign not conforming to this specification will not be accepted.

2.3 Sample. If requested by the Chief Procurement Officer, a sample of the sign intended to be provided under this specification, shall be submitted to the Division of Electrical Operations within fifteen (15) business days after receipt of the request.

2.4 Warranty. The manufacturer shall warrant the sign against defects in material and workmanship for a period of two (2) years after City acceptance. If the sign comes with batteries, the warranty on the batteries shall be one (1) year. The manufacturer shall provide a replacement of any failed sign (or battery) at no cost to the City.

3. DISPLAY

- 3.1 The size of the lettering and numbers, as well as the colors, and format of the display shall meet the requirements of the latest edition of the MUTCD, as detailed in Chapter 2 "SIGNS" and Chapter 2L "CHANGEABLE MESSAGE SIGNS".
- 3.2 The display shall contain only electronic letters and numbers. There shall be no permanent letters and numbers in the display.
- 3.3 The display shall be programmable to display either miles per hour or kilometers per hour.
- 3.4 Two lines of text with variable message
- 3.5 Light sensor for automatic brightness adjustment
- 3.6 LEDs
1. 1200 minimum, yellow
 2. Luminous intensity per LED: 5680-8200 mcd
- 3.7 Digits: 18 inches high by 10 inches wide
Variable message matrix: 12.5 inches high by 24 inches wide

4. HOUSING

- 4.1 Housing shall be approximately 31 inches wide by 42 inches tall, and 5 inches deep. Total weight without batteries not to exceed 55 pounds. No separate housing for batteries (if batteries are required).
- 4.2 Access by front or rear door. Door shall be hinged on one side and securely closed with screws or clamps on the other side.
- 4.3 Body of housing shall be powder coated gray. Front of housing shall be powder coated yellow with black stripe outlining frame.
- 4.4 12 gauge aluminum or thicker
- 4.5 Weatherproof, NEMA 4X-12, IP65 compliant
- 4.6 Non-sealed and ventilated
- 4.7 Mounting brackets to accommodate 3/4" stainless steel banding
- 4.8 UV protected polycarbonate sheet over display area.

5. POWER

5.1 The unit shall be equipped to be hard wired for 240 volt operation or be equipped for solar power.

5.2 240 volt:

1. Nominal 240 VAC input for power supply to provide 12VDC for LEDs and circuit boards
2. Hardwired
3. 10 amp fusing

5.3 Solar:

1. Solar panel (85w) to provide 12VDC for sign and circuit boards
2. Crystalline solar cells
3. Laminate: Glass/EVA/TPT/or TPE
4. Front side: high-transmission 3.2mm tempered glass
5. Back side: TPT/TPE
6. Frame: clear anodized aluminum
7. Junction box for cable
8. Batteries: two 12 volt 18amp/hour AGM; provides up to 14 days of back-up operation when fully charged
9. Side of pole mount for panel, bracket or banding
10. Max surface area: 40" X 26" for northern latitudes
11. Charge controller: manages flow of energy to batteries
12. Low battery cut-off feature

6. ENVIRONMENT

6.1 Operating temperature: -40° C to +85°C

6.2 Humidity: 5 to 95 % non-condensing

6.3 Vibration: ANSI C136.31 for luminaires

7. RADAR

7.1 Internal radar: Doppler (FCC Part 15 compliant)

7.2 RF output: 5 milli-watts maximum

7.3 Frequency-center: 24.125 Ghz +/-25Mhz

7.4 Pick-up distance: 1200 feet

- 7.5 Beam angle: 12° +/-2°
- 7.6 Beam polarization: linear
- 7.7 Speed detection range: 5-127 MPH

8. PROGRAMMING

8.1 Manufacturer shall include all necessary software.

8.2 Display settings:

1. Stealth mode: speed not displayed but data is collected
2. Display minimum speed/ Display maximum speed
3. Digit flashing: digits flash above selected speed
4. Message flashing: message flashes above selected speed
5. 4 standard messages: SPEED LIMIT, YOUR SPEED, SLOW DOWN, TOO FAST
6. 4 custom message slots

8.3 Data Collection:

1. Total vehicle count
2. Total speed violations
3. Average vehicle count in selected period
4. Average number of violations in selected period
5. Average speed in selected period
6. Data stored for up to 12 months
7. Store data for up to 1 million vehicles

8.4 Data Reports:

1. Data collected and stored at location
2. Download data via Bluetooth
3. Summary reports
4. Period comparison reports
5. Reports can be printed directly or exported into CSV format, Excel, Adobe Acrobat PDF or HTML.

9. COMMUNICATIONS

9.1 Bluetooth 4.0 for local downloading and programming

9.2 Licensed software using the Cloud for data storage and allowing for remote programming and data collection.

10. SHIPPING

10.1 General. The sign must be shipped fully assembled and ready for installation. Each assembly must be individually wrapped and boxed so that the assembly is not damaged in shipment. If batteries are required, they shall be supplied with the sign. If a solar panel is required it shall be packaged so as not to be subject to damage in shipping or handling.

10.2 Labeling. Each box must be labeled in 3/8 inch high letters " RADAR SPEED SIGN" and/or "SOLAR PANEL FOR RADAR SPEED SIGN". The City Commodity Code, contract number, manufacturer, and date of manufacture must be clearly labeled on the box.

**ELECTRICAL SPECIFICATION 1635
DIVISION OF ELECTRICAL OPERATIONS
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
NOVEMBER 10, 2020**

WIRELESS TRANSCEIVER, TRAFFIC SIGNAL COMMUNICATIONS

1. SUBJECT

This specification states the requirements for a wireless transceiver to be installed in a traffic signal cabinet to establish wireless communications between a traffic controller and one or more other traffic controllers with like wireless transceivers. Each wireless transceiver will require an externally mounted antenna. The antenna requirements are also part of this specification.

2. GENERAL

2.1 Specifications. The transceiver shall conform in detail to the requirements herein stated and to the latest referenced specifications of the following organizations:

National Electrical Manufacturers Association (NEMA)
Federal Communications Commission (FCC)
Underwriters Laboratories (UL)

2.2 Acceptance. Any transceiver not conforming to this specification will not be accepted.

2.3 Sample. If requested by the Chief Procurement Officer, a sample of the transceiver intended to be provided under this specification, shall be submitted to the Division of Electrical Operations within fifteen (15) business days after receipt of the request.

2.4 Warranty. The manufacturer shall warrant the transceiver against defects in material and workmanship for a period of one (1) year after City acceptance. The manufacturer shall provide a replacement of any failed transceiver at no cost to the City.

3. ENVIRONMENTAL

- 3.1 The transceiver shall operate between -40° C to +75° C.
- 3.2 The transceiver shall perform in 0% to 95% humidity, non-condensing.
- 3.3 The antenna and clamp shall withstand winds of up to 100 MPH.

4. HOUSING

- 4.1 Housing shall be approximately 7 inches wide by 3 inches tall, and 5 inches deep.
- 4.2 All access shall be in the front of the unit.
- 4.3 Body of housing shall be extruded aluminum.
- 4.4 Total weight shall be approximately 2 pounds.
- 4.5 Unit shall be shelf mounted.

5. PORTS

- 5.1 Data port: female RS232
- 5.2 Diagnostic port: female RS232
- 5.3 Antenna: female N type

6. POWER

- 6.1 The unit shall operate at a supply voltage of 6VDC to 30VDC.
- 6.2 A power supply/cable shall be provided that can be plugged into a 120 volt AC power strip.
- 6.3 RF output power:

- | | | |
|----|----------|-------|
| 1. | sleep | 5mA |
| 2. | idle | 21mA |
| 3. | receive | 86mA |
| 4. | transmit | 250mA |

6.4 Max transmit current for 1 W transmit power (low MCU speed):

1. 6 VDC - 1 A
2. 12 VDC - 500 mA
3. 30 VDC - 200mA

6.5 Max receive current (low MCU speed):

1. 6 VDC - 110 mA
2. 12 VDC - 60 mA
3. 30 VDC - 40 mA

6.6 Max idle current:

1. 6 VDC - 30 mA
2. 12 VDC - 16 mA
3. 30 VDC - 9mA

6.7 Max sleep current:

1. 6 VDC - 8 mA
2. 12 VDC - 5 mA
3. 30 VDC - 2 mA

7. **FREQUENCY**

902 to 928 MHz

8. **TRANSMITTER**

8.1 Output power: 1mW to 1 W (+30dBm)

8.2 Range: 60 miles

8.3 Modulation: spread spectrum GFSK, 120kBs to170kBs

8.4 Frequency hopping

8.5 Occupied bandwidth: 230kHz

9. **RECEIVER**

9.1 Sensitivity:

1. -108 dBm for 10^{-6} BER standard speed
2. -111 dBm for 10^{-6} BER low speed

3. -110 dBm for 10^{-4} BER standard speed
4. -113 dBm for 10^{-4} BER low speed

9.2 Selectivity:

1. 20 dB at $f_c \pm 115$ kHz
2. 60 dB at $f_c \pm 145$ kHz

9.3 System gain: 140 dB

10. DATA TRANSMISSION

10.1 Error transmission: 32 bit CRC, resend on error

10.2 Forward error correction(low speed): (24,12) Golay, retransmit on uncorrectable error

10.3 Data encryption: substitution, dynamic key

10.4 Max link throughput: 115 Kbaud standard speed, 38.4 Kbaud low speed

10.5 Data interface: RS-232/RS485 1200 buad to 230.4 Kbaud,asynch, full duplex

11. OPERATING MODES

11.1 point-to-point

11.2 point-to-multipoint

11.3 peer-to-peer

11.4 store and forward repeater

12. ANTENNA

12.1 The antenna shall be a multiple dipole known as a Yagi antenna, consisting of one electrically activated dipole along with a number of additional dipole elements. There shall be a minimum of seven elements.

12.2 The entire structure shall consist of aluminum tubing with a female N connector for coaxial cable. All pieces shall be welded and the entire structure shall be powder coated black.

12.3 A zinc plated steel clamp shall be provided that can be bolted to the antenna and be clamped to a 3" or less O.D. pipe.

12.4 Voltage Standing Wave Ratio 2:1

12.5 Power rating: 300 Watts

12.6 Gain: 9dBd/11dBI

13. ISOLATOR

A grounded isolator shall be used between the antenna and the transceiver to protect the electronics.

14. SHIPPING

Each transceiver and each antenna shall be individually wrapped and boxed so that the items are not damaged in shipment. Each box must be labeled indicating the contents. The manufacturer and model numbers must be prominently displayed.

**ELECTRICAL SPECIFICATION 1636
DIVISION OF ENGINEERING
DEPARTMENT OF TRANSPORTATION
CITY OF CHICAGO
NOVEMBER 1, 2020**

**ADVANCED TRANSPORTATION CABINET AND
ADVANCED TRANSPORTATION CONTROLLER WITH
UNINTERRUPTIBLE POWER SUPPLY**

1. GENERAL REQUIREMENTS

- 1.1 This specification details the requirements for traffic signal control equipment for use in the City of Chicago. This equipment shall control traffic signal timing and sequencing at a large or complex intersection. The equipment shall have a 120 channel input and a 32 channel output. The equipment shall also include load monitoring. The equipment shall include a battery back-up system which shall maintain power to the signals during a power failure. The cabinet shall meet the high voltage (HV) requirements of the "Advanced Transportation Controller Cabinet Standard Version 02" (ATCC 5301 V02.02), herein after referred to as the Cabinet Standard. The controller shall meet the applicable requirements of "Advanced Transportation Controller Standard Version 5.2b" and NEMA TS2-2003. If there exists any differences in this specification and the Cabinet Standard that creates a conflict, the Cabinet Standard shall take precedence.
- 1.2 If requested by the Chief Procurement Officer, within thirty (30) days from the receipt of such request, the bidder shall provide a sample to the Division of Electrical Operations, 2451 South Ashland Avenue, Chicago, Illinois 60608. The sample shall consist of the controller, cabinet, UPS, load switches, and all appurtenant equipment and wiring completely assembled as a working unit. If the sample is acceptable and the bidder is awarded a contract, the sample shall become the property of the City of Chicago with a suitable credit issued to the contract.
- 1.3 All tests as outlined herein shall be regarded as minimum requirements. The contractor shall submit his testing procedure for approval prior to performing any testing functions. Upon successful completion of all testing, certified test reports shall be submitted for each unit. Units not successfully passing these tests or lacking proper documentation will be rejected. The manufacturer, or manufacturer's representative, must be available for shop testing at the City's facilities.
- 1.4 Standards. Equipment furnished under this specification shall meet the

appropriate requirements of the following standards, as required within the body of this specification:

American Association of State Highway and Transportation
Officials (AASTHO)
American Society for Testing and Materials (ASTM)
Institute of Transportation Engineers (ITE)
Manual on Uniform Traffic Control Devices (MUTCD)
National Electrical Manufacturers Association (NEMA)
Occupational Safety and Health Administration (OSHA)
Underwriters Laboratories (UL)

- 1.5 Training. If requested, the contractor shall provide training at the City's facilities. The training must be on the actual equipment provided under the contract, and must include, but not be limited to, programming all features, connecting and wiring, and troubleshooting. Training shall be structured for both field personnel and shop personnel.
- 1.6 Warranty. The manufacturer(s) shall warranty the performance and construction of the traffic signal controller and other major components to meet the requirements of this specification, and shall warranty all parts, components, and appurtenances against defects in design, material, and workmanship for a period of one (1) year after acceptance by the City. In the event of defects or failures during this period, the manufacturer(s) must repair and/or replace all defective or failed parts or appurtenances at no expense to the City.
- 1.7 Manufacturer. The manufacturer(s) of the cabinet, of the controller and of the battery back-up system shall demonstrate a knowledge of past production, or have been actively engaged in the sale and/or service of the equipment herein described, as demonstrated by a submitted list of comparable projects. The manufacturer shall be a recognizable company that manufactures ATC controllers and ATC cabinets.

2. CONTROLLER REQUIREMENTS

- 2.1 ATC. The controller shall be an Advanced Transportation Controller (ATC) meeting the requirements of the specification "Advanced Transportation Controller (ATC) Standard Version 5.2b" dated June 26, 2006. and the requirements of NEMA TS2-2003. The referenced specification is a joint effort of AASTHO, NEMA, and ITE. Since each user agency has different controller needs, for the City of Chicago, the controller must meet the programming modifications and options listed in the ATC Matrix as indicated in Table A. All software necessary to make the controller operational must be included.
- 2.2 Power. The controller must operate on single phase alternating current. The

controller must function in the range from 89 to 135 Volts AC at 50/60 Hz \pm 3 Hz.

- 2.3 Packing. (For City commodity contracts only) Each controller, with all its component parts, must be suitably packed in a single container in such a manner as to prevent damage to the contents in shipment and handling.
- 2.4 Instructions. One (1) complete set of up to date instructions providing complete information on installation, adjustment, operation and maintenance, including both up to date "Logic Schematics" and "Electronic Circuit" diagrams, of these controllers, must be furnished to the Division of Electrical Operations for approval prior to the first shipment of controllers. All information, including photos and schematics, must reference to the controller being furnished on this contract and must be a high quality, completely legible reproduction. Upon approval, one complete set of data must be furnished with each controller.
- 2.5 Chassis. The chassis shall be aluminum with a powder coat finish. No plastic chassis or composite chassis will be allowed. The chassis shall fit into a standard 19 inch rack. The controller must not exceed the following dimensions: 19 inches wide, 10.5 inches deep, and 7 inches tall.
- 2.6 Processor / Memory. At a minimum, the processor will be:

Processor speed - 3000MHz
Non-volatile Memory - 16MB Flash
SDRAM - 64MB
(All memory and firmware must be stored in flash memory. No EPROMS will be allowed.)
- 2.7 Display. The display shall be a 40 character by 16 line backlit LCD. Keypad shall have 32 keys. Display and keyboard shall be permanently attached to chassis. Detachable keypads will not be allowed.
- 2.8 Environmental. The controller must operate in the temperature range of -40° Celsius to +80° Celsius. The controller must operate within the relative humidity of 0% to 95%.
- 2.9 All printed circuit boards must be mounted vertically.
- 2.10 Encapsulation of 2 or more discrete components into circuit modules is prohibited except for transient suppression circuits, resistor networks, diode arrays, solid-state switches, optical isolators and transistor arrays. All encapsulated components must be second sourced and must be of such design, fabrication, nomenclature or other identification as to be purchased from a wholesale distributor or from the component's manufacturer as a standard product. Custom encapsulated components are not allowed.

- 2.11 Obsolete components, components no longer supported by the manufacturer, components not recommended for new designs, components which have been discontinued or which the contractor should have reasonably been expected to know were discontinued, or components which the vendor/manufacturer has announced plans to discontinue at the time of the bid/contract must not be used in the design of any subassemblies provided under this contract.
- 2.12 As allowed by ATC v5.2b, Section 8.1.1, the controller will utilize NEMA 'A', 'B', and 'C' I/O connectors. Pin assignments for NEMA 'A', 'B', and 'C' connectors must follow the NEMA TS2 2003 standards for I/O. Port 2 must be the ATC v5.2b pin-limited version of NEMA TS2 Port 2. Port 4 (C50S) must be a 9-pin connector with only limited signals being required.

Special function connector for the TS2-2 must follow the CPC style "D" pin outs as follows:

CPC MSD Pin	Function
1	Flash
2	Offset 1
3	Interconnect Common
4	User defined input 6
5	Offset 2
6	Offset 3
7	Time Plan A
8	User defined input 7
9	User defined input 8
10	Call to Free
11	Call to week 10
12	Time Plan B
13	Time Plan C
14	Time Plan D
15	Alt Seq A
16	Alt Seq B
17	Alt Seq C
18	Dimming
19	Monitor status bit C
20	System Input
21	Alt Seq D
22	Monitor status bit A
23	Monitor status bit B
24	Veh Det 13
25	Veh Det 9
26	Veh Det 10
27	Veh Det 11

28	Polarizing Pin
29	Veh Det 12
30	Veh Det 14
31	Veh Det 15
32	Veh Det 16
33	SGO/Conditional Service
34	Preempt input 5
35	Preempt output 1
36	Preempt output 2
37	Interconnect inhibit
38	Time Clock sync
39	Sync inhibit
40	Preempt input 1
41	Preempt input 2
42	Preempt input 3
43	Preempt output 3
44	Polarizing Pin
45	Preempt output 4
46	Preempt output 5
47	System Out
48	Preempt output 6
49	Preempt input 4
50	Clock Ckt 9 (Aux 1)
51	Clock Ckt 10 (Aux 2)
52	Clock Ckt 11 (Aux 3)
53	Clock Ckt 12 (Aux 4)
54	Clock Ckt 13 (System)
55	Clock Ckt 8 (Flash)
56	Clock Ckt 3 (Offset 1)
57	Clock Ckt 4 (Offset 2)
58	Clock Ckt 5 (Offset 3)
59	Clock Ckt 1 (T/P A)
60	Clock Ckt 2 (T/P B)
61	Clock Ckt 6 (T/P C)
62	Clock Ckt 7 (T/P D)
63	Preempt input 6

2.13 Communication.

- (1) NTCIP (National Transportation Communications for ITS Protocol).
 - a. The controller must be compliant with NTCIP Standards as outlined in NEMA TS2 – 2003 and must be tested and documented

for compliance.

- b. Global objects must be compliant to NTCIP 1201 v2.26 or later.
 - c. Actuated Signal Controller objects must be compliant to NTCIP 1202 v2.19f or later.
- (2) Serial ports, one of which must be set as either RS-232 or RS-485.
 - (3) Ability to add an internal GPS module.
 - (4) Ethernet. The controller must be equipped with a minimum of four front panel mounted 100Base-T Ethernet ports.
 - (5) Two USB interface ports must be provided to facilitate database transfers, re-flashing of operation software and log transfer.
 - (6) The unit must be fully compatible with, and fully functional within, the City's existing traffic management system. All available functions and capabilities that exist within controllers in the existing management system must be available within this unit. Any additional software or hardware necessary to fully integrate the controller into the City's traffic management system must be provided by the bidder/contractor and will be considered as part of the requirements of this specification.
 - (7) A Windows based laptop utility software must be provided for data transfers and monitoring of controller operation.

2.14 Software operation.

- (1) The controller must have the ability to re-synch a minimum of 8 cycle lengths to an "absolute zero" reference point. It must be possible to set absolute zero by either global command or individual cycle length.
- (2) In addition to hardwire input, it must be possible to set Absolute Zero via keyboard command or fiber optic communication.
- (3) The controller must have the ability to operate in two modes of operation, selectable by time of day:
 - a. Actuated control per NEMA TS2 – 2003.
 - b. Pre-timed Interval based control per NEMA TS2 – 2003.
- (4) The controller must have the ability to transfer between actuated

control and interval based control by time of day schedule.

- (5) The controller will have 32 Pre-timed plans
 - a. Each plan will allow for up to 32 timing intervals
 - b. Each plan will allow for 64 circuit outputs. Each output must be individually programmable per interval.
- (6) The controller must have 100 coordination plans.
- (7) The controller must provide 6 preempts per NEMA TS2-2003.
- (8) The controller must offer security as follows:
 - a. Two 4 digit security codes can be programmed (one for timing data, one for signal plan data), which when activated, allow data changes. These codes must automatically de-activate 10 minutes after the last user keystroke. It will be possible to re-program the security codes if the previous security code is known or has been defeated.
 - b. It must not be possible to read the security code from the controller's display.
 - c. It must be possible to access the controller in the case of a lost security code through a "back door" which is provided only by the controller manufacturer. This "back door" security code must change based upon the controller's internal calendar.

3. CABINET MONITORING UNIT (CMU)

3.1 General. The Cabinet Monitoring Unit (CMU) shall meet the requirements of Section 6.3 of the Cabinet Standard. The CMU shall be for 120 volts AC (High Voltage - HV). CMU 2212.

3.2 Conflict Assignments

- (1) Conflict channels shall be assigned as follows:

Channel 1	Load Switch 1	Phase 1 Vehicle
Channel 2	Load Switch 2	Phase 2 Vehicle
Channel 3	Load Switch 3	Phase 3 Vehicle
Channel 4	Load Switch 4	Phase 4 Vehicle

Channel 5	Load Switch 5	Phase 5 Vehicle
Channel 6	Load Switch 6	Phase 6 Vehicle
Channel 7	Load Switch 7	Phase 7 Vehicle
Channel 8	Load Switch 8	Phase 8 Vehicle
Channel 2W	Load Switch 9	Phase 2 Ped
Channel 4W	Load Switch 10	Phase 4 Ped
Channel 6W	Load Switch 11	Phase 6 Ped
Channel 8W	Load Switch 12	Phase 8 Ped
Channel 9	Load Switch 13	Overlap A
Channel 10	Load Switch 14	Overlap B
Channel 11	Load Switch 15	Overlap C
Channel 12	Load Switch 16	Overlap D

4. SUPER P CABINET

4.1 Housing. Each cabinet shall be fabricated in Type 5052-H32 aluminum of 0.125 inch thickness. The exterior dimensions of the cabinet shall be approximately 57 inches high, 58 inches wide, and 26 inches deep. The top of the cabinet shall be approximately 58 inches wide and 29 inches deep. The top of the cabinet must have a front to rear slope that will direct rain away from the front cabinet door. Door openings shall be double-flanged. The interior of the cabinet will be divided into two compartments. The interior of the main cabinet must be equipped with 19" racks and enough shelf space for shelf mounted accessories. The UPS portion of the cabinet must be equipped with two (2) "C" mounting channels on each of the two side walls. All shelves, panels and individual equipment items must be mounted to these channels using 1.0" channel nuts with 1/4-20 bolts. All items mounted on panels must be securely fastened by bolting into drilled and tapped holes. No pop rivet or similar fastening methods will be accepted.

4.2 Doors. The cabinet shall have a main door hinged with one-quarter inch (1/4") minimum, continuous, removable stainless steel pins. The hinges themselves will be aluminum secured to the cabinet with stainless steel bolts. The battery compartment door on the side of the cabinet must be similarly hinged. The main cabinet door will be hinged on the right side. The battery compartment door will be hinged on the left side. The doors must be closely fitted to a neoprene gasket making the doors dust, water and weather resistant.

Opening of the main door must provide complete access to the cabinet interior. The door must be embossed, subject to approval, with the legend "CITY OF CHICAGO-TRAFFIC CONTROL" in letters at least one (1) inch high. The main door and the battery compartment door must have stops at 90, 150 and 180 degrees, from the closed position. The door latches must have three (3) point locking with rollers at the ends of the latch rods. The latch handle must be capable of being padlocked. The key lock for the latch mechanism must be a

Corbin cylinder lock with keys to match existing City of Chicago controller cabinets. Two (2) keys must be furnished with each cabinet. Both the main door and the battery compartment door will have stainless steel handles with an 8" shank. The handles must be able to be padlocked. The padlocking arrangement must clear the lock and key.

All components in the main compartment must be accessible from the main door. The layout of the main compartment must be approved by the Division of Electrical Operations for this purpose.

Police Panel Door. The police panel door on the main door must be furnished with a lock for a modified Chicago police key per sample to be furnished to the supplier. This key must have a shaft of at least one and three quarter inches (1-3/4") in length. Two keys must be furnished with each cabinet. The door will have a stainless steel piano hinge and be sealed with a neoprene gasket.

Generator Door. This door will be on the rear of the cabinet. This door will have a stainless steel piano hinge and be sealed with a neoprene gasket. Two keys will be furnished for this door.

- 4.3 Cabinet Ventilation. The main cabinet compartment must be provided with a mounting assembly to hold the forced air fan system. A fan, having a minimum air movement capacity of 100 CFM, must be mounted in the air baffle in the top of the cabinet with an air outlet built into the roof overhang. The main door must be louvered and equipped with a removable, standard, commercially available aluminum dust filter. The battery compartment must have a similar fan system. The battery compartment door must also have a louvered section with a removable dust filter. The ventilation openings must be equipped with removable covers for summer operation. No external fan housings or air outlets will be allowed. Any other method must be approved.
- 4.4 Shelves and Racks. The cabinet must contain at least one vertically adjustable shelf large enough to accept the shelf mounted devices. A 19 inch rack must be provided for the controller and other rack mounted devices. The battery compartment must have a minimum of three shelves.
- 4.5 Bolt Pattern. The bolt pattern must be a four (4) point rectangular pattern matching the corresponding foundation. The dimensions will be 40.75" center-to-center and 18.5" center-to-center.
- 4.6 Finish. The exterior surfaces of the cabinet must be smooth. All drilled, tapped, or punched holes on the outer surface must be filled with liquid metal and ground smooth, and slotted screw heads must be ground smooth flush with surface. Bolts extending through cabinet wall must be round head, carriage, square shoulder type and fastened on the inside of the cabinet with an Esna nut and necessary gaskets to insure the weatherproofing integrity of the cabinet. The

finished cabinet must be thoroughly degreased in a wash process and dried in a heated chamber. A thermosetting, ultra violet resistant, polyester powder coat must be electrostatically applied to all cleaned and treated surfaces and cured to a hard, mar resistant finish in a heated chamber at a temperature recommended by the powder coat paint manufacturer. Exterior color must conform to Federal Standard 595,FS 17038, gloss black. Exterior color must be as defined in the contract, and color samples must be submitted for approval prior to acceptance of cabinet. Cabinet interior must be glossy white and may be either baked enamel or thermosetting, polyester powder coat. For either process, the interior must be prepared as described above. If the baked enamel finish is used, it must be preceded by one (1) coat of primer.

5. **POWER SUPPLY**

The power supply shall meet the high voltage (HV) requirements of Section 6.4 of the Cabinet Standard. It shall be Model 2216-24, HV 48VDC and 24VDC for a 19" rack.

6. **UNINTERRUPTIBLE POWER SUPPLY**

6.1 General. The uninterruptible power supply (UPS) will consist of batteries which will recharge through the 120 volt electric service line. In the event of a power disruption, the unit will automatically activate. The transfer from utility power to battery power will not interfere with the normal operations of the traffic controller, conflict monitor, or any other part of the traffic system. A generator port will be provided to accept input from an external generator that can operate the traffic signals. The UPS must be the product of an established manufacturer, and suitable for the service required. The UPS must be manufactured by an established manufacturer who has been in the business for a minimum of five (5) years.

6.2 General Operation

(1) The line power provided by ComEd is nominally 120 volt, single phase, 60 Hertz. The UPS system must take the line power, regulate it, and provide continuous 120 volt, single phase, 60 hertz power to the traffic system. The UPS must regulate the input line voltage within the limits specified herein. The input line voltage must also be transformed and rectified to charge the batteries. Under battery operation, the output from the batteries will go through an inverter to provide the proper A.C. current to provide continuous 120 volt, single cycle, 60 Hertz power to the traffic system. In the event of a power loss, the system must automatically switch to battery operation, without adversely affecting the traffic system. When power is restored, the system must automatically switch back without adversely affecting the traffic system. In the event the UPS system fails, an automatic

switch must bypass the UPS and connect unconditioned power from ComEd directly to the traffic system. A manual bypass switch must also be provided. The system must be capable of running off a generator. The UPS will allow the generator to be put in or out of the system without adversely affecting the traffic system.

- (2) The system will be capable of providing power for normal full timing mode, flash mode, or a combination of both. The operation will be field programmable to activate at various times, to change operation due to changing battery capacities, and to track alarm conditions, using the touch pad or remotely using the RS-232 interface. Programmability must be in ASCII formats and must not require any external or proprietary software. The DB-9 connector for the RS-232 interface must be located on the front panel of the UPS. The UPS must provide a minimum of 4 hours of full normal timing for a full LED controlled intersection.
- (3) In the event ComEd line voltage falls outside the high and low limits (95VAC and 130VAC should be the default values) the UPS must transfer the load to battery power. The high and low limits must be programmable.
- (4) The UPS must return to line mode when the ComEd power is restored within the proper limits for a specified period of time. The limits must be programmable. The default values should be 105VAC and 125VAC. This time must be programmable and should range from 3 to 30 seconds.
- (5) The transfer time allowed, from disruption of normal utility line voltage to batteries or from batteries back to line voltage, must be such that the traffic signal system is not disrupted. The maximum transfer time allowed will be 60 milliseconds.

6.3 Specifications

- (1) The UPS capacity will be a minimum of 2000VoltAmps/ 1500 watts.
- (2) The inverter must have a minimum efficiency of 80%.
- (3) The UPS will have an operating range of between -37°C. to +74°C.
- (4) The manual bypass switch must be rated at 240 volts, 40 amps.
- (5) The UPS must have a temperature compensated battery charging system. The charging system must compensate over a range of 2.5mV to 4 mV per degree centigrade per cell. Batteries must not be charged when

temperatures exceed 50°C. The temperature sensor must be located in the cabinet near the batteries.

- (6) The charger must be rated at 10 amps at 48 VDC.
- (7) When under battery operation the UPS output voltage must be between 110 VAC and 125VAC, with a sine wave with THD less than 3% at 60 Hertz (± 3 Hz).
- (8) The UPS must be equipped to prevent a malfunction feedback to the utility service or to the cabinet per UL 1778, Section 48 “Back-Feed Protection Test”. The upstream back-feed voltage from the UPS must be less than 1 volt AC.
- (9) The UPS must have a lightning surge protection in compliance with IEEE/ ANSI C.62.41 for 2000 volts AC.
- (10) The UPS must not weigh more than 50 pounds.
- (11) The UPS must have a minimum efficiency of 95%.
- (12) The generator bypass switch must be supplied with a 30 amp, weather-proof locking receptacle and cover plate.

6.4 Computer Control and Display

- (1) The UPS must include an LCD display with programmable keypad, a red LED and a green LED, and an RS-232 interface.
- (2) The UPS processor must be capable of indicating, through the LCD display or the RS-232 interface, the current battery charge status, various input/output voltages, power output, battery temperature, date, time, settings of programmable relays, events, and various other functions.
- (3) The UPS must provide a temperature control for the cabinet fan.
- (4) The UPS must be provided with a resettable inverter event counter and a cumulative inverter timer.
- (5) The UPS must be equipped with an event log for a minimum of 100 events. Each event must have a date and time.
- (6) The UPS must be capable of performing a self-test.
- (7) Password protection must be provided.

- (8) The following LED conditions must be used to indicate current status:
- RED FLASHING - Alarm
 - RED STEADY - Fault
 - GREEN FLASHING - Battery Mode
 - GREEN STEADY - Line Mode
- (9) The manual UPS bypass switch will allow the UPS to be maintained or replaced.

6.5 Battery System

- (1) Individual batteries must be 12 volt, and must be commercially available and easily replaced.
- (2) Four 79ah batteries must be supplied.
- (3) The batteries will be connected in series. The wiring harness must be color coded with quick disconnects.
- (4) Batteries must be certified to operate over a temperature range of -25° C. to $+74^{\circ}$ C.
- (5) The batteries must be extreme temperature, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (absorbed glass mat/valve regulated lead acid) .
- (6) Maximum recharge time from protective low cut-off to 80% of full capacity must not exceed 20 hours.
- (7) Thermostat controlled heater strips or pads must be supplied to keep battery operation efficient.

6.6 Relay Contacts

- (1) The UPS must provide 6 sets of panel-mounted, potential free, fully programmable relay contacts rated at 1 amp, 120 volt. The relays must be numbered from C1 to C6.
- (2) Each relay must be programmable to activate under any number of the following conditions:
 - ON BATTERY, relay activates when UPS switches to battery power.
 - LOW BATTERY, relay activates when batteries have reached a certain level of remaining capacity. This is adjustable from 0 to 100%.

TIMER, relay activates after battery power is on for a certain amount of time. This is adjustable from 0 to 8 hours.

ALARM, relay activates after a specific alarm is detected. Alarm conditions include line frequency, low output voltage, no temperature reading, overload, batteries not connected, high temperature, and low temperature.

FAULT, relay activates after a specific fault is detected. Fault conditions include short circuitry, low battery voltage, high battery voltage, high internal temperature, and excessive overload.

OFF, relay is not active.

7. LOAD SWITCHES

- 7.1 The load switches shall be High Density switch pack/flasher units as defined in Section 6.2, MODEL 2202, of the Cabinet Standard. The Model 2202 shall be the HV version as defined in the Cabinet Standard.
- 7.2 The slots for the load switches shall be as defined in Section 7.4 OUTPUT SLOTS.

8. POLICE PANEL

- 8.1 The police panel shall meet the requirements of Section 8.4.2 of the Cabinet Standard.
- 8.2 Auto-Off Flash Switch. Each controller must be provided with an auto-off-flash switch. In the "AUTO" position the signals will be on and the controller timing unit will run normally. In the "OFF" position the signals will be OFF and the controller timing unit will continue to run. In the "FLASH" position the signals will flash and the controller timing unit will continue to run. The auto-off flash switch must be located on the side of the police switch panel that faces outward when the police door is open.
- 8.3 Auto-Hand Switch. Each controller will have an auto-hand switch on the back side of the police switch panel. This switch must be so arranged that the switch can be physically rotated 180 degrees to provide usage after opening the police panel door. It must be so mounted that the act of rotation does not affect the police switch panel. Switch terminals must not be exposed on either position. The auto-hand switch must provide a means of manually timing the signals by use of a separate, momentary contact, hand switch. Operation of the timer by manual control must provide the same color sequence as an automatic operation with no momentary undesirable indications appearing. Manual control must be possible with the door of the cabinet closed. The hand switch required for manual control must only be supplied when specified in the contract. It must be of an approved weatherproof construction with a six (6) foot, retractable, flexible,

extension cord to allow connection to the appropriate terminals on the panel of the controller. It must be possible to manually step through a vehicle clearance interval.

8.4 Terminal Block. A two point terminal block must be mounted on the back side of the police switch panel and the hand control circuit terminated on this block. This will be for installation of a hand control cord by others, as required.

8.5 Space Requirement. Adequate room must be provided in the police panel section to store the manual switch and retractable cord.

9. **RAILROAD INTERCONNECT REQUIREMENTS**

9.1 General. The railroad preemption will meet the requirements of the ICC (Illinois Commerce Commission) and the requirements of IDOT (Illinois Department of Transportation).

9.2 IDOT. The railroad preemption will meet all the requirements of the Illinois Department of Transportation's Standard Specifications for Road and Bridge Construction, adopted January 1, 2012. It must meet all the requirements of Article 1073.01 (c) (2) and Article 1074.03 (a) (5) e.

9.3 ICC. The railroad preemption will meet all the requirements of the Illinois Commerce Commission, as stated herein.

(1) The railroad preempt relays and the City traffic cabinet in general must be able to be wired as indicated in IDOT's Standard 857006-01 "SUPERVISED RAILROAD INTERCONNECT CIRCUIT". A failure in the interconnection circuit will result in activation of a supervisory failure alarm.

(2) Remote Flash. The Remote Flash input to the controller must be inverted from normal NEMA logic. Instead of grounding the input to Logic Ground (0 volts DC) to activate, the Remote Flash will be normally grounded and will be activated when the input is in the Logic 1 (+24 volts DC) state. This will preclude the installation of a controller without the proper railroad software and a normal controller with standard (non-railroad) software will not be able to run the traffic signals.

(3) Critical Components Series Loop. All critical components to railroad preemption such as relays and harnesses must utilize the 24 VOLT DC monitor voltage to form a series loop. Removal of any component will result in the traffic signals entering a flashing red condition. The 24 VOLT latch in the Management Malfunction Unit will be programmed, requiring manual reset if a failure in the series loop

occurs.

- (4) Controller Preempt Input Verification. Like the supervisory interconnection circuit monitors the integrity of the interconnect cable, this feature monitors the integrity of the controller railroad preemption input and associated wiring within the traffic controller cabinet. This will utilize a secondary railroad preemption input that is normally active (on) when no demand for railroad preemption is present. When a demand for railroad preemption is received, the normal railroad preemptor input is applied and the secondary input is dropped. If both inputs are either simultaneously on or simultaneously off for a time period of more than one (1) second, the controller will recognize this as an input failure. When a failure occurs, the traffic controller will be configured to provide a track clearance interval followed by a flashing red condition. This occurrence will set a preempt input alarm and also will require a manual reset of the controller.
- (5) Track Clearance Green Re-service. Any demand for railroad preemption received at any point in the normal sequence, the emergency vehicle preemption sequence, a bus preemption sequence, or any other form of low priority preemption, or a previously called for railroad preemption sequence will result in the traffic controller providing a track clearance green indication within a “maximum time to track clearance green “ (usually 8 seconds depending upon site specific criteria) and will provide a full track clearance green time interval after the preemption demand was received. The controller software must have the capability to restart the railroad preemption sequence providing a full track clearance green interval from any point within the railroad preemption sequence from the start of track clear green through the entire dwell/hold interval(s) including any exit yellow and red clearance intervals, if the demand for preemption drops and is reapplied. The number of times the controller is able to react to successive demands for railroad preemption must not be limited. This will be a software based routine that does not require any user programming and must be designed into the software.
- (6) Preemption Priority. Preemptor number 1 is typically assigned to a supervisory failure in the interconnection circuit and preemptor 2 is typically assigned to a normal railroad preemption demand. Preemptor 1 must have priority over preemptor 2. Preemptor 2 must have priority over all other forms of preemption.
- (7) Delay Time. In order to compensate for noisy or intermittent calls, the controller must have a programmable delay timing parameter for railroad preemptors, programmed at 1 second. Any demands for

railroad preemption lasting less than this time will be ignored. This will apply to any subsequent demands for railroad preemption that may occur while the controller is still within the railroad preemption sequence from a prior demand.

- (8) Non-Locking Preemption. The controller must have the capability to configure the railroad preemptors as non-locking calls. If a demand for preemption is placed for a duration of less than 1 second (as programmed in the delay timer), the call will not lock and the controller will not initiate the preemption sequence. Furthermore, if an initial demand for preemption is dropped prematurely while the preemption sequence is still timing, the non-locking feature will allow the controller to re-service another demand for preemption.
- (9) Minimum Green before Preemption. The controller must have a separate minimum green timing parameter, programmed at 1 second, that replaces normal controller phase minimum green times when entering railroad preemption. When a demand for preemption is applied, any active phase(s) must terminate immediately or after they have been active for 1 second if the demand occurs at the start of the phase(s). If any indications that are part of the track clearance green are active when the demand for railroad preemption is placed, those indications will not terminate until after the track clearance green interval is completed.
- (10) Railroad Hold/Dwell Interval. The controller must have the capability to display a programmable phase(s) and rest in that phase(s) until the demand for railroad preemption is released. The controller must also have the option to cycle between a set of programmable phases that don't conflict with the railroad crossing, or rest in an all-red steady state until the demand is released. The necessity for cycling during the hold interval or the use of an all-red steady state is determined by an assessment of the specific site. The controller must have a timing parameter that will provide a minimum hold/dwell time, even if the demand for preemption is dropped prematurely. The controller must be able to re-service any subsequent demands for preemption during this minimum hold/dwell time.
- (11) Railroad Hold/Dwell Extension. The controller must have a timing parameter that will extend the hold/dwell interval for a programmed time after the demand for railroad preemption has been released. The controller must be able to re-service any subsequent demands for preemption during this extension time.
- (12) Pre-signal Timing. When pre-signals are present in advance of a railroad crossing, during normal operation the pre-signal green

indications terminate a programmable time (timed overlap) prior to the indications at the intersection. The duration of the timed overlap should not be reduced when leaving normal operation to service other forms of preemption, such as emergency vehicle or bus preemption. If a demand for railroad preemption occurs during the timed overlap portion of the normal sequence, the overlap timer must terminate and the track clear green interval must begin immediately, after the pre-signal yellow and red vehicle clearance intervals are completed.

- (13) Remote Monitoring and Alarms. Capabilities to remotely monitor the traffic controller must be provided, including the capability to monitor the operation of the controller, upload logs/events, and to verify the integrity of the database. In addition, the controller must have the ability to automatically report alarms, such as preempt 1 activation, preemptor input failure, automatic flash, CRC failure, 24 volt failure, and other defined alarms. The controller must have the ability to prevent the remote download of changes to the critical data protected by the railroad preemption security feature.
- (14) Blank-out Signs. If these signs are used for railroad preemption, they should activate immediately with the activation of the railroad interconnect circuit. They should deactivate immediately with the deactivation of the interconnect circuit, not after the controller exits the railroad preemption sequence. Whenever the traffic signals are in flashing red operation, cabinet circuitry must be such that the signs will remain operational if the interconnect circuit activates due to railroad warning device activation.

9.4 CRC. A CRC module with all connections, a USB memory device, software, and any other firmware necessary to make the CRC fully functional will be provided if so designated.

- (1) Hardware. A 16 bit CRC (cyclical redundancy check) module must be provided. The module will connect to the ATC controller using unused I/O pins. Reassignment of unused inputs on the NEMA 'A', 'B', and 'C' connector I/O pins or connection to a proprietary 'D' module's input pins will be acceptable. The final CRC value for the specific intersection requirements will be set on the module for that intersection. Removing the CRC module during normal operation of the intersection, or mismatching the values in the database and the CRC, will result in a fault condition and put the intersection in flash mode.
- (2) Software. The controller software/firmware will provide the logic and control facilities to fully implement CRC error detection. All the data elements (objects) required for the implementation will be

contained in a proprietary data block. The software will provide a mechanism to “display” the final CRC value to be set on the CRC module.

A USB memory device will be utilized to ‘lock’ or ‘unlock’ the database. When the USB device is inserted into the controller, the controller will display a menu that will include a utility to ‘unlock’ the database. The USB device will contain a file structure that will allow access to the protected areas of the database. Once ‘unlocked’, the database can be edited through normal user interfaces. While the database is ‘unlocked’, the controller will drop the voltage/fault monitor signal to the conflict monitor to keep the intersection in flash. The CRC comparison check will be disabled during this period.

After all the changes to the database are completed, the user will use a utility on the USB to ‘lock’ the database. After the database is ‘locked’, another utility will allow the calculated CRC to be displayed. This can be used to configure the CRC module. After the CRC is connected and the USB is removed from the controller, the voltage/fault monitor signal to the conflict monitor will be enabled. A restart will be required to restart the controller.

Once the CRC module has been set (programmed), and the database has been locked, the controller can resume normal operation. The controller firmware will validate the stored CRC against the CRC module’s value at least once per second.

10. WIRING

All wiring shall meet the requirements of Section 12, WIRE REQUIREMENTS, of the Cabinet Standard.

11. TESTING REQUIREMENTS

- 11.1 General. The testing of cabinets shall be done according to the requirements in the ATC cabinet standard. The testing of the controllers shall be done according to the requirements of the ATC controller standard and as described herein. Environmental testing shall be done at the manufacturer’s facilities or at an independent laboratory, and shall be certified by the manufacturer or the independent laboratory. Functional testing will be done at the City’s facilities. All controllers provided under the contract shall be tested as stipulated under “Functional Burn-In Testing” and “Physical Inspection” at the manufacturer’s facilities. In addition to the NEMA environmental tests and the "burn in" requirements for the controller, satisfactory performance of the traffic signal cabinet and its equipment must be demonstrated as required in the cabinet standard Section 11. Functional testing must include, but not be limited to,

phasing for multiple legged intersections, bridge and railroad pre-empts, flash operation, actuation, and any combinations of these features. Controllers designed to function without railroad pre-empts must be shown to function without the presence of a railroad interconnect. In addition, it should be demonstrated that the controller functions within the City's traffic control system.

- 11.2 N.E.M.A. Environmental Test for Controllers. One controller, unless approved previously, must be tested, at the manufacturer's expense, in accordance with Part 2 of NEMA Standards Publication TS1-1983. All of the tests listed must be performed with all data properly recorded and certified. If the manufacturer changes the design, fabrication or components of a previously tested and approved controller, then a sample of the controller containing the new design, fabrication or components must be retested at the manufacturer's expense. Any N.E.M.A. environmental test references to minimum recall must include but not be limited to: All sixty-four (64) output circuits must be programmed in a sequence to simulate the normal functioning of the entire controller cabinet assembly; the conflict monitor must have a test board with the allowable channel jumpers installed to simulate normal operation; All thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval.
- 11.3 Functional "Burn In" Testing for controllers. The manufacturer of the controller must perform, at his manufacturing facilities, a one hundred (100) hour burn-in test on every controller, conflict monitor, and appurtenant devices. This test period must be certified by the manufacturer with supportive documentation and must include the device serial number, dates and times of test periods, and results. Any failed, or nonconforming components, must be replaced at this time. After each of the components has passed the burn-in test, they may be used in the assembly of the complete controller unit. Each completed unit must be subjected to the seventy-two (72) hour function test as described in this specification. The "burn in" requirement must include a test that uses all sixty-four (64) output circuits in "solid" burn as well as 1 pps and 5 pps for each circuit. All thirty-two (32) intervals must be programmed with a minimum of two (2) seconds per interval. The documentation for a test program to simulate the normal functioning of the controller phasing must be supplied. A copy of the test program must be approved by the City of Chicago, Division of Electrical Operations prior to testing. Certification of these tests must be attached to the outside of the shipping container. This certification is in addition to any other documentation and/or testing required by these specifications.
- 11.4 UPS. Testing of the equipment must verify that the operation meets the requirements of this specification. All equipment must be shown to operate correctly, including the rectifier, charger, inverter, batteries, and control unit. The UPS must be connected to a dummy load at the factory and tested for performance under various conditions of line voltage and frequency, varying loads, temperature range, and humidity range. The automatic switching must be successfully demonstrated; losing line power and restoration of line power must

not adversely affect the operation of the traffic signals. Use of the manual bypass switch must be successfully demonstrated. A generator must be connected to the unit and successfully operate the system without interruption. The batteries must be shown to be able to operate the traffic signals for the specified time. The batteries must be shown to be able to be recharged in the specified time between failures. The control unit, including the LCD display and the RS-232 interface, must be shown to function according to this specification. All reports and event monitoring must be successfully demonstrated. Programming functions must also be shown to work properly.

11.5 Physical Inspection. The "physical inspection" portion of the test procedure shall require the manufacturer to perform a physical inspection of workmanship and specification compliance for each traffic signal controller and cabinet assembly. The inspection shall be done using a detailed check list defining items to be inspected and criteria for acceptance. The inspection shall include, but not be limited to, the following items:

- (1) Hardware installation.
- (2) Assembly mounting.
- (3) Dimensions.
- (4) Presence of specified devices and materials.
- (5) Presence of required documents.
- (6) Labeling and required serial numbers.
- (7) Wiring including routing, covering, gauge, length, and soldering of terminations.
- (8) Arrangement of equipment for safety and ease of calibration reprogramming troubleshooting and maintenance.
- (9) Condition of cabinet body and finish.
- (10) Condition and installation of doors, panels, gaskets and ventilation.

11.6 Functional Testing. The "functional testing" portion of the test procedure shall require the manufacturer to perform a complete room-temperature functional test of each complete traffic signal controller and cabinet assembly for a minimum of seventy-two (72) hours. This test shall be designed to concurrently check integrated hardware systems e.g., from simulated input to load switch output. All interface/controller interconnections must be tested. All load switch and interconnect relay positions must be tested, regardless of the number of load switches and interconnect relays being purchased. The functions tested shall include, but not be limited to, the following:

- (1) Flash logic and operation (color, phases).
- (2) Police panel switch operation.
- (3) Auxiliary panel switches (including fans).
- (4) Interface panel.
- (5) Time switch operation.
- (6) Load switches (with a continuous ten (10) ampere load on each signal

circuit).

- (7) Outputs.
- (8) Power interruptions of less than 500 ms.
- (9) Power interruptions of more than 1.0 sec.
- (10) Generator Hook-up.

12. SHIPMENT AND DELIVERY (Only applies to City commodity contracts)

12.1 Packaging. The cabinets shall be shipped on individual pallets. Each cabinet must be individually wrapped and protected so that it can be handled without damage to the cabinet or its finish. If subassemblies or parts are ordered they shall be suitably packaged to prevent damage during shipping and handling. All packages should be clearly labeled indicating the contents.

12.2 Delivery. The assembled cabinets, or subassemblies and parts, shall be delivered to the Division of Electrical Operations at 2451 S. Ashland Avenue, unless otherwise directed. Assembled cabinets, or subassemblies and parts, must be available for testing and shipping within six weeks of the placement of an order.

CHICAGO ATC MATRIX - TABLE A

(ATC Standard Version 5-2b June 26, 2000)

Since the ATC standard specifies a “family” of controllers, the following options have been selected from the ATC standard to meet the City’s needs.

Functional Requirement	ATC Clause #	Status	Details
Shelf Mounted	2.2.1 4.3.2.1	Required	(Shelf mount only)
Use of ATC Engine Board	2.2.2 4.3.2.2 5.1.1 5.1.2 5.3.2 5.3.4 5.3.5 5.3.5.1 5.4.2 5.4.3 5.4.4 5.4.5	Required	
Use of ATC Engine Board	5.2.1	Required	<ul style="list-style-type: none"> Allowed component height below Engine Board PCB provided that the overall envelope remains unchanged, the clearance between the Host Board and Engine Board remains as specified, and the Engine Board still fits into a compliant Host Board
Use of ATC Engine Board	5.2.2 5.4.5	Required	<p>In order to show the Ethernet communications to the Engine Board, the following “Reserved” pins can assume the following legacy functions:</p> <ul style="list-style-type: none"> P1-34: ENET2 Speed P1-35: ENET2 Link/Activity P1-36: ENET1 Speed P1-37: ENET1 Link/Activity
Use of ATC Engine Board	5.3.1	Required	Minimum CPU capability of 500 MIPS
Use of ATC Engine Board	5.3.3	Required	Additionally, must provide a minimum of 16 MB of Flash total to accommodate future applications.
Use of ATC Engine Board	5.4.1	Required	<ul style="list-style-type: none"> Engine Board shall not draw

			<p>more than 4W of power from VPRIMARY (due to battery backup in Chicago)</p> <ul style="list-style-type: none"> • Engine may supplement VSTANDBY_5 with on-board storage for its standby power.
Use of ATC Engine Board	5.4.3	Required	<ul style="list-style-type: none"> • All optional baud rates shall be supported
Parallel I/O	2.2.4	Required	<ul style="list-style-type: none"> • No support required for TS2 Type 1 or ITS cabinets • Must provide parallel I/O for TS2 Type 2 cabinets and legacy parallel I/O interfaces via interchangeable modules
Linux O/S and ATC BSP	2.2.5 4.3.1 4.3.3	Required	
Linux O/S and ATC BSP	2.2.5 4.3.1 4.3.3	Required	
Linux Kernel	Annex A	Required	
Parallel I/O	3.4	Required	Not required to support ITS Cabinet standard (NEMA cabinets are used)
Manage Clock/Calendar functions and synchronize with external source	3.5.1.3	Required	Must also support synchronization with absolute zero.
Manage Clock / Calendar functions and synchronize with External Source	4.1.3	Required	<ul style="list-style-type: none"> • BSP RTC driver shall automatically update the RTC with the OST time once per second with an accuracy of 0.1 seconds • Successive interruptions (e.g. on for 5 minutes, off for 3 minutes over a period of 8 hours) shall not introduce cumulative error
Configure and Verify Parameters	3.5.1.4 4.1.4	Required	
Upload/Download blocks of data	3.5.1.5 4.1.5	Required	

Monitor & Verify Application Status	3.5.1.6 4.1.6	Required	
Operator Control of Application Execution	3.5.1.7	Required	<u>Only</u> a local operator is allowed to manage the starting, stopping and scheduling of one or more applications on the ATC.
Operator Control of Application Execution	4.1.7	Required	
Long Term Storage of Log Data, etc	3.5.1.8 4.1.8	Required	
Support Diagnostics	3.5.3.3 4.3.4	Required	
Modes of Operation	3.7	Required	(Must support Standalone, Direct, and Distributed modes of operation)
Manage/Control a Variety of External Devices	4.2.1	Required	<ul style="list-style-type: none"> • Fixed Ports on the front panel shall be specified by the City • Only SP1 and SP2 are required to be supported on the modem slot • The dedicated synchronous serial port (SP5) is to be used exclusively for supporting a parallel I/O module (NEMA TS2 or legacy interface)
Monitor the Status of External Devices	4.2.2	Required	<ul style="list-style-type: none"> • Fixed Ports on the front panel shall be specified by the City • Only SP1 and SP2 and required to be supported on the modem slot • The dedicated synchronous serial port (SP5) is to be used exclusively for supporting a parallel I/O module (NEMA TS2 or legacy interface)
Support future Hardware Upgrades	4.3.2	Required	
Environmental Requirements	5.2.3	Required	
Front Panel Serial Ports	6.2.3.1 6.1.3 6.3.2.1	Required	One serial port on the front panel shall satisfy this section as an EIA-574 (25-pin) and be labeled "Port 2".
Front Panel Serial Ports	6.2.3.1 6.3.2.1	Required	One serial port shall satisfy this section as an EIA-574 (9-pin) with a reduced

			pin-out (TXD, RXD, and DC Reference at a minimum) and be labeled "Port 4". C50_ENABLE shall not be supported. A second serial port shall fully satisfy this section as an EIA-574 (25-pin) and be labeled "Port 5."
Front Panel Serial Ports	6.2.3.2 6.1.3 6.3.2.2	Required	One serial port shall satisfy this section as an EIA-485 (15-pin) with the TS2 Type 1 Port 1 pin-out and be labeled "Port 1".
Front Panel Ethernet Ports	6.2.3.9 6.3.2.9 7.1.4.4	Required	There shall be a minimum of two Ethernet ports on the Front Panel (one for ENET1, one for ENET2)
User Interface	7.1 7.1.1.2 7.1.4.4 7.1.4.5 7.1.4.7	Required	
User Interface	7.1.1	Required	Must meet City's Minimum requirements
User Interface	7.1.1.1 7.1.2.1 7.1.3 7.1.4.1 7.1.5	Required	<ul style="list-style-type: none"> • Data key is not required • Front Panel Interface is to be integral to the controller (i.e. not removable, no SP6 connector) • "Option 1" to be selected but AUX switch is optional • Keypad shall have a minimum of 24 keys • LCD Display shall be graphical with a minimum resolution of 128 rows x 240 columns (up to 16 lines x 40 characters). • LCD pixel size shall be a minimum of 0.32mm x 0.32mm with a minimum pitch of 0.325mm with character size defined as 6 pixels wide x 8 pixels high • Refresh rate is a minimum of 10 times per second (due to larger display requirements) • LCD heater is mandatory to ensure sub-second LCD display

			<p>response over full temperature range. Heater shall only be active when needed and User is interacting with the controller locally (due to battery backup requirements).</p> <ul style="list-style-type: none"> • Heater Power shall be up to 15V at 1A current maximum
Power Supply	7.2 7.2.2 7.2.3 7.2.4 7.2.5 7.2.5.1 7.2.5.2 7.2.6.1 7.2.6.2 7.2.6.3 7.2.6.4 7.2.6.6	Required	12 V not required As applicable for NEMA cabinets only
Mechanical/Chassis	7.3.1.3 7.3.1.4	Required	<ul style="list-style-type: none"> • Only Shelf mounted units are acceptable • Only components / connectors specified by the City shall be located on either the Front or Rear panels. No C1 Type Connectors allowed.
I/O Interfaces	8.1.1 8.2.2 8.2.2.1 8.2.2.2 8.2.2.3	Required	<ul style="list-style-type: none"> • Support for TS2 Type 2 and TS1 Interfaces
I/O Interfaces	8.1.2 8.2.2.5	Required	<ul style="list-style-type: none"> • Support is only required for NEMA TS2 Type 2, TS1, and other similar legacy interfaces • NEMA TS2 Port 1 shall also be provided (for detectors only)
I/O Interfaces	8.2.3	Required	Port 1 Connector shall be provided as specified within this section (only used for detectors)
I/O Interfaces	8.2.1.13	Required	Legacy I/O interfaces shall respond as

			required.
I/O Interfaces not required	8.2.1	Required	<ul style="list-style-type: none"> No support for Model 332 Cabinets or ITS Cabinets & devices is to be provided
Environmental & Test Procedures	9	Required	All subsections are required
Performance & Material Requirements	10	Required	All subsections are required
Performance & Material Requirements	10.1.15	Required	All PCBs and similar construction mechanisms shall be mounted vertically (i.e. no horizontal PCBs are allowed).
Quality Control	11	Required	All subsections are required

**CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
STANDARD ELECTRICAL DRAWINGS
UPDATED 3/23/2022**

Number	Title	Date
	ELECTRICAL CODE SHEET	
826	Traffic Signal/Street Light Code Sheet	01-08-14
	MANHOLES/HANDHOLES/UNDERGROUND CONDUIT	
579	Trench Backfill	07-14-61
729	3'x4'x4' Manhole/ 30" F&C	08-21-02
730	3'x4'x4' Manhole/ 24" F&C	08-21-02
732	4'x6'x6' Manhole/ 24" F&C	10-08-02
733	4'x6'x6' Manhole/ 30" F&C	10-08-02
813	Installation of Conduit under Pavement	03-13-81
814	Installation of Conduit through Manhole Wall	03-13-81
866	36" Heavy Duty Handhole / 24" F&C	01-23-00
867	30" Handhole / 24" F&C	01-23-00

871	36" Heavy Duty Handhole / 30" F&C	01-23-00
872	24" Frame and Cover	04-24-92
874	30" Frame	05-05-92
966	Polymer Concrete 24" Manhole Cover	03-06-11
967	Bracket Detail 30" Fiberglass Handhole	03-06-11
968	Polymer Concrete 24" Frames	07-21-11
970	Square Composite Cover Chicago Park District	06-01-12
7878	Pulling Iron	11-30-73
10792	Grate for Sump	11-30-73
10927	30" Manhole Cover	08-09-85
	FOUNDATIONS	
565	Foundation for Pole, 10" B.C., 5 Foot	10-24-06
709	Foundation for Pedestal, 3 Bolt 13" B.C., 5 Foot	08-21-02
793a	Steel Cage for Light Pole Foundation	12-30-02
806	1-1/2"x60" Steel Anchor Bolt	07-29-82
811	1-1/4"x60" Steel Anchor Bolt	07-29-82

812	Typical Foundation in Vaulted Walk (retired)	01-21-81
816	Foundation for 34'-6" Pole / 17-1/4" B.C./ 9 Foot	08-21-02
817	Foundation for 34'-6" Pole / 16-1/2" B.C./ 11 Foot	08-21-02
818	Foundation for 34'-6" Pole/ 15" B.C./ 9 Foot	08-21-02
854	Foundation for Traffic Controller/ M Cabinet	09-23-93
888	Foundation for Traffic Controller - P Cabinet	06-19-02
888A	Foundation for Traffic Controller - Super P Cabinet	02-28-22
956	Foundation for Loop/Extended Loop Poles, 30"x7', 1" A.R., 15" B.C.	08-21-02
936	Helix Foundations for Poles	12-27-02
937	Offset Foundation	01-28-03
937A	Offset Foundation	02-27-12
953	Foundation for Chicago 2000 Gateway/Pedestrian Poles, 28"x7', 1.25" A.R., 15" B.C.	08-21-02
11825	Conduit Elbow / Galvanized Rigid Steel	04-03-79
11972	Foundation for Terminal Cabinet	05-13-81
830	1"x 60" Steel Anchor Bolt	09-06-83
844	3/4"x 30" Steel Anchor Bolt	10-31-85
891	Construction Method for Installation of Helix Foundation in Sidewalk	08-26-14

982	Cable Anti-Theft Device for Helix Foundations	01-27-15
	ARTERIAL POLES/ARMS	
620	8 Foot Steel Mast Arm	02-26-64
652	3.7" x 6.5" Steel/20'-0" Pole 11 Gauge	10-03-01
659	2 Bolt Mast Arm Attachment - Pole Plate	05-27-76
661	4 Foot Steel Mast Arm	10-26-66
724	2 Bolt Mast Arm Attachment - Arm Plate	03-01-02
762	3.95"x8.5" Steel Pole / 32'-6" 7 Gauge	10-03-01
763	3.95"x8.5" Steel Pole / 32'- 6" 3 Gauge	01-04-84
785	Steel Ballast Housing /10" & 15" Bolt Circle/ 7 Gauge	10-19-81
808	5.17"x10.0" Steel Pole / 34'-6" 7 or 3 Gauge	10-03-01
824	6.17"x11.0' Steel Pole/ 34'-6"/ 3 Gauge /17-1/4" B.C.	10-03-01
827	7.67"x12.5" Steel Pole/ 34'-6'/ 3 Gauge/ 16-1/2" B.C.	10-03-01
837	Double Nut Construction	06-07-85
839	12 Foot Steel Mast Arm	07-08-85
840	15 Foot Steel Mast Arm	07-08-85

907	Davit Arm, Steel	01-31-03
916	34'-6" Embedded Pole	05-14-98
938	Aluminum Pole / 10"x6"x 27'-10.5"/ Arterial Streets / Conventional	01-29-02
939	Aluminum Pole/ 8"x4.5"x32'-10.5"/ Skyway / Conventional	01-29-02
971	Aluminum Davit Pole, 10" x 6" x 35'	04-15-13
941	Aluminum Davit Pole/10"x6"x24'-5"/ Arterial	06-15-12
941A	Aluminum Davit Pole/10"x6"x20'-5"/ Arterial	
942	Aluminum Davit Pole/8"x4.5"x29'-5"/ Skyway	01-29-02
975	Aluminum Davit Pole/8"x4.5"x27' For Bridge Parapet Wall	10-02-13
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948	Aluminum Davit Arm /6"x8'	06-15-12
949	Aluminum Davit Arm /6"x12'	06-15-12
950	Aluminum Davit Arm /6"x15'	06-15-12
972	Aluminum Davit Pole 10" x 6" x 40' For Arterial Streets	04-15-13
988	4.15" x 8" x 29'-6", 7 Gauge Anchor Base Steel Pole	02-01-21
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940A	Aluminum Davit Pole/ 7"x4.5"x10'-0"/ Residential	
943	Aluminum Truss Arms / 4.5" pole tops	01-29-02
945	Aluminum Davit Arm / 4.5"x 8'	06-15-12
946	Aluminum Davit Arm / 4.5"x 12'	06-15-12
947	Aluminum Davit Arm /4.5"x15'	01-29-02
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641b	21" Lighting Arm for Alley Light	07-15-66
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895	Victorian Gaslight Ornamental Street Light Pole/ Fixture	01-07-02
898	10' Ornamental Concrete Pole	06-01-95

899	13'-9" Ornamental Concrete Pole	06-01-95
900	Steel Base for Ornamental 10' Concrete Pole	06-01-95
901	Steel Base for Ornamental 13'-9" Concrete Pole	06-01-95
911	Loop Light Pole / Fluted Steel	01-30-02
914	Electrolier Light Pole and Luminaire	10-08-02
928	Chicago 2000 Pedestrian Pole	01-26-01
929	Extended Loop Pole and Base	01-26-01
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11925	Service on CE Wood Pole	09-03-96
989	Arterial & Residential 240v Single Node Wiring Diagram for Cobra And Piggy Back	2/2/22
990	Aerial Arterial 240v Single Node Wiring Diagram for Cobra And Piggy Back	2/2/22

Aluminum Alloy Tube
5.563" O.D. x 0.187"
Wall Thickness.

1/2 x 13 - 3/4" Lg. Allen Head CAPTIVE
Stainless Steel Locking
Screw.

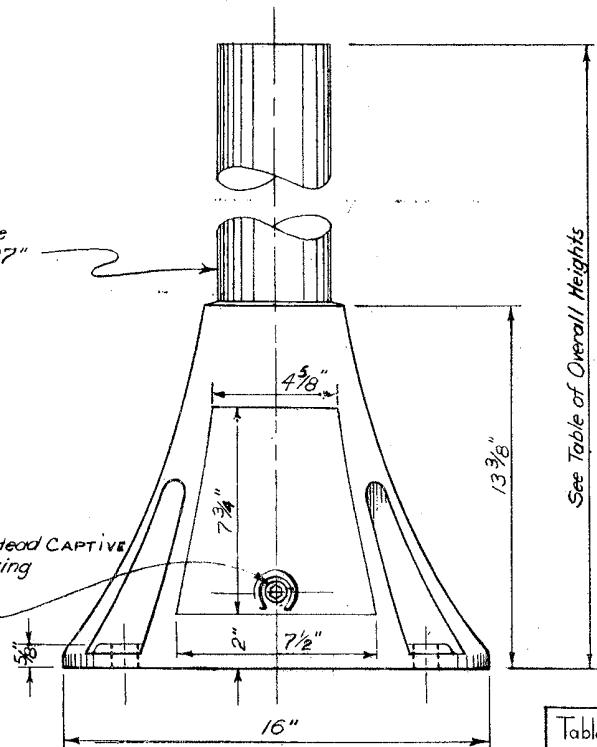
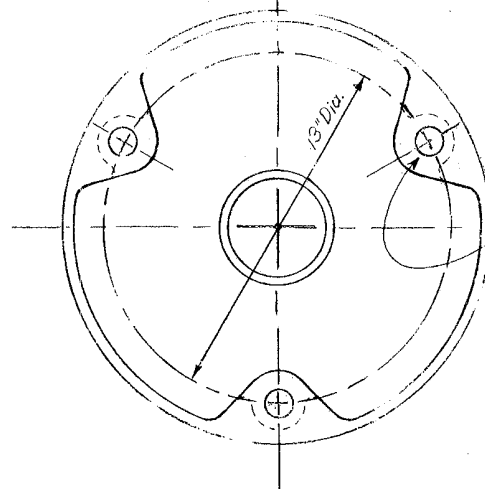


Table of Overall
Heights

20'-
11"-
18'-
9"-
6"-

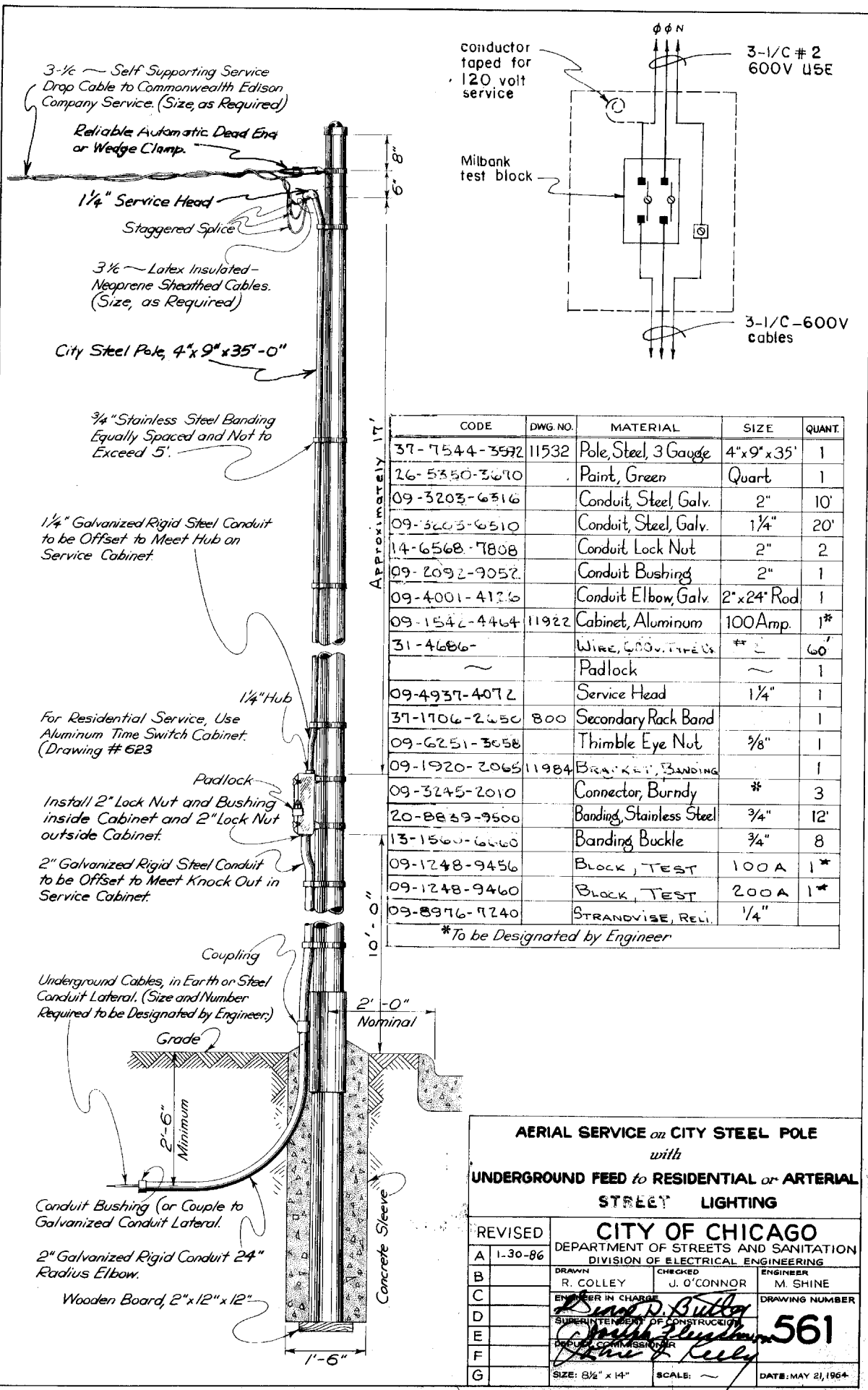


Drill 15/16" Diameter
3 Holes 120° Apart.

ALUMINUM PEDESTAL BASE WITH HANDHOLE

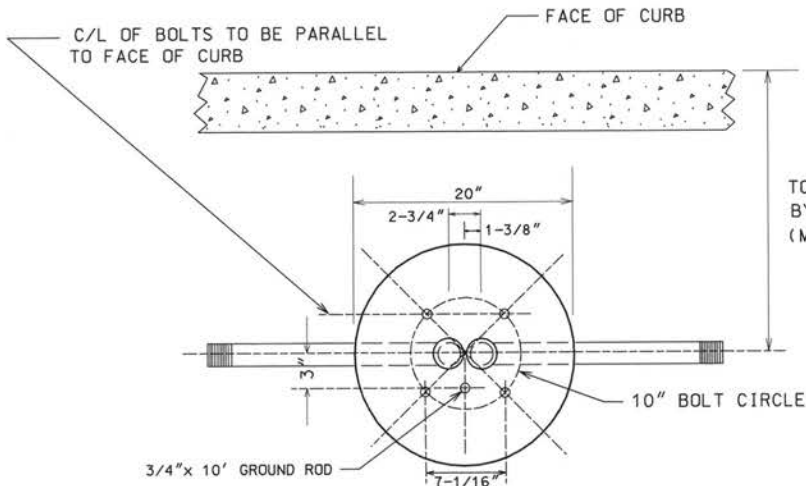
for
Street Lighting Controller, Traffic Signal
Controller and Traffic Signal Heads.

REVISED		CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING		
J CHANGED OVERALL HEIGHTS 5-22-81	A	5-5-60	DRAWN R. COLLEY	CHECKED J. BORE
Revised Table of Overall Heights	B	6-30-60	ENGINEER Ruzicha	
Revised O.D. of Pedestal	C	12-21-60	DRG. NO. 526	
Revised Specification Number	D	3-23-62	ENG. IN CHARGE D. D. Butler	
REVISED TABLE OF OVERALL HEIGHTS	E	6-4-64	DEPT. OF CONSTRUCTION	
REVISED DOOR DIMENSIONS	F	7-14-71	DEPUTY COMMISSIONER	
Revised Overall Heights.	G	002.26, 73	SCALE 8 1/2" x 14"	DATE 4-13-60
REVISED OVERALL HEIGHTS	H	5-4-79		

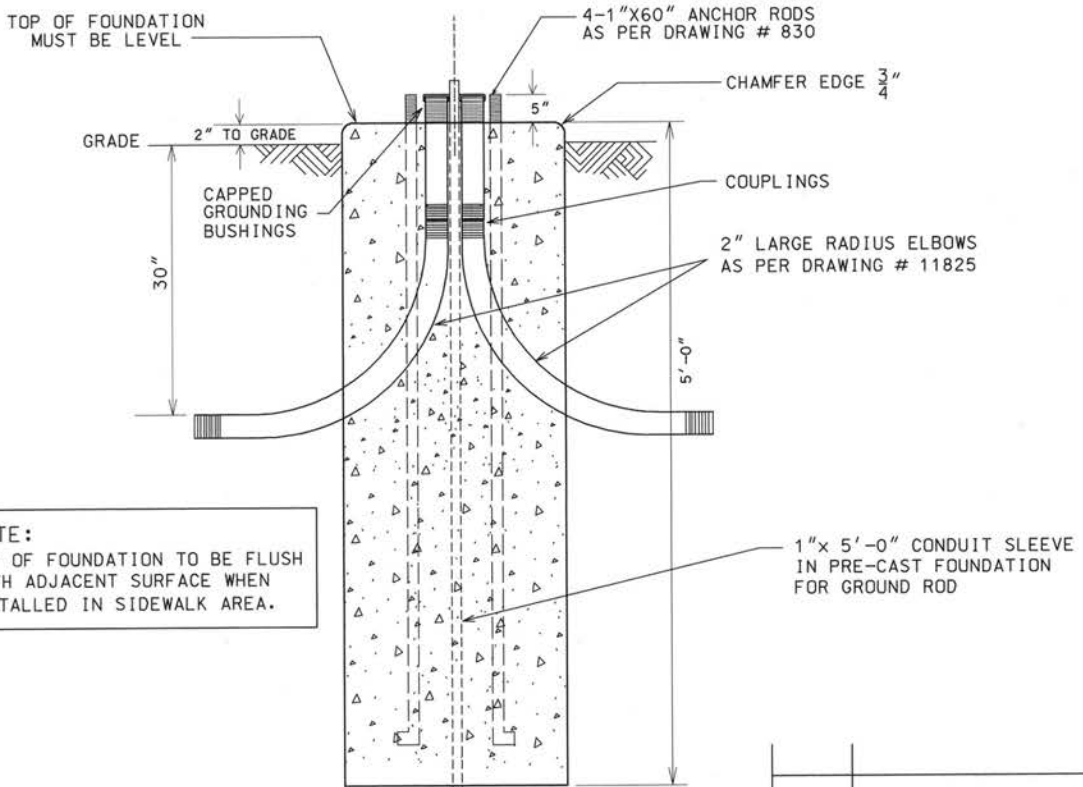


AERIAL SERVICE on CITY STEEL POLE
with
UNDERGROUND FEED to RESIDENTIAL or ARTERIAL STREET LIGHTING

CITY OF CHICAGO			
DEPARTMENT OF STREETS AND SANITATION			
DIVISION OF ELECTRICAL ENGINEERING			
REVISED	A	1-30-86	
DRAWN	B	R. COLLEY	CHECKED
			J. O'CONNOR
ENGINEER IN CHARGE	C	ENGINEER	
		M. SHINE	
SUPERINTENDENT OF CONSTRUCTION	D	DRAWING NUMBER	
		561	
DATE	E	MAY 21, 1964	
SIZE: 8 1/2" x 14"	F	SCALE: ~	
	G		



TOP VIEW

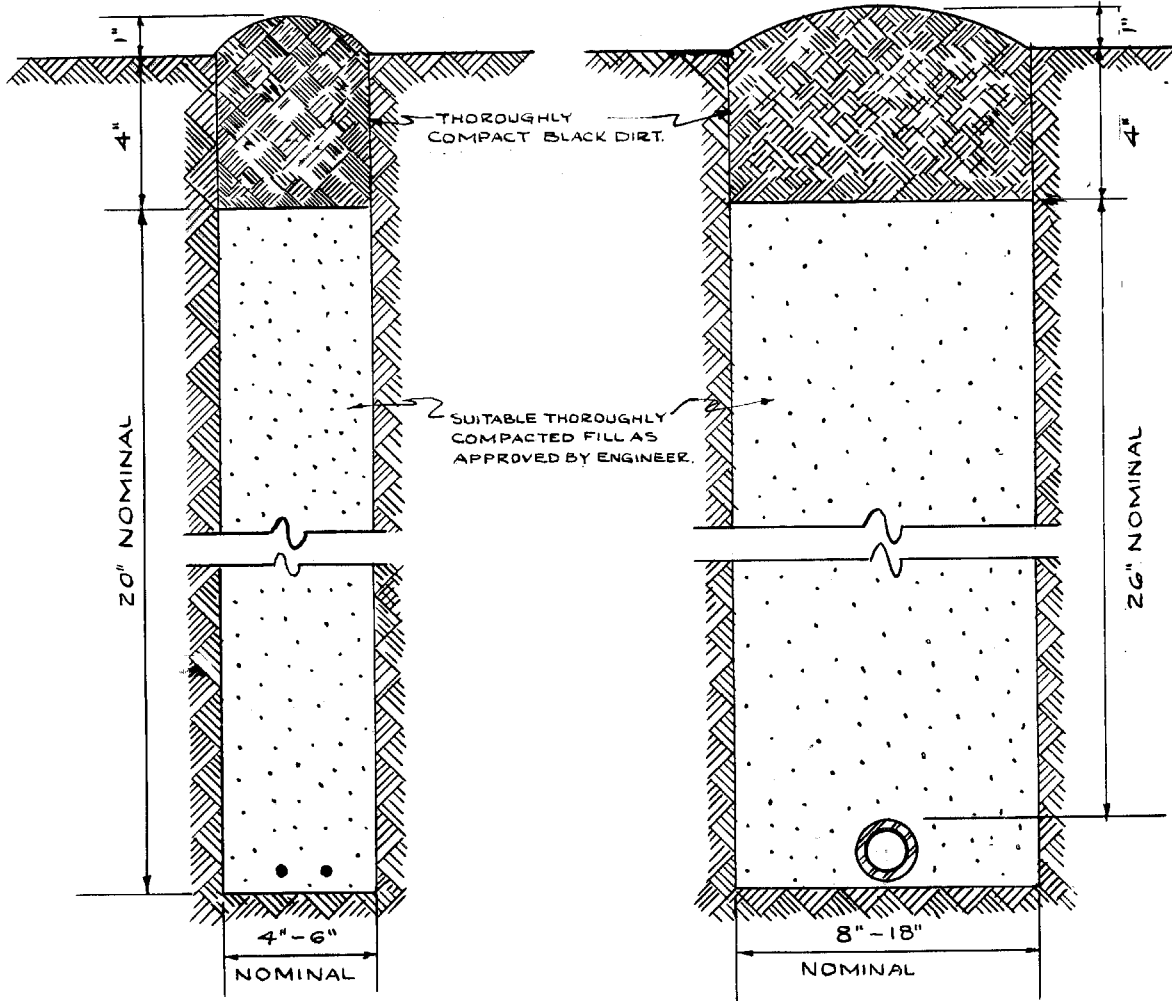


ELEVATION

NOTE:
TOP OF FOUNDATION TO BE FLUSH WITH ADJACENT SURFACE WHEN INSTALLED IN SIDEWALK AREA.

CODE	DRG.	MATERIAL	SIZE	AMT
0574-6580		SAND	BAG	5.6
0581-8470		STONE	BAG	9.3
0520-2650		CONCRETE	BAG	1.8
3752-0200	830	ANCHOR ROD	1"X60"	4
2726-7600	11825	CONDUIT ELBOW	2"X18"R.	2
0922-2316		CONDUIT NIPPLE	2"X12-3/4"	2
0911-8911		CONDUIT BUSHING	2"	2
0928-3080		CONDUIT COUPLING	2"	2
0978-9200		GROUND ROD	3/4"X10'	1

10/24/06	SUPERCEDES DWG #565 DRAWN 8/21/02
8/21/02	SUPERCEDES DWG #565 DRAWN 2/28/61
DATE	REVISION
FOUNDATION FOR RESIDENTIAL LIGHT POLE WITH 10" BOLT CIRCLE/5' DEPTH	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY	CHIEF DRAFTSMAN: ENGINEER: R. CARTER B. GARNSEY
ELECTRICAL DESIGN ENGINEER H. R. [Signature]	DRAWING NO. 565
ENGINEER OF ELECTRICITY M. [Signature]	GENERAL SUPERINTENDENT [Signature]
DEPUTY COMMISSIONER [Signature]	DATE: 10/24/06
SIZE: 11" x 17"	SCALE: NONE



CABLE TRENCH

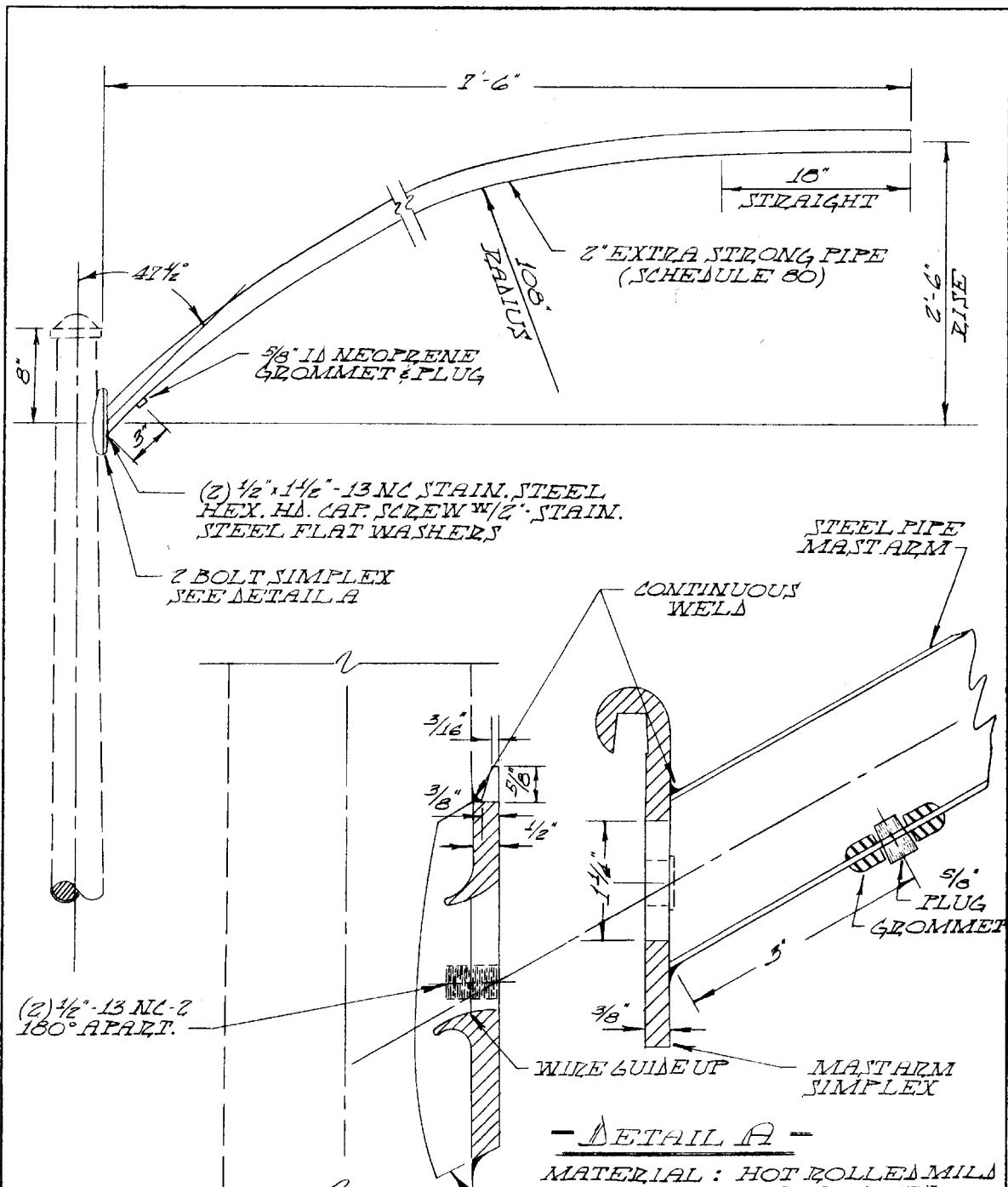
CONDUIT TRENCH

— NOTE —

EXCESS SOIL FROM TRENCH TO BE COMPLETELY REMOVED FROM SITE AS SOON AS PRACTICABLE.

BLACK DIRT TO BE TAMPED & THOROUGHLY COMPACTED AS SHOWN.

STANDARD METHOD FOR BACKFILLING CABLE & CONDUIT TRENCHES IN SODDED PARKWAY & LAWNS			
CITY OF CHICAGO			
DEPT. OF STREETS & SANITATION			
DIVISION OF ELECTRICAL ENGINEERING.			
REVISION	DRAWN: W. E. HARP		CHECKED: M. Shine
A			ENGINEER: J. O'CONNOR.
B			DRG. NO.
C	ENGR. IN CHARGE: <i>Frank D. Butts</i>		579
D	Supt. of Const. <i>Joseph J. ...</i>		
E	DEPUTY COMM. <i>Robert J. Kelly</i>		
F	SIZE 8 1/2 x 14"		DATE: 7-14-61
G	SCALE: N		
H			



(2) 1/2" x 1 1/2" - 13 NC STAIN. STEEL
 HEX. HD. CAP. SCREW W/ 2" STAIN.
 STEEL FLAT WASHERS

2 BOLT SIMPLEX
 SEE DETAIL A

STEEL PIPE
 MAST ARM

CONTINUOUS
 WELD

(2) 1/2" - 13 NC - 2
 180° APART.

5/8" PLUG
 GROMMET

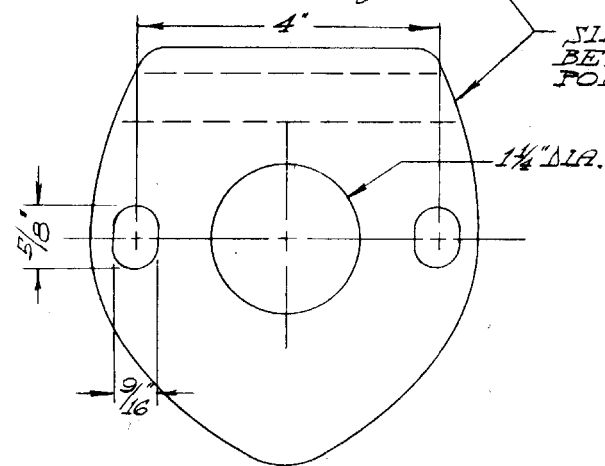
WIRE GUIDE UP

MAST ARM
 SIMPLEX

- DETAIL A -

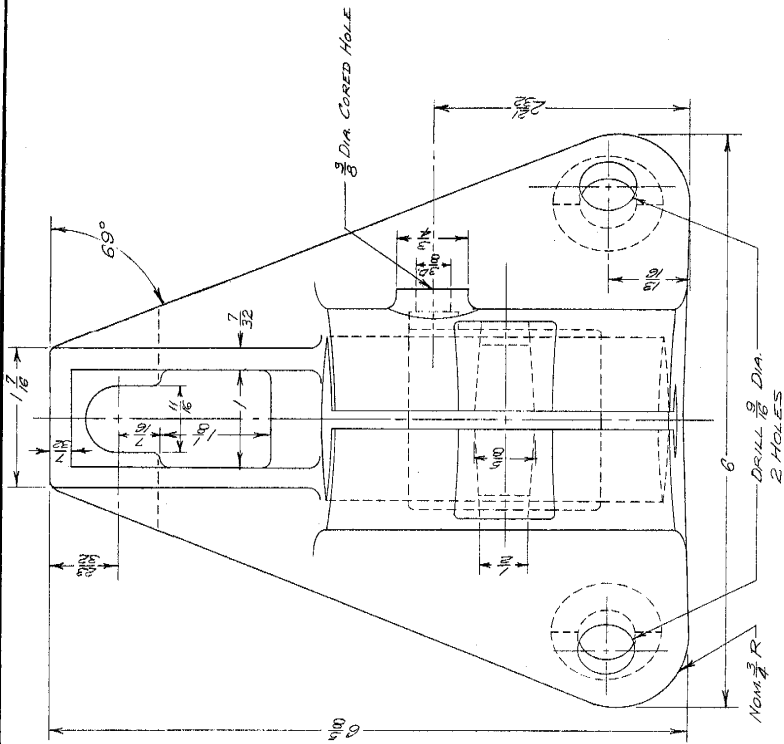
MATERIAL: HOT ROLLED MILLS
 STEEL S.A.E. *2030

SIMPLEX POLE ATTACHMENT TO
 BE FORMED TO FIT 29'-6" STEEL
 POLE, ARG. *557



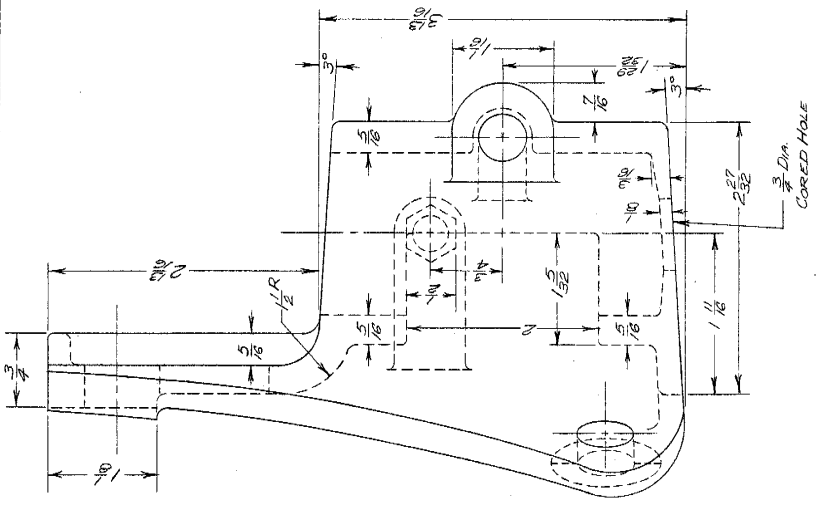
**B' STEEL MAST ARM
 WITH 2 BOLT SIMPLEX
 ATTACHMENT**

REVISED	CITY OF CHICAGO		
A	DEPT. OF STREETS AND SANITATION		
B	DIV. OF ELECTRICAL ENGINEERING		
C	DESIGNED	ENGINEER	DATE
D	CHECKED	SHINE	CONNOR
E	APPROVED		ARG. NO.
F	670		
G	SCALE	DATE	

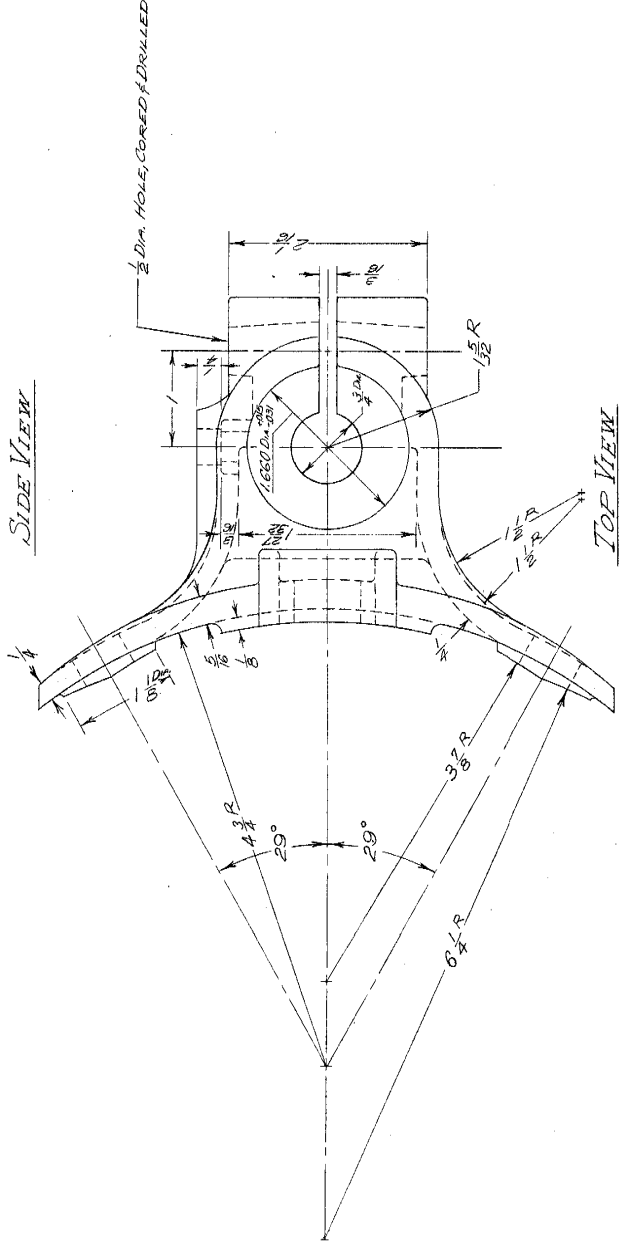


FRONT VIEW

NOTE:
CASTING TO BE ALUMINUM ALLOY MEETING
A.S.T.M. SPECIFICATION B719 ALLOY ZG-42A

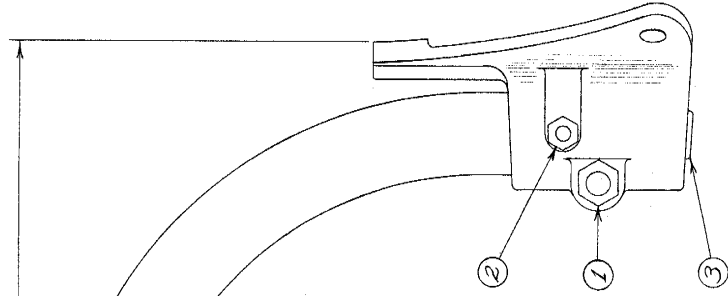


SIDE VIEW



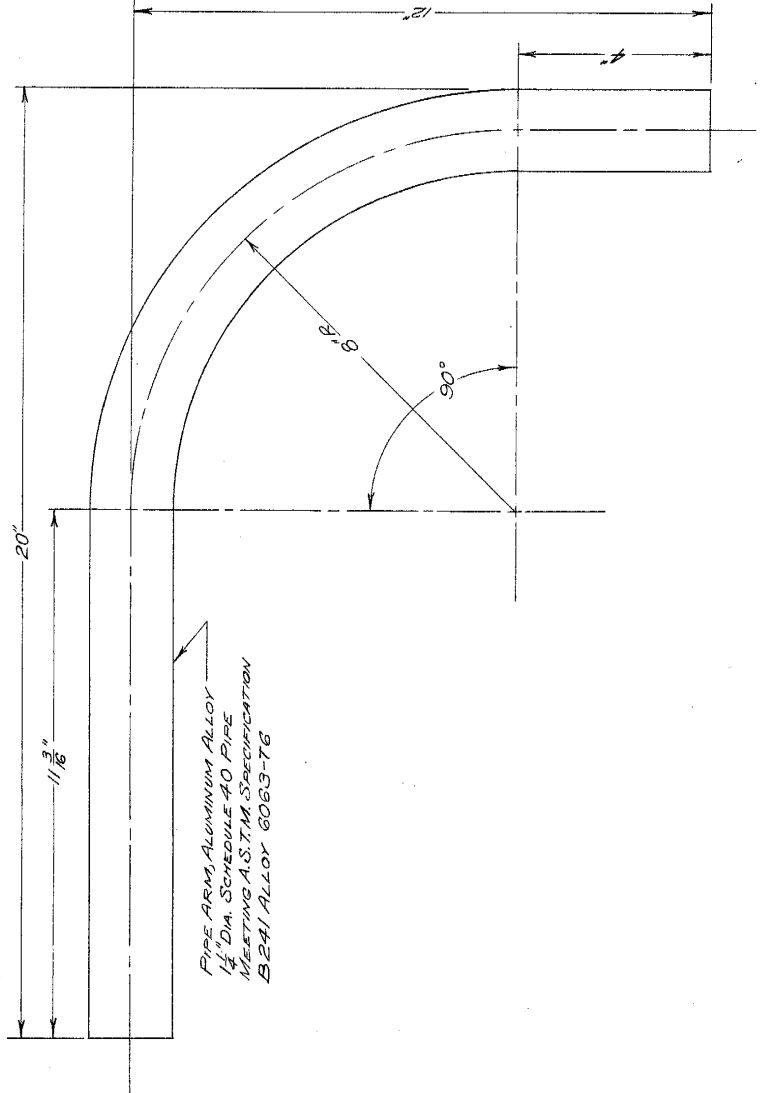
TOP VIEW

REVISED		CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING		21" LIGHTING BRACKET-ARM BRACKET DETAIL	
A	U. W. WILFELDT	DESIGNED	U. W. WILFELDT	DRAWN BY	U. W. WILFELDT
B		CHECKED		DATE	7-15-66
C		APPROVED		SCALE	1/8" = 1"
D		ENGINEER			
E		IN CHARGE			
F		BY			
G		DATE			



NOTES:

1. CLAMPING BOLT TO BE STAINLESS STEEL
HEX BOLT $\frac{1}{2}$ -13 NC. X $2\frac{1}{2}$ LG. WITH
STAINLESS STEEL HEX NUT
2. GROUNDING BOLT TO BE STAINLESS STEEL
HEX BOLT $\frac{3}{8}$ -18 NC. X $\frac{3}{4}$ LG. WITH
STAINLESS STEEL FLAT WASHER & HEX NUT.
3. RUBBER GROMMET 1" O.D. X $\frac{1}{2}$ " I.D. X $\frac{3}{8}$ THICK
WITH $\frac{3}{8}$ X $\frac{3}{8}$ GROOVE.



**21" LIGHTING BRACKET-ARM
ARM DETAIL AND ASSEMBLY**

REVISED	ENGINEER	CHECKED	DATE
A	W. W. W. W.	J. W. W. W.	5-22-79
B	D. O. D. O.	J. W. W. W.	
C	J. W. W. W.	J. W. W. W.	
D	J. W. W. W.	J. W. W. W.	
E	J. W. W. W.	J. W. W. W.	
F	J. W. W. W.	J. W. W. W.	
G	J. W. W. W.	J. W. W. W.	

CHANGE BOLT & NUT
TO STAINLESS STEEL

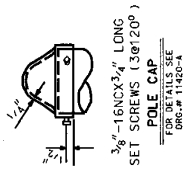
CITY OF CHICAGO
DEPT. OF STREETS AND SANITATION
DIVISION OF ELECTRICAL ENGINEERING

ENGINEER
J. W. W. W.
DRG. NO.
6241

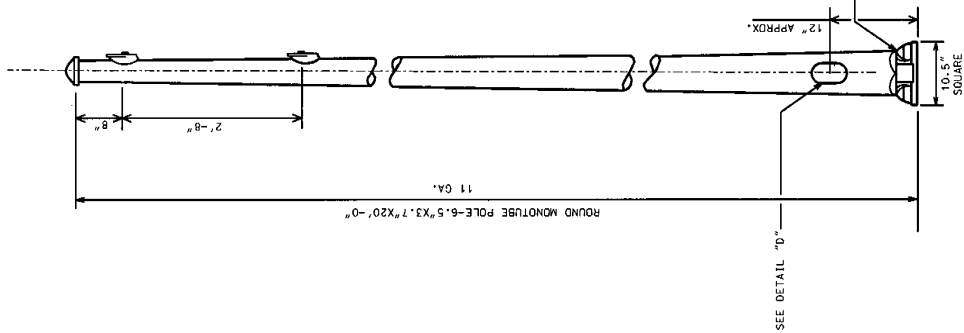
DATE
7-15-68

SCALE
1/2" = 1"

PIPE ARM, ALUMINUM ALLOY
1/4" DIA. SCHEDULE 40 PIPE
MEETING A.S.T.M SPECIFICATION
B241 ALLOY 6063-T6

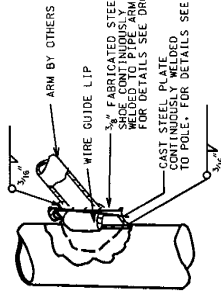


3/8" - 16NCX3/4" LONG
SET SCREWS (30720P)
POLE CAP
TRW # 11432-4
TRW # 11432-4



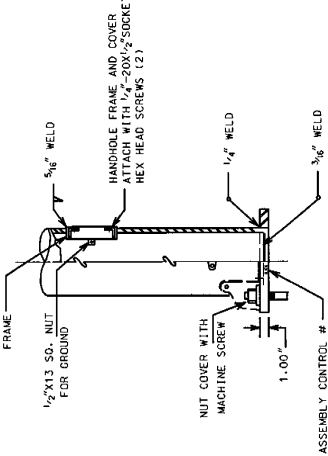
ROUND MONOTUBE POLE-6.5"X3.7"X20'-0"

SEE DETAIL "D"

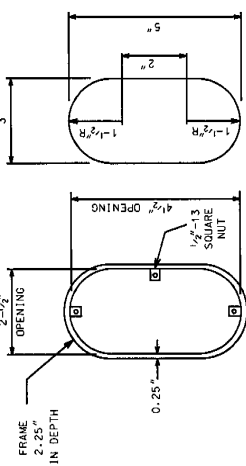


SECTION AT POLE PLATE

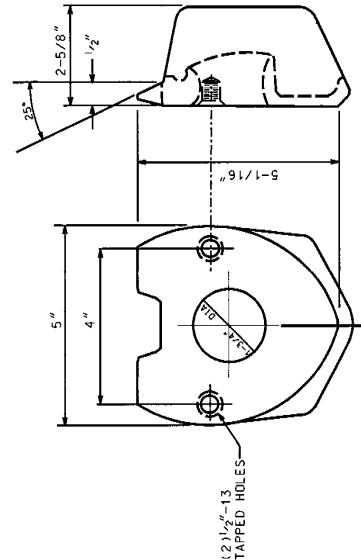
CAST STEEL PLATE CONTAINING HOLES TO POLE. FOR DETAILS SEE DRG. #659



DETAIL "D"

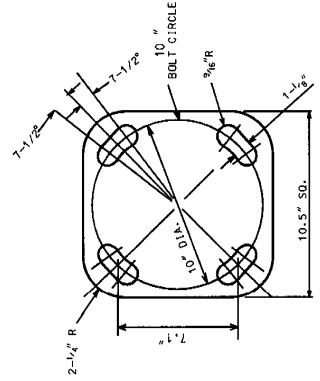


HANDHOLE DETAIL



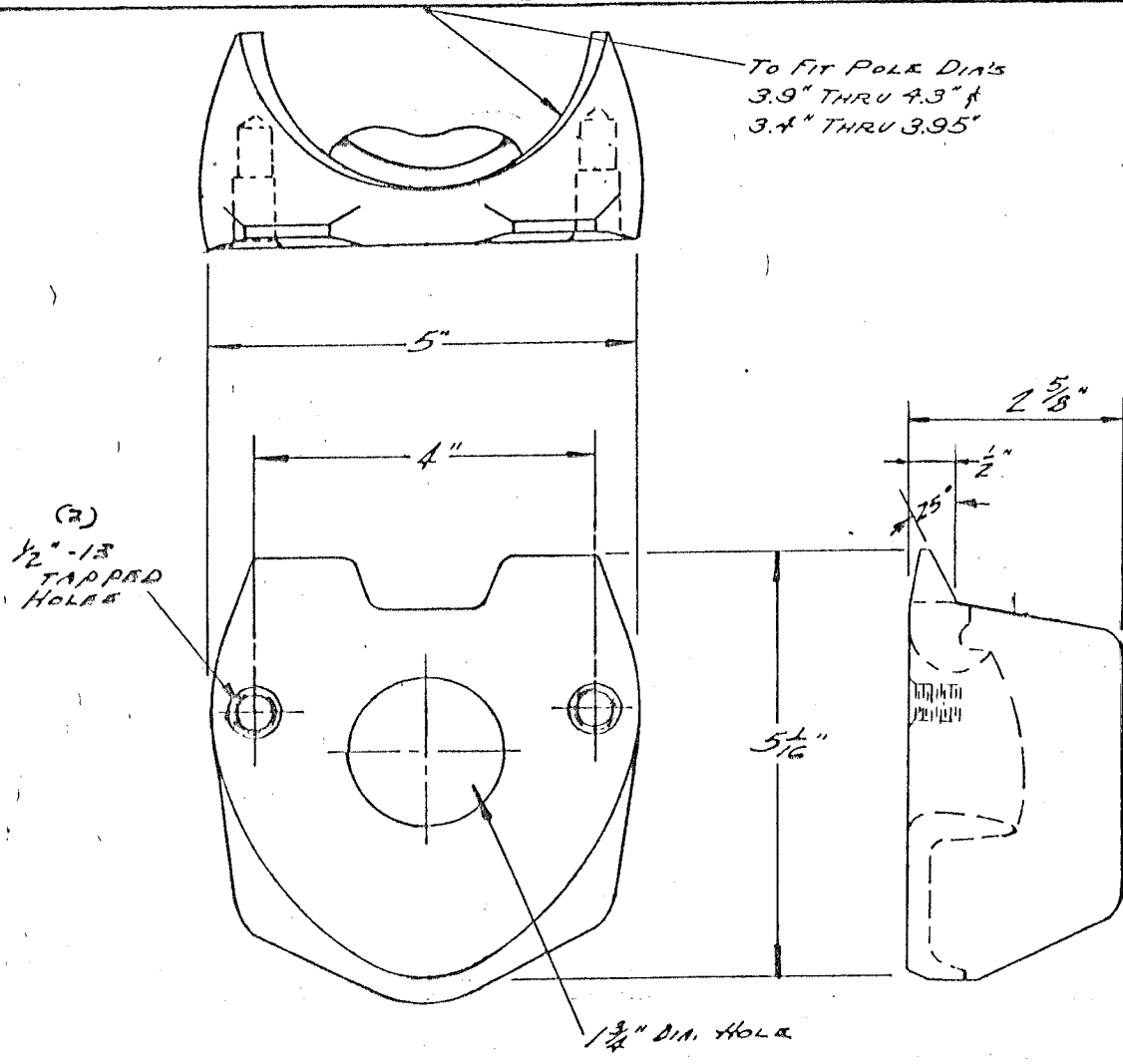
2 BOLT MAST ARM ATTACHMENT

FOR DETAILS SEE DRG. # 659 MATERIAL: CAST STEEL



DETAIL "A"
BOLT SLOTS

3.7" X 6.5" STEEL/20'-0" POLE	
11 GAUGE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: ROBERT IVY	ENGINEER: RON POOL
SUPERVISING ENGINEER: ROBERT CARTER	ELEC. DESIGN ENGR. <i>[Signature]</i>
ENGINEER OF ELECTRICITY: <i>[Signature]</i>	DWG. NO. 652
GEN'L Supt. OF ELECTRICITY: <i>[Signature]</i>	DEPUTY COMMISSIONER: <i>[Signature]</i>
10-03-01	



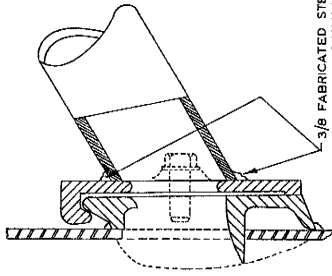
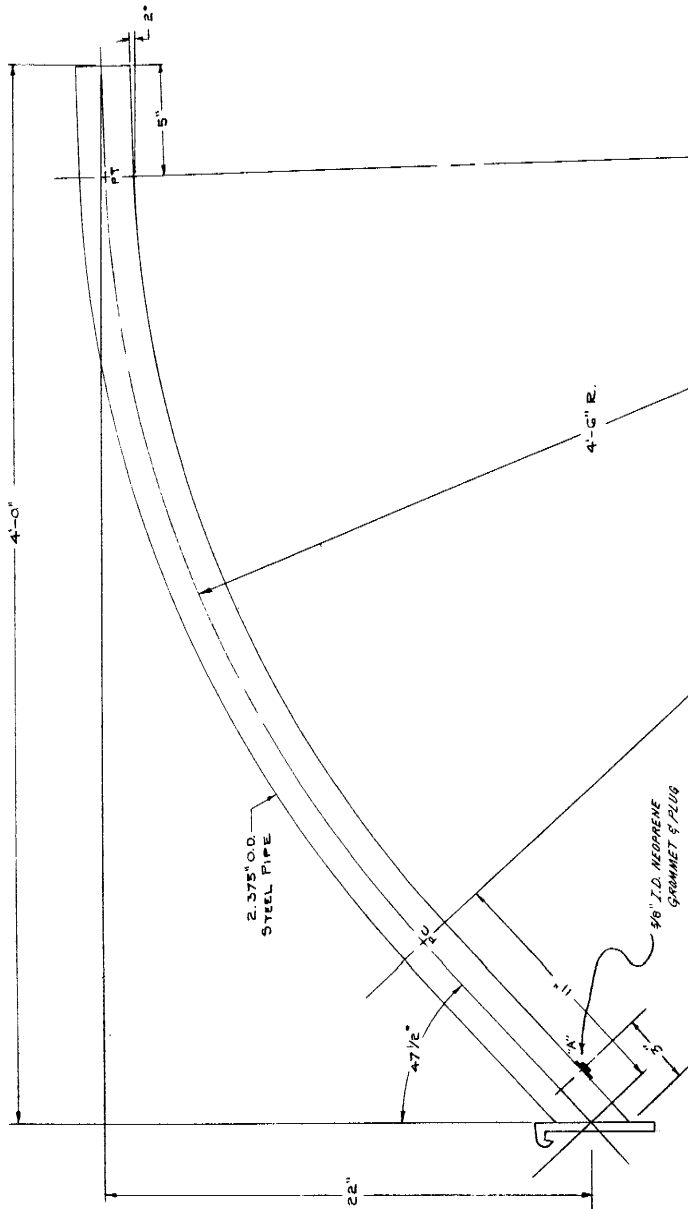
To Fit Pole Dia's
 3.9" THRU 4.3" \pm
 3.4" THRU 3.95"

(2)
 1/2" - 13
 TAPPED
 HOLES

1 3/4" DIA. HOLE

MATERIAL: CAST STEEL

A		J.O'C. MATERIAL NOTE ADDED.		
2 BOLT MAST ARM ATTACHMENT POLE PLATE DETAILS				
REVISED		CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING		
A B C D E F G	5-27-76	DRAWN J. WANLFELDT	CHECKED U. BORE	
		ENGINEER J. BORE		
		DRG. NO. 659		
		Supt. of Const. John J. Keely		
		Deputy Comm.		
		SIZE 8 1/2" x 14"	SCALE	DATE 10-25-66



3/8 FABRICATED STEEL SHOE
CONTINUOUSLY WELDED TO
PIPE ARM FOR DETAILS
SEE DRG. 724

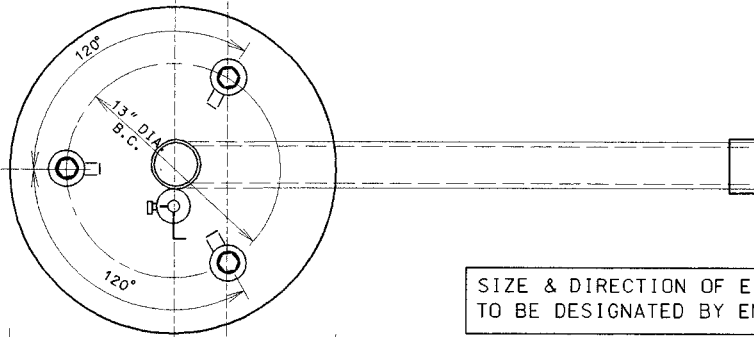
— MAST ARM —
SCALE 5/8"=1'

4' STEEL MAST ARM WITH 2 BOLT MAST ARM ATTACHMENT	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION	
DESIGNED BY M. DEBARTOLO	CHECKED BY V. BORE
DRAWN BY J. [Signature]	ENGINEER J. [Signature]
DATE 10-26-66	PROJECT NO. 661
SCALE 1/8" = 1'-0"	DEPT. COMM. SCALE

REVISED	
A	
B	
C	
D	
E	
F	
G	

ORIENTATION OF BASE
TO BE DESIGNATED
BY ENGINEER

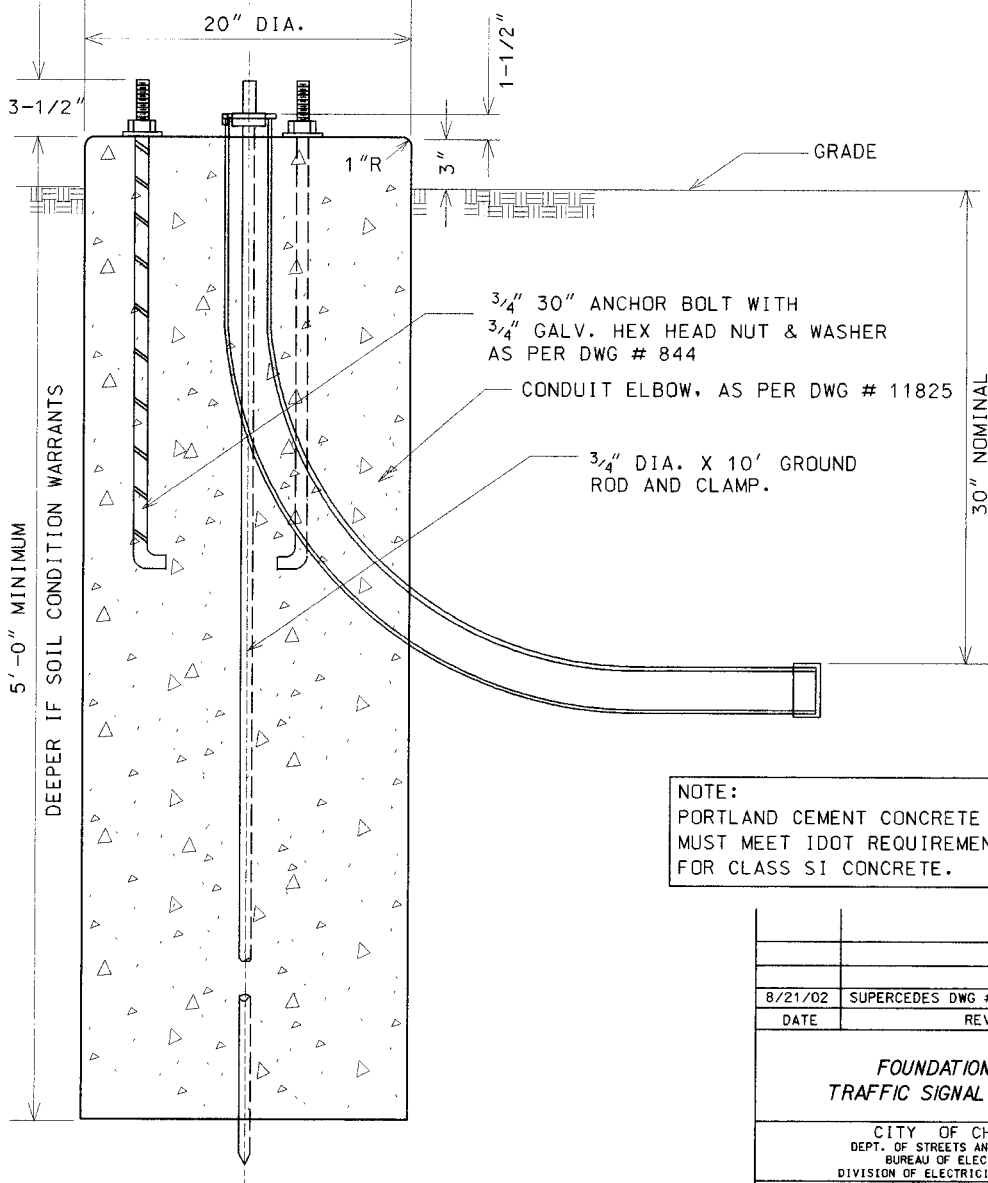
C/L OF BOLTS TO BE PERPENDICULAR TO
ENTERING LATERALS OR AS DESIGNATED
BY CITY ENGINEER.



SIZE & DIRECTION OF ELBOWS
TO BE DESIGNATED BY ENGINEER.

ALL DIMENSIONS MUST BE MAINTAINED
EXCEPT WHERE NOTED OTHERWISE.

TOP VIEW



5'-0" MINIMUM
DEEPER IF SOIL CONDITION WARRANTS

3/4" 30" ANCHOR BOLT WITH
3/4" GALV. HEX HEAD NUT & WASHER
AS PER DWG # 844

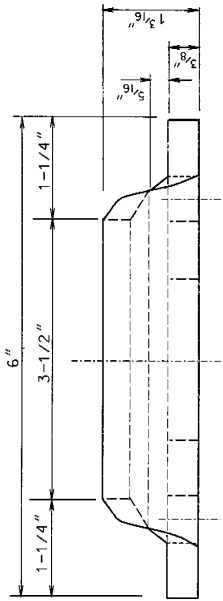
CONDUIT ELBOW, AS PER DWG # 11825

3/4" DIA. X 10' GROUND
ROD AND CLAMP.

NOTE:
PORTLAND CEMENT CONCRETE
MUST MEET IDOT REQUIREMENTS
FOR CLASS SI CONCRETE.

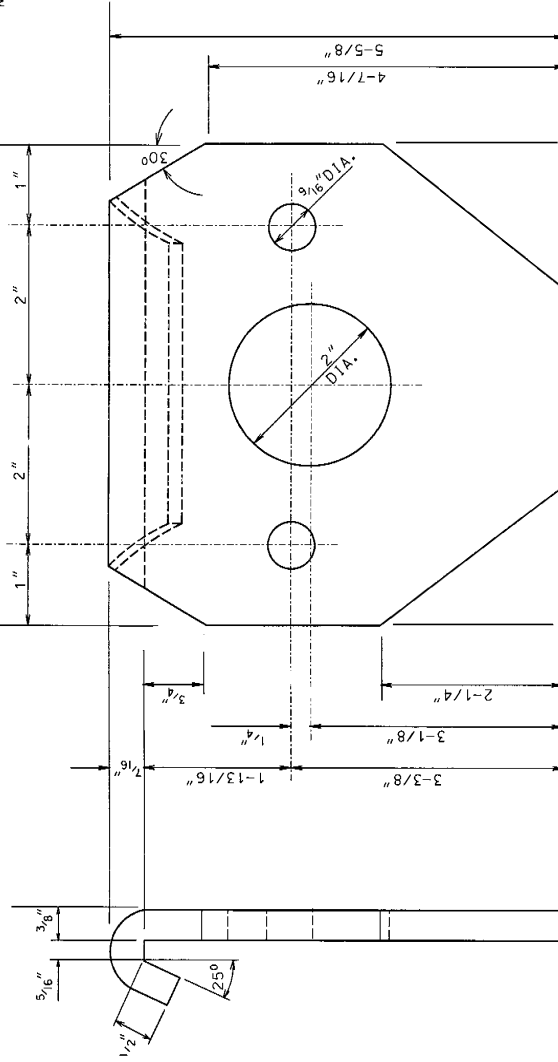
ELEVATION

8/21/02		SUPERCEDES DWG #709 DRAWN 7/22/80	
DATE	REVISION		
FOUNDATION FOR TRAFFIC SIGNAL PEDESTAL			
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING			
DRAFTSMAN: B. GARNSEY	CHIEF DRAFTSMAN: R. CARTER	ENGINEER: B. GARNSEY	
ELECTRICAL ENGINEER			DRAWING NO.
ENGINEER OF ELECTRICITY			709
GENERAL SUPERINTENDENT			
DEPUTY COMMISSIONER			DATE: 8/21/02
SIZE: 11" x 17"	SCALE: NONE		



TOP VIEW

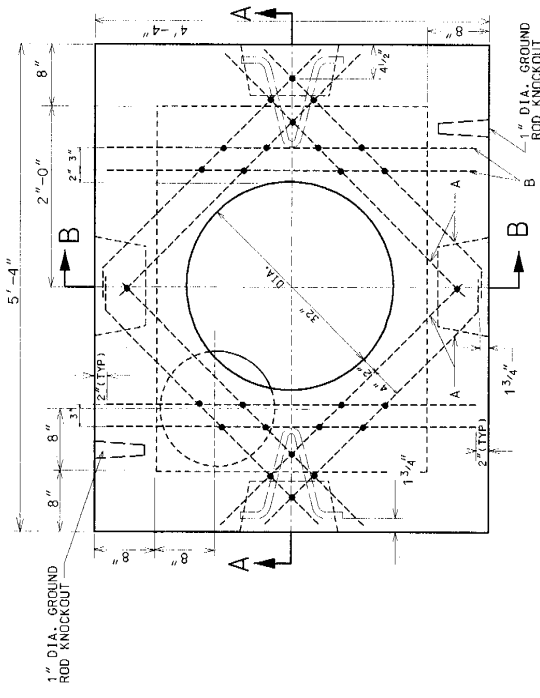
NOTE: REMOVE ALL SHARP EDGES
 MATERIAL: HOT ROLLED STEEL
 ASTM A-36



FRONT VIEW

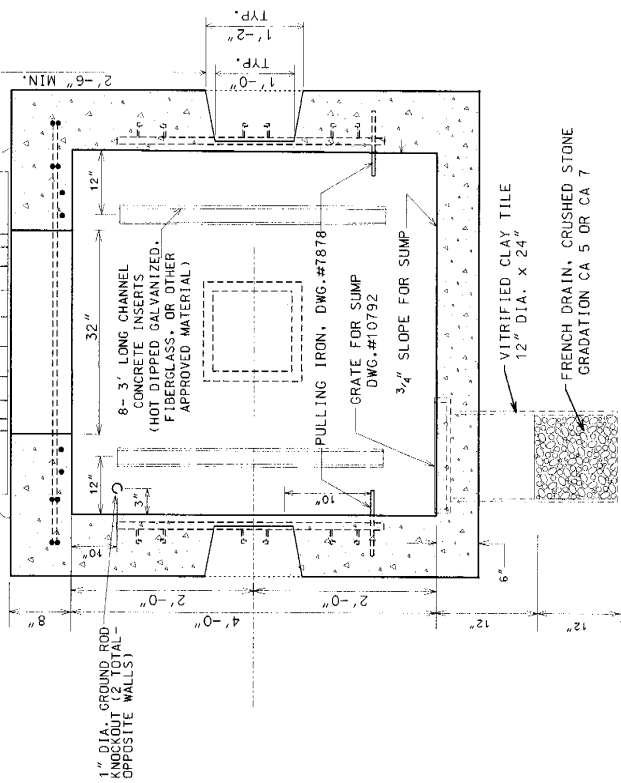
SIDE VIEW

03-01-02	REDRAWN
TWO BOLT MAST ARM ATTACHMENT (BRACKET DETAILS)	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAWN BY: ROBERT IVY	ENGINEER: RON POOL
SUPERVISING ENGINEER: ROBERT CARTER	ENGINEER: RON POOL
ENGINEER OF ELECTRICITY: DEPT. SUPV. OF ELECTRICITY	DWG. NO. 724
DEPUTY COMMISSIONER: <i>Blair A. Murphy</i>	DATE: 03-01-73
SIZE:	SCALE: NONE



ROOF PLAN

SEWER BRICK OR CONCRETE COLLAR - LAYERS AS REQ.
 FRAME AND COVER DWG. # 10927, 874



SECTION A-A

EXCAVATION (CONSTRUCTION INFORMATION)

COMPLETE MANHOLE	5.0 CU. YDS.
NEW ROOF ONLY	2.0 CU. YDS
SHEETING MANHOLE	150.0 SQ. FT.

#5 REINFORCING BARS

BAR	LENGTH	NO. OF RODS	TOTAL FT.
A	2'-9"	8	22'-0"
B	4'-0"	4	16'-0"

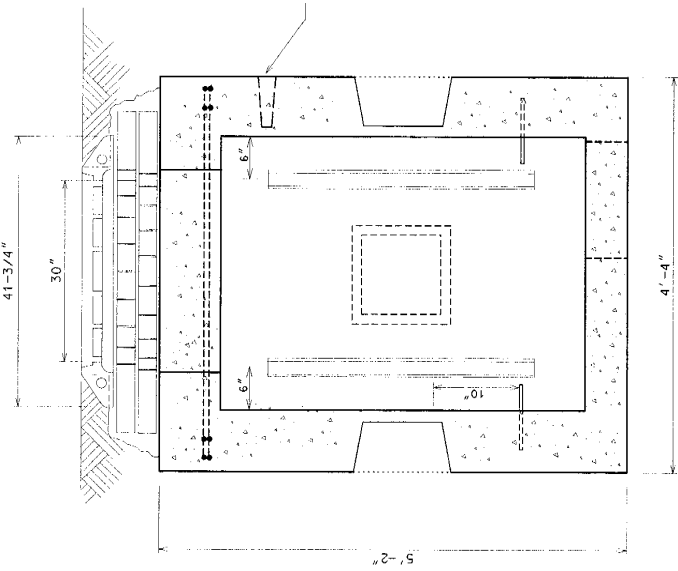
MATERIALS FOR ROOF ONLY

CONCRETE	0.5 CU. YDS.
REINFORCING BARS #5	38'

DRG.	MATERIAL	CODE	SIZE	No. Req'd
	FORM FOR MANHOLE	17-6671-6680	3x4x4	1
	CONDUIT END BELL	17-6668-5383	AS REC.	
	TILE, SEWER	39-4038-32000	12"x24"	
	SLAB BOLSTER		2" 20'	
	BAR, REINFORCING	20-5472-9650	3/8" 138'	
	TIE WIRE	13-9938-6106	#20GA. 35'	
7878	PULLING IRON	02-4483-6970	3/4" 2	
	CONCRETE	05-3267-2940	3 CU. YDS	
	SEWER BRICK	08-1482-9720	STD. 50	
10792	GRATE FOR SUMP	02-4368-7100	15" 1	
	GROUND ROD	09-7796-9200	3/4"x10' 1	
	GROUND ROD CLAMP	09-2636-3240	3/4" 1	
	CRUSHED STONE	05-9087-5471	3/4" ONE BAG	
874	MANHOLE FRAME	02-4299-5524	30" 1	
10927	MANHOLE COVER	02-4574-5040	30" 1	
	CONC. CHANNEL INSERT	02-4574-5040	3" 8	

NOTES:

1. PRECAST MANHOLES MUST BE PROVIDED WITH CHANNEL INSERTS, PULLING IRONS, AND CONDUIT KNOCK-OUTS.
2. ALL CONCRETE MUST BE PORTLAND CEMENT CONCRETE MEETING IDOT REQUIREMENTS FOR CLASS PC CONCRETE FOR PRE-CAST STRUCTURES, OR CLASS S1 CONCRETE FOR CAST-IN-PLACE STRUCTURES.
3. REINFORCING BARS MUST MEET ASTM A615 GRADE 60.



SECTION B-B

8/21/02 SUPERCEDES DWG. 729 DATED JAN 12, 1996
 1/12/96 SUPERCEDES DWG. 729 DATED NOV. 21, 1973

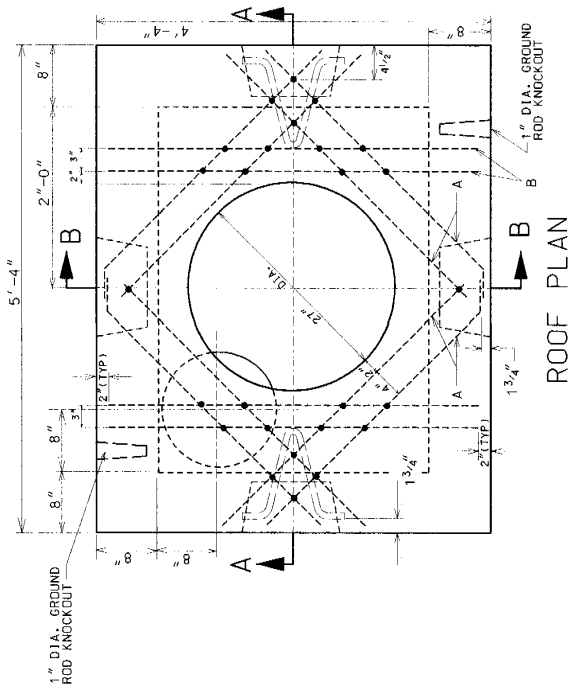
DATE: _____ REVISION: _____

3' x 4' x 4'
CONCRETE MANHOLE
WITH 30" FRAME AND COVER

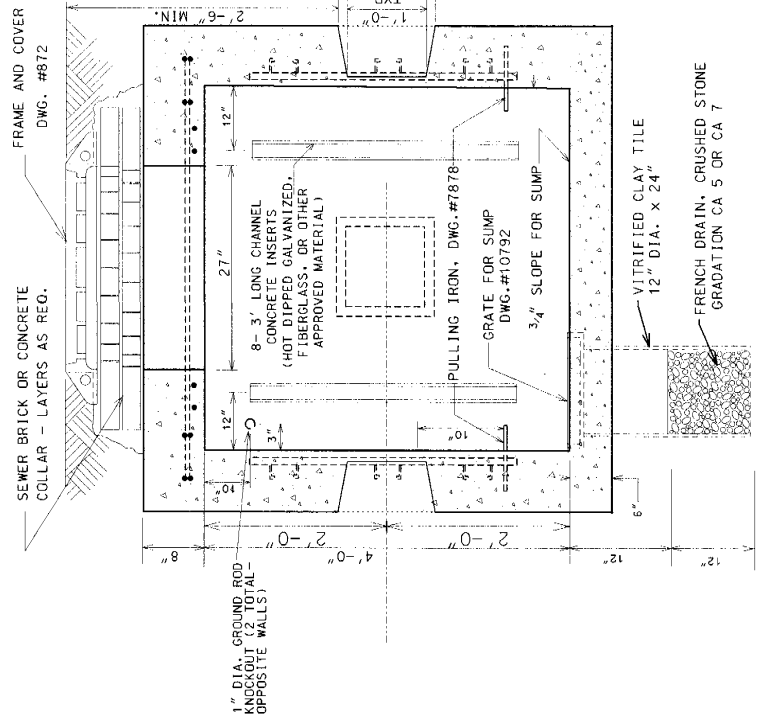
CITY OF CHICAGO
 DEPT. OF STREETS AND SANITATION
 BUREAU OF ELECTRICITY ENGINEERING
 DIVISION OF ELECTRICAL ENGINEERING
 DRAFTSMAN: R. GARNSEY
 ELECTRICAL DESIGN ENGINEER: R. GARNSEY
 GENERAL SUPERVISOR: _____
 DEPUTY COMMISSIONER: _____

DRAWING NO. **729**

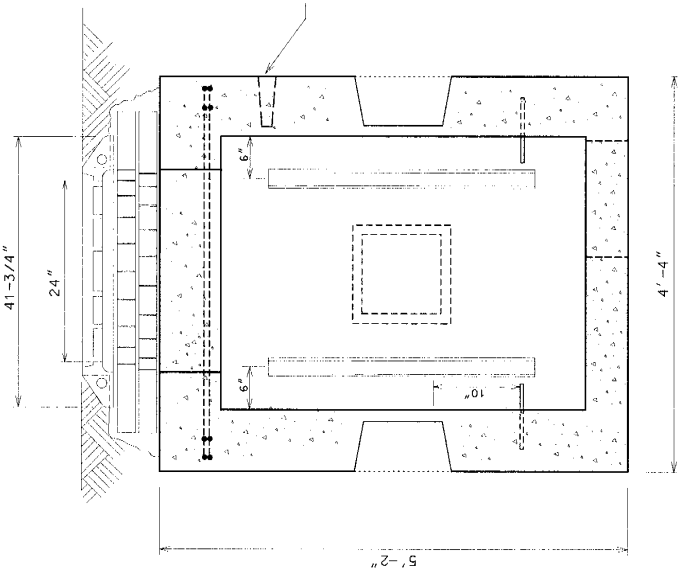
DATE: 8/21/02
 SCALE: NONE



ROOF PLAN



SECTION A-A



SECTION B-B

EXCAVATION (CONSTRUCTION INFORMATION)	
COMPLETE MANHOLE	6.0 CU. YDS.
NEW ROOF ONLY	2.0 CU. YDS.
SHEETING MANHOLE	150.0 SQ. FT.

#5 REINFORCING BARS	
BAR	LENGTH
A	3'-4"
B	4'-0"

MATERIALS FOR ROOF ONLY	
CONCRETE	0.45 CU. YDS.
REINFORCING BARS #5	54'

DRG.	MATERIAL	CODE	SIZE	No. Req.
	FORM FOR MANHOLE	17-6574-6090	3x4x4	1
	CONDUIT END BELL	17-6648-9320	AS REC.	
	TILE, SEWER	39-4038-3200	12 7/8" x 4"	1
	SLAB BOLSTER		2" x 20'	
	BAR, REINFORCING	20-5472-9650	5/8" x 15'	
	TIE WIRE	13-9938-6106	#200A, 35'	
7878	PULLING IRON	02-4483-6970	3/4" x 10'	2
	CONCRETE	05-3267-2940	3 CU. YDS.	
	SEWER BRICK	05-1452-9720	STD. 50	
0792	GRATE FOR SUMP	02-4368-7100	15" x 15" x 1"	1
	GROUND ROD	09-7796-9200	3/4" x 10'	1
	GROUND ROD CLAMP	09-2636-3240	3/4" x 1"	1
	CRUSHED STONE	05-9087-5471	3/4" x 3/4" x 3/4"	1
872	MANHOLE FRAME	02-4239-5524	24" x 24" x 4"	1
872	MANHOLE COVER	02-4574-5040	24" x 24" x 1"	1
	CONC. CHANNEL INSERT	02-4574-5040	3" x 3" x 8"	1

NOTES:

1. PRECAST MANHOLES MUST BE PROVIDED WITH CHANNEL INSERTS, PULLING IRONS, AND CONDUIT KNOCK-OUTS.
2. ALL CONCRETE MUST BE PORTLAND CEMENT CONCRETE MEETING 100T REQUIREMENTS FOR CLASS PC CONCRETE FOR PRE-CAST STRUCTURES, OR CLASS S1 CONCRETE FOR CAST-IN-PLACE STRUCTURES.
3. REINFORCING BARS MUST MEET ASTM A615 GRADE 60.

8/21/02 SUPERCEDES DWG. 730 DATED JAN 12, 1996
 1/12/96 SUPERCEDES DWG. 730 DATED NOV. 21, 1973

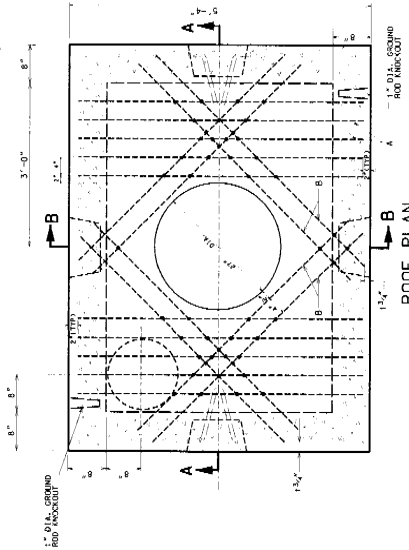
DATE: _____ REVISION: _____

3' x 4' x 4'
CONCRETE MANHOLE
WITH 24" FRAME AND COVER

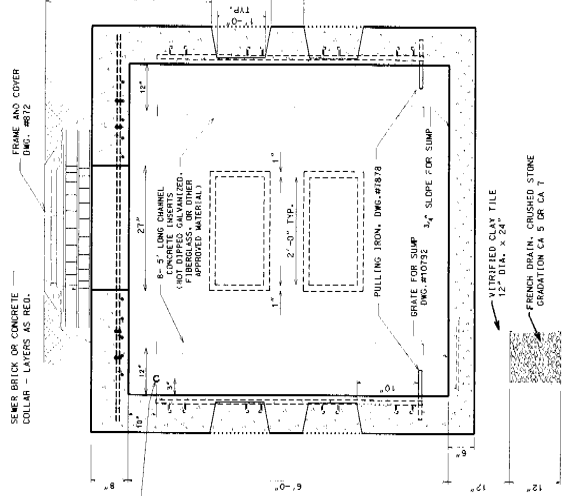
CITY OF CHICAGO
 DEPT. OF STREETS AND SANITATION
 BUREAU OF ELECTRICAL ENGINEERING
 DIVISION OF ELECTRICAL ENGINEERS
 DRAFTSMAN: B. GARNSEY
 CHECKED: R. CARTER
 ELECTRICAL DESIGN ENGINEER: B. GARNSEY
 ENGINEER OF ELECTRICITY: _____
 GENERAL SUPERINTENDENT: _____
 DEPUTY COMMISSIONER: _____

DRAWING NO. **730**

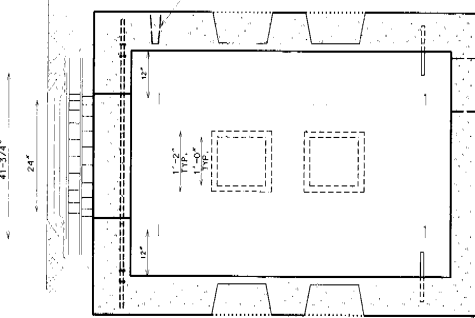
DATE: 8/21/02
 SCALE: NONE



ROOF PLAN



SECTION A-A



SECTION B-B

EXCAVATION (CONSTRUCTION)

COMPLETE MANHOLE	11.5 CU. YDS.
NEW ROOF ONLY	2.2 CU. YDS.
SHEETING MANHOLE 254 SQ. FT.	

#5 REINFORCING BARS

BAR	LENGTH	NO. OF ROBS	TOTAL FT.
A	5'-0"	10	50'-0"
B	5'-6"	8	44'-0"

MATERIALS FOR ROOF ONLY

CONCRETE	1.25 CU. YDS.
REINFORCING BARS #5	94'-0"

DRG.	MATERIAL	CODE	SIZE	No. Req.
	FORM FOR MANHOLE	11-464-5000	4' x 6' x 6'	1
	CONDUIT END BELL	11-464-5000	4"	AS
	TELE. SEWER	19-4018-3200	12"/24"	50
	SLAB BOLSTER	20-5172-2650	2" x 25'	
	BAR, REINFORCING	20-5172-2650	5/8" x 34'	
	TIE W/RE	13-9938-8108	#20GA. 45'	
	PULLING IRON	22-4483-6970	3/4" x 2	
	CONCRETE	05-3287-2940	8'-5" CU. YDS.	
	SEWER BRICK	05-1462-9120	31D.	50
	10995 GRADE FOR SUMP	02-4388-1100	15' x 1	1
	GROUND ROD	09-7786-2020	3/4" x 10'	1
	GROUND ROD CLAMP	09-2636-3240	3/4"	1
	CRUSHED STONE	05-9067-5471	3/4"	800
	872 MANHOLE FRAME	02-4239-5524	24"	1
	872 MANHOLE COVER	02-4514-5040	24"	1
	CONC. CHANNEL INSERT	02-4574-5040	5'	8

NOTES:
 1. PRECAST MANHOLES MUST BE PROVIDED WITH CHANNEL INSERTS, PULLING IRONS, AND CONDUIT KNOCK-OUTS.
 2. ALL CONCRETE MUST BE PORTLAND CEMENT CONCRETE. ALL CONCRETE REQUIREMENTS FOR CLASS PC CONCRETE FOR PRE-CAST STRUCTURES, OR CLASS S1 CONCRETE FOR CAST-IN-PLACE STRUCTURES.
 3. REINFORCING BARS MUST MEET ASTM A615 GRADE 60.

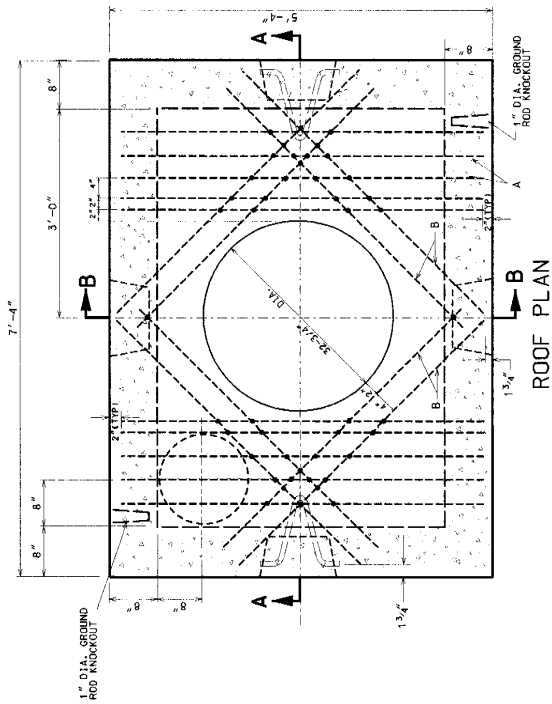
DATE	10/8/02	SUPERCEDES DWG. 732 DATED 3/21/74
REVISION		
4' x 6' x 6' CONCRETE MANHOLE WITH 24" FRAME AND COVER		
CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS SUPERVISOR OF UTILITIES		
DRAWN BY	B. GARNSEY	CHECKED BY
ELECTRICAL DESIGN	R. CARTER	ENGINEER
ENGINEER-IN-CHARGE	B. GARNSEY	DRAWING NO.
DESIGNED BY		
DEPARTMENT	UTILITIES	
SIZE	11" x 22"	SCALE
		DATE
		10/08/02

732

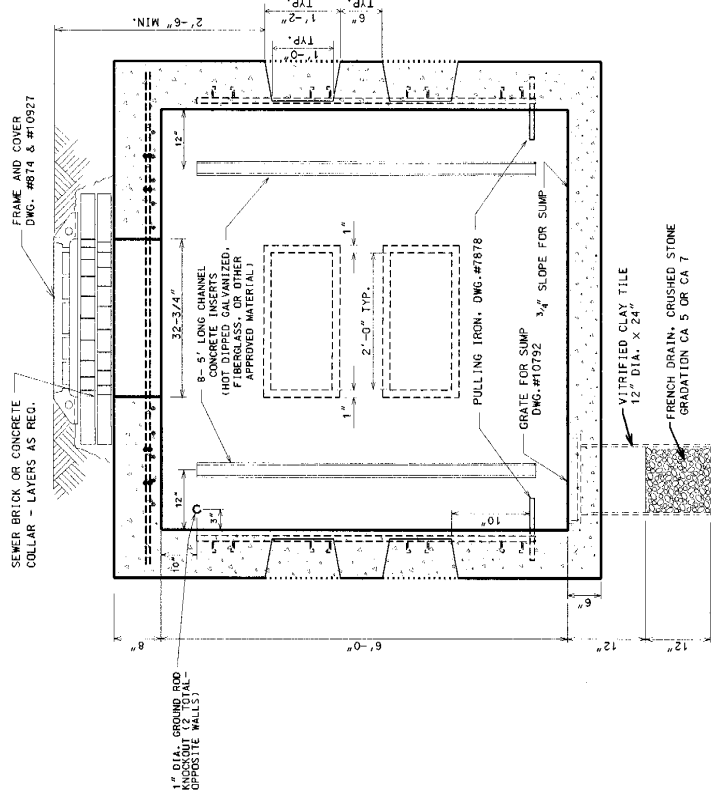
EXCAVATION (CONSTRUCTION INFORMATION)	
COMPLETE MANHOLE	11.5 CU. YDS.
NEW ROOF ONLY	2.2 CU. YDS.
SHEETING MANHOLE	254 SQ. FT.

#5 REINFORCING BARS	
BAR LENGTH	NO. OF RODS
A 5'-0"	10
B 5'-0"	8

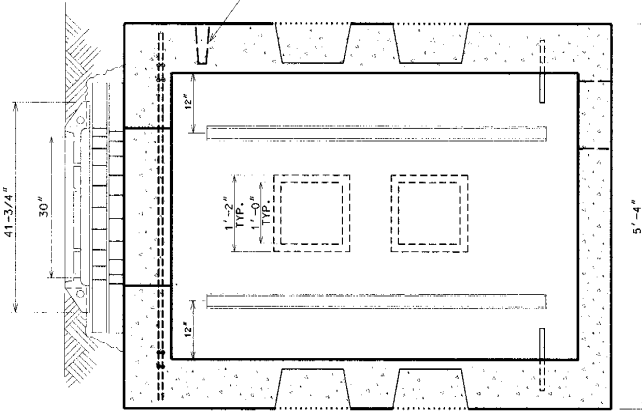
MATERIALS FOR ROOF ONLY	
CONCRETE	1.25 CU. YDS.
REINFORCING BARS #5	90'-0"



ROOF PLAN



SECTION A-A



SECTION B-B

DRG.	MATERIAL	CODE	SIZE	No. Req.
	FORM FOR MANHOLE	11-4571-6500	4' x 6' x 6'	1
	CONDUIT END BELL	11-6648-5320	AS	RECD.
	TILE, SEWER	39-4038-3200	12" x 24"	50
	SLAB BOLSTER		2"	25'
	BAR, REINFORCING	20-5472-9650	5/8" ø	94'
	TIE WIRE	13-9938-6106	#20GA.	45'
7878	PULLING IRON	02-4483-6970	3/4" ø	2
	CONCRETE	05-3267-2940	CU. YDS.	8.5
	SEWER BRICK	05-1452-9720	STD.	50
10792	GRATE FOR SLUMP	02-4368-7100	15" ø	1
	GROUND ROD	09-7796-9200	3/4" x 10'	1
	GROUND ROD CLAMP	09-2636-3240	3/4"	1
	CRUSHED STONE	05-9057-5471	3/4"	#605
874	MANHOLE FRAME	02-4299-5524	30"	1
10927	MANHOLE COVER	02-4574-5040	30"	1
	CHNG. CHANNEL INSERT	02-4574-5040	5"	8

NOTES:

1. PRECAST MANHOLES MUST BE PROVIDED WITH CHANNEL INSERTS, PULLING IRONS, AND CONDUIT KNOCK-OUTS.
2. ALL CONCRETE MUST BE PORTLAND CEMENT CONCRETE MEETING 1907 REQUIREMENTS FOR CLASS "C" CONCRETE FOR PRE-CAST STRUCTURES OR CLASS "S1" CONCRETE FOR CAST-IN-PLACE STRUCTURES.
3. REINFORCING BARS MUST MEET ASTM A615 GRADE 60.

DATE	REVISION
10/8/02	SUPERCEDES DWG. 732 DATED 3/21/74

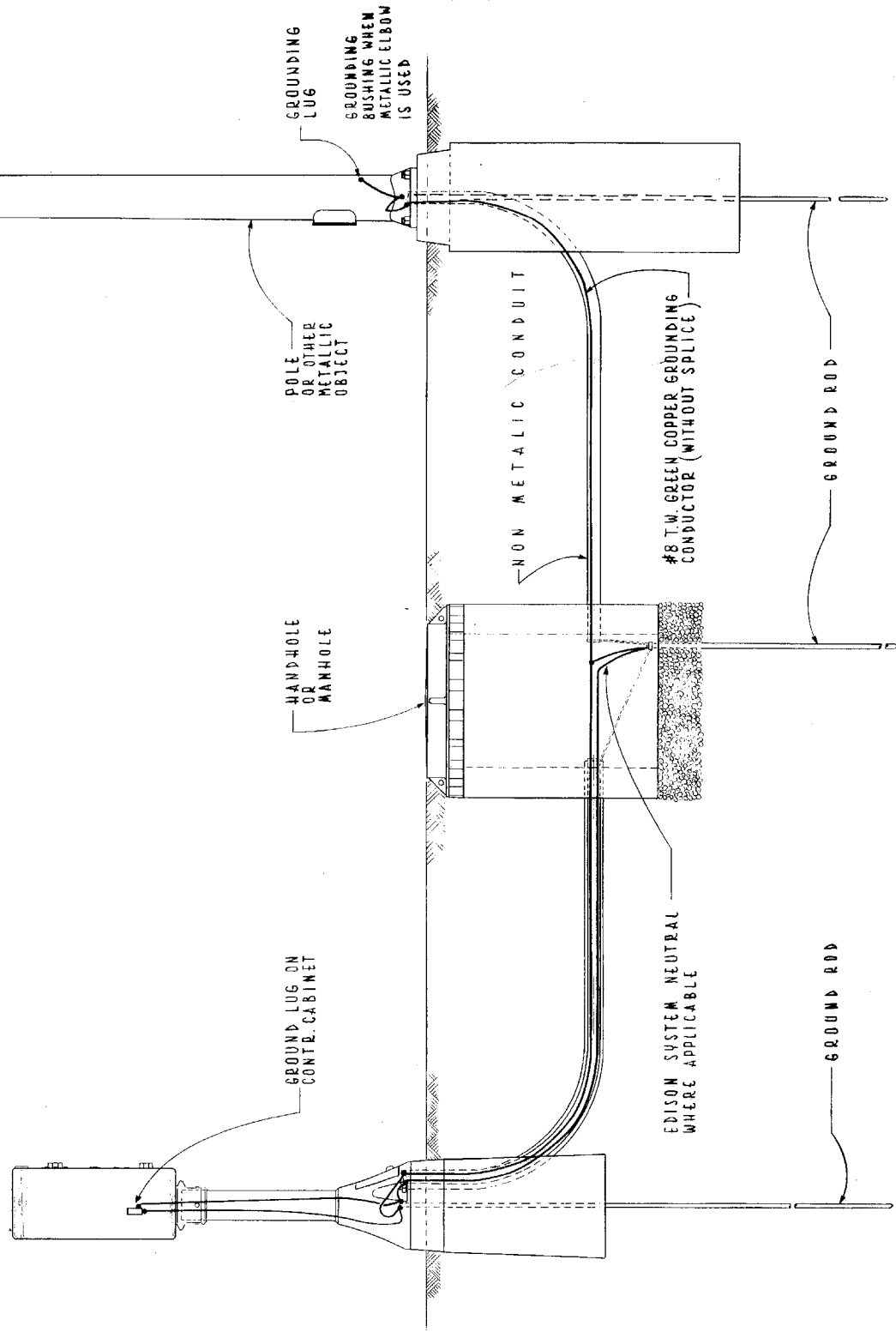
4' x 6' x 6'
CONCRETE MANHOLE
WITH 30" FRAME AND COVER

CITY OF CHICAGO
DEPT. OF PUBLIC WORKS AND SANITATION
DIVISION OF ELECTRICAL ENGINEERING
DRAFTSMAN: B. GARNSEY
ELECTRICAL DESIGN ENGINEER: R. CARTER
ENGINEER-IN-CHARGE: B. GARNSEY
GENERAL SUPERINTENDENT: [Signature]
DEPUTY COMMISSIONER: [Signature]

DRAWING NO. **733**

SIZE: 17" x 22" SCALE: NONE DATE: 10/08/02

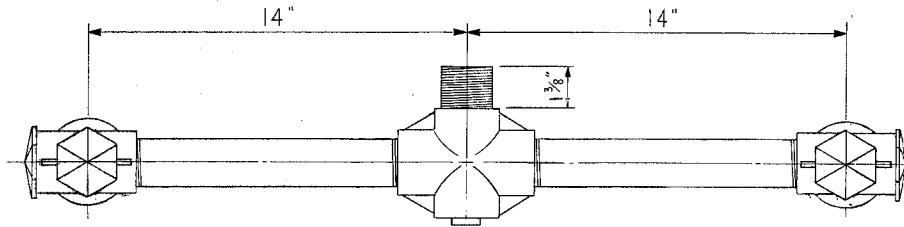
NOTE: TERMINATE ALL METALLIC CONDUIT WITH GROUNDING BUSHING & GROUND TO GROUND ROD
 WHEN METALLIC CONDUIT IS USED DELETE GROUNDING CONDUCTOR.



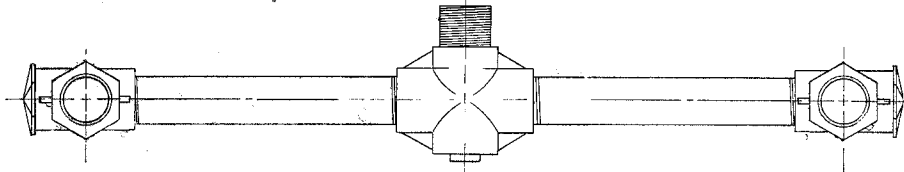
TYPICAL GROUNDING METHODS FOR BUREAU OF ELECTRICITY EQUIPMENT

CITY OF CHICAGO
 DEPT. OF STREETS & SANITATION
 BUREAU OF ELECTRICITY
 DIVISION OF ELEC. ENGINEERING

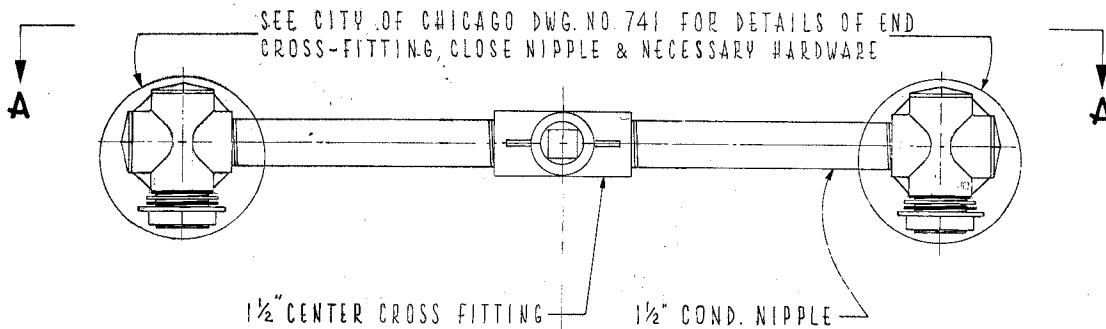
REVISED	DRAWN: E. GERULIS	CHECKED: M. SHINE	ENGINEER: J. O'CONNOR
A	ENG. OF ELEC.		DWG. NO.
B	Supt. of Const. <i>Thomas J. Lehoff</i>		736
C	Supt. of Const. <i>Joseph J. Bickel</i>		
D	Dep. Supt. of Const. <i>Charles E. Bumbler</i>		
E	SIZE: 8 1/2" x 14"	SCALE: 1" = 10'	DATE: 5-12-70



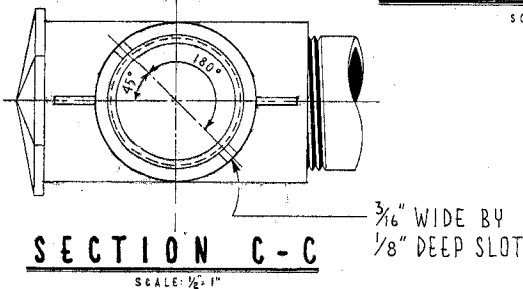
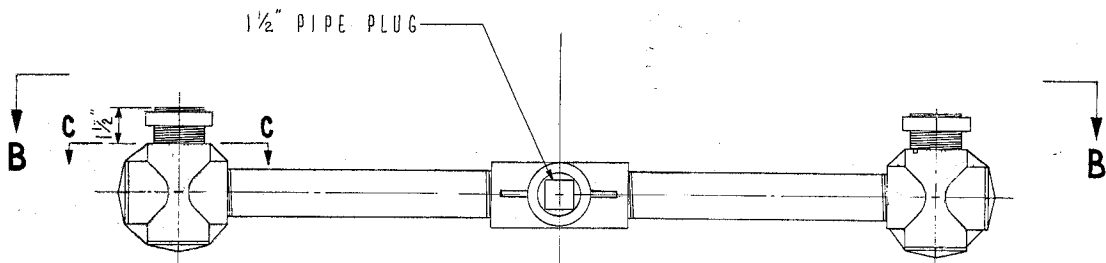
TOP VIEW A - A



TOP VIEW B - B



FRONT VIEW



SECTION C - C

3/16" WIDE BY
1/8" DEEP SLOT

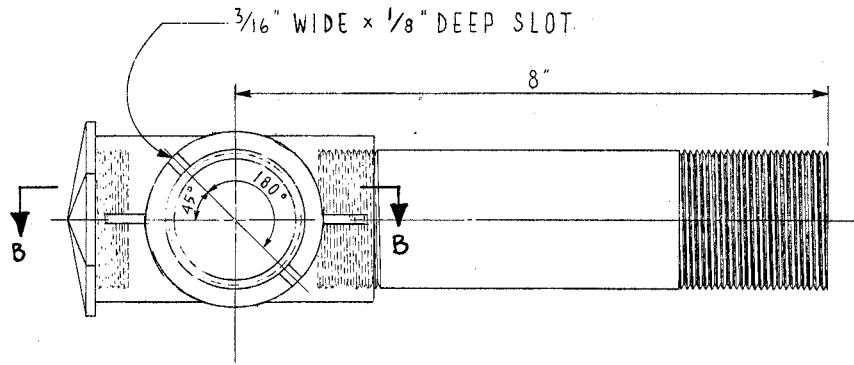
SCALE: 1/2" = 1"

**TRAFFIC SIGNAL
UPPER & LOWER
BRACKET ARM ASSEMBLY**

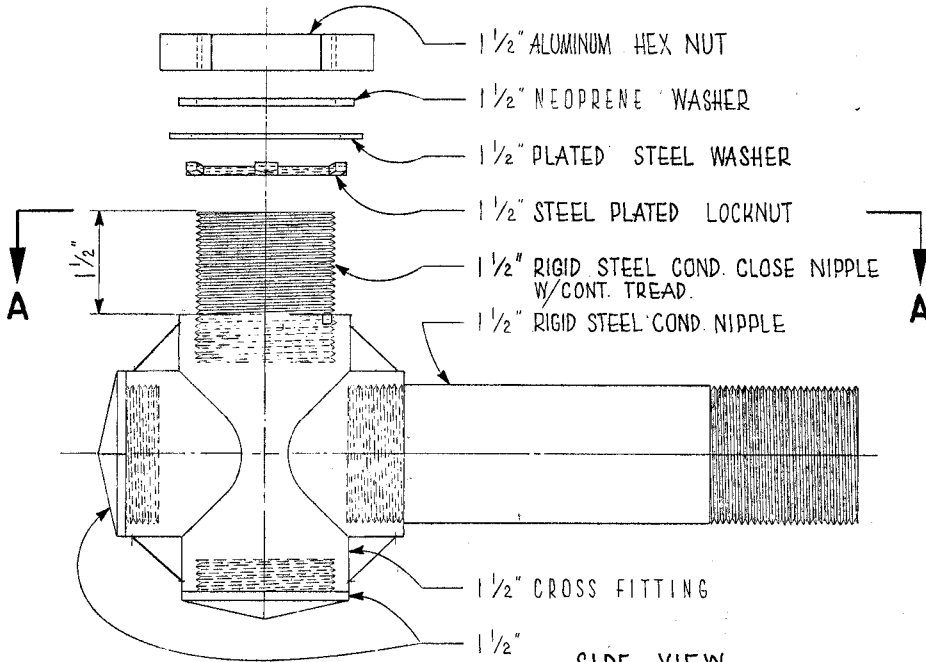
CITY OF CHICAGO
DEPT. OF STREETS & SANITATION
BUREAU OF ELECTRICITY
DIVISION OF ELEC. ENGINEERING

REVISED	DRAWN: E. GERULIS ENG. OF ELEC.	CHECKED: D.C. / m.s.	ENGINEER: L. CUCCI DWG. NO.
A 1-23-1981	<i>Thomas Midluff</i> SUPT. OF CONST.		740
B	<i>Joseph J. Lesnicki</i> MEMBER P.E.M.M.		
C	<i>Charles E. Bursley</i>		DATE: 8-21-74
D	SIZE: 11 x 17	SCALE: AS NOTED	
E			
F			

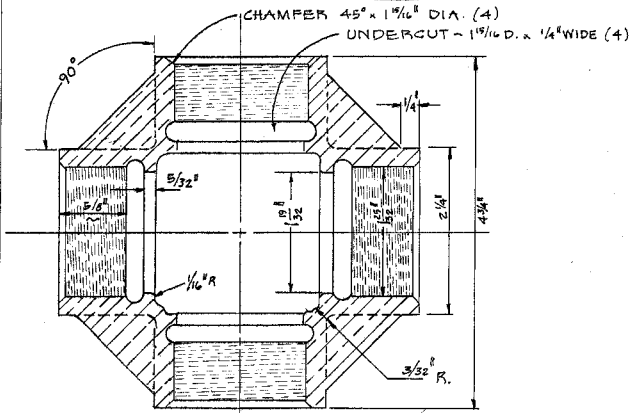
CHANGE TYPE TA CONDULET TO CENTER CROSS & DELETE CENTER CONDUIT



TOP VIEW A - A



SIDE VIEW



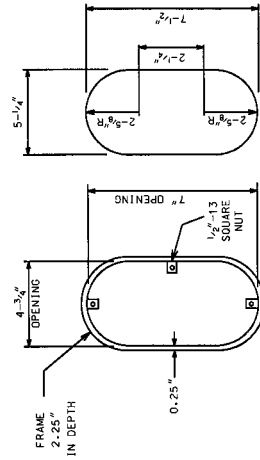
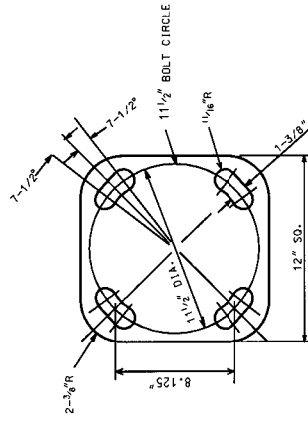
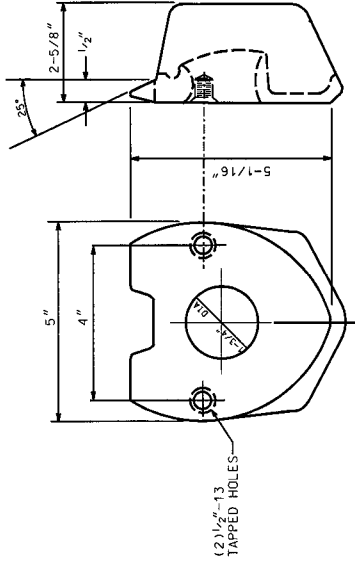
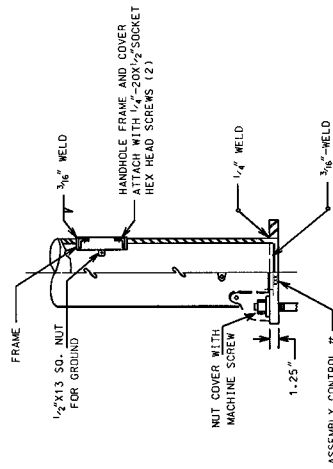
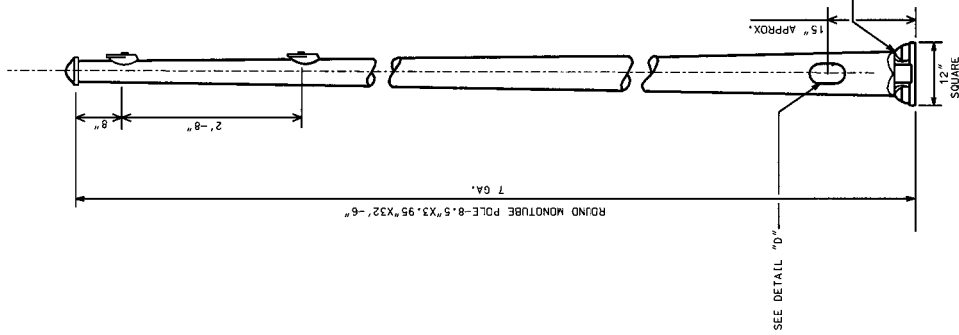
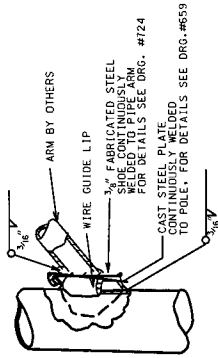
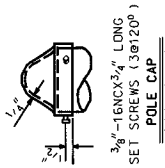
SECTION B-B

TRAFFIC SIGNAL BRACKET ARM ASSEMBLY

CITY OF CHICAGO
DEPT. OF STREETS & SANITATION
BUREAU OF ELECTRICITY
DIVISION OF ELECT. ENGINEERING

DELETE SET SCREWS
ADDED SECTION B-B

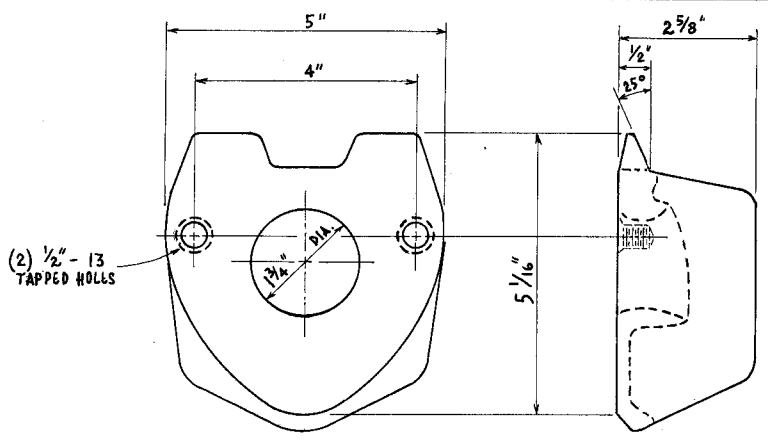
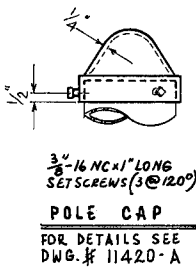
REVISED	DRAWN: <i>E. GERULIS</i>	CHECKED: <i>D.C. / M.S.</i>	ENGINEER: <i>L. CUCCI</i>
A 1-23-81	ENG. OF ELEC.		
B 12-6-85	<i>Thomas Wildoff</i>		741
C	<i>Joseph P. ...</i>		
D	<i>Charles E. Buckley</i>		
E			
F	SIZE: 1/2" x 1/2"	SCALE: 1/2" = 1"	DATE: 8-21-74



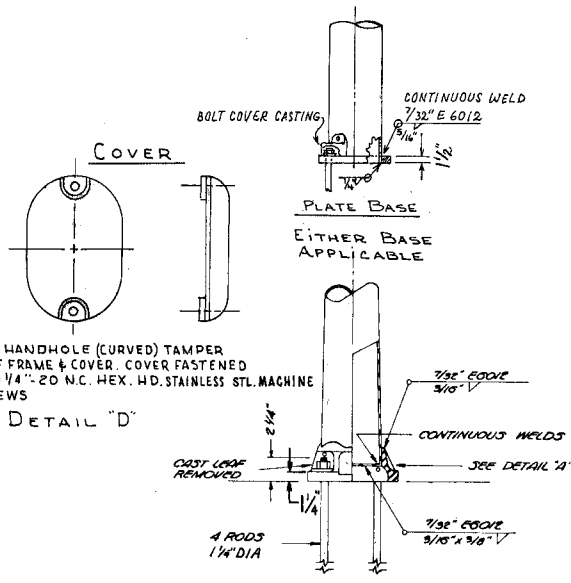
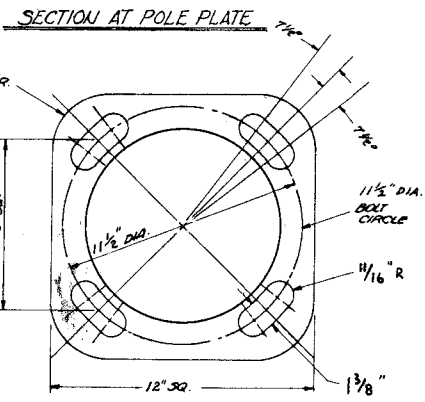
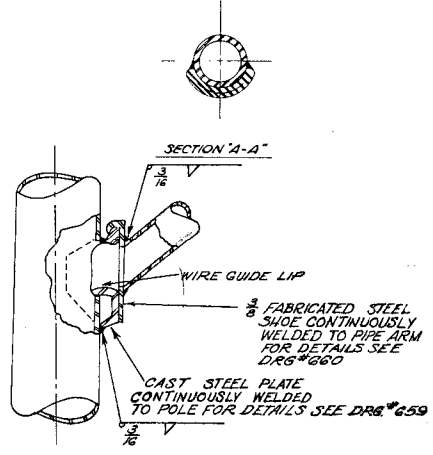
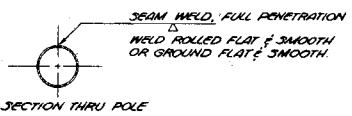
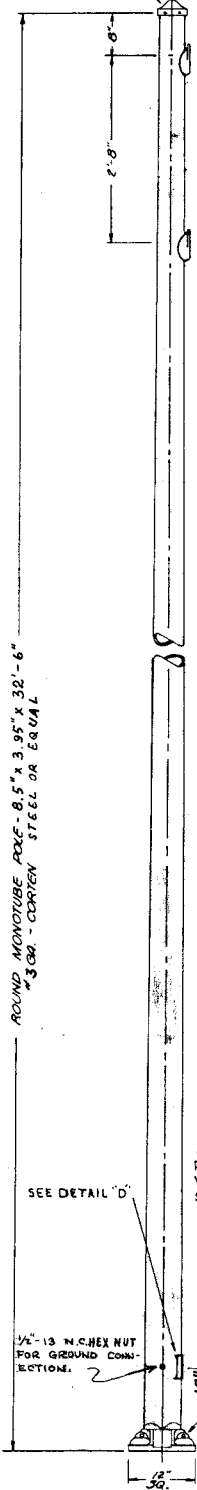
HANDHOLE DETAIL

3.95" X 8.5" STEEL / 32' - 6" POLE 7 GAUGE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
CHIEF DRAFTSMAN: ROBERT IVY	ENGINEER: RON POOL
SUPERVISING ENGINEER: ROBERT CARTER	ELEC. DESIGNER: [Signature]
ENGINEER OF ELECTRICITY: [Signature]	DWG. NO. 762
GENL. Supt. OF ELECTRICITY: [Signature]	10-03-01
DEPUTY DESIGNER: [Signature]	

POLE CAP
THREE 3/8" HD.
SET SCREWS
FOR DETAILS SEE DWG.#11420-A



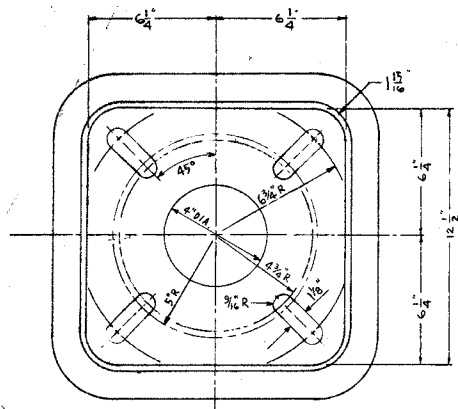
2-BOLT MAST ARM ATTACHMENT
FOR DETAILS SEE DWG. # 659 MATERIAL: CAST STEEL



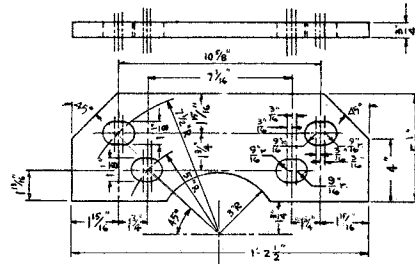
DETAIL "D"

CAST BASE
SCALE: 1" = 1'-0"

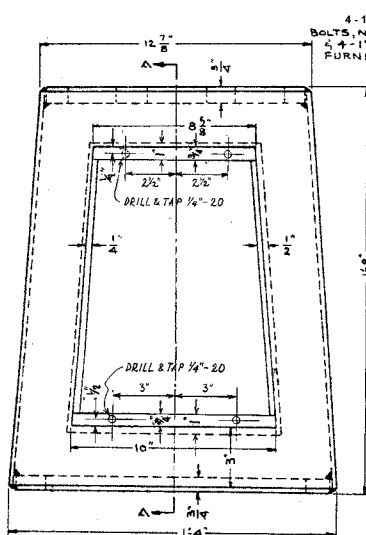
32'-6" MONOTUBE STEEL ANCHOR BASE 3 GA. POLE WITH 2 BOLT MAST ARM ATTACHMENTS			
REVISED	CITY OF CHICAGO		
A	1-4-84	DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
B		DRAWN: E. GERULIS	ENGINEER: M. SHINE
C		ENG. OF ELECTRICALITY: <i>Thomas M. Bluff</i>	ENGINEER: JOHN O'CONNOR
D		SUPV. OF CONST. <i>Charles Reischer</i>	DWG. NO. 763
E		DEBYN DONN <i>Charles E. Bumble</i>	
F		SIZE: 15" x 21"	
G		SCALE: 3/4" = 1'-0"	DATE: MAY 18, 1976



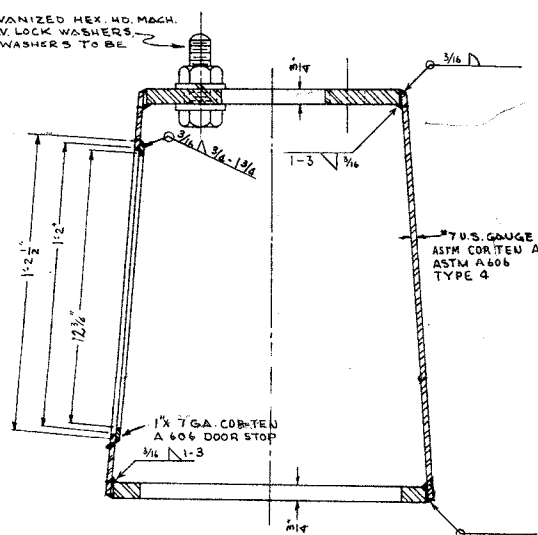
TOP VIEW



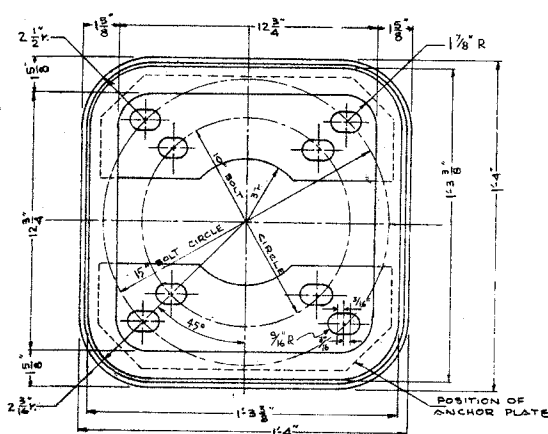
ANCHOR PLATE
2 REQUIRED
FABRICATED FROM 3/4" ASTM A-36 STEEL



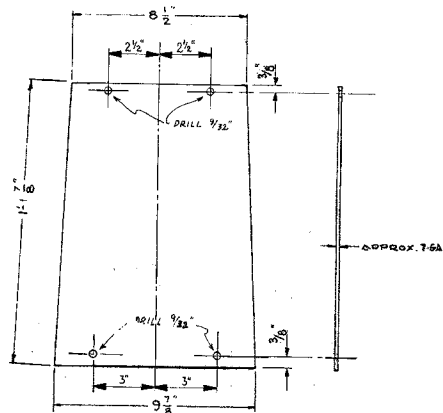
FRONT VIEW



SECTION A-A



BOTTOM VIEW
WITH ANCHOR PLATE IN PLACE



DOOR

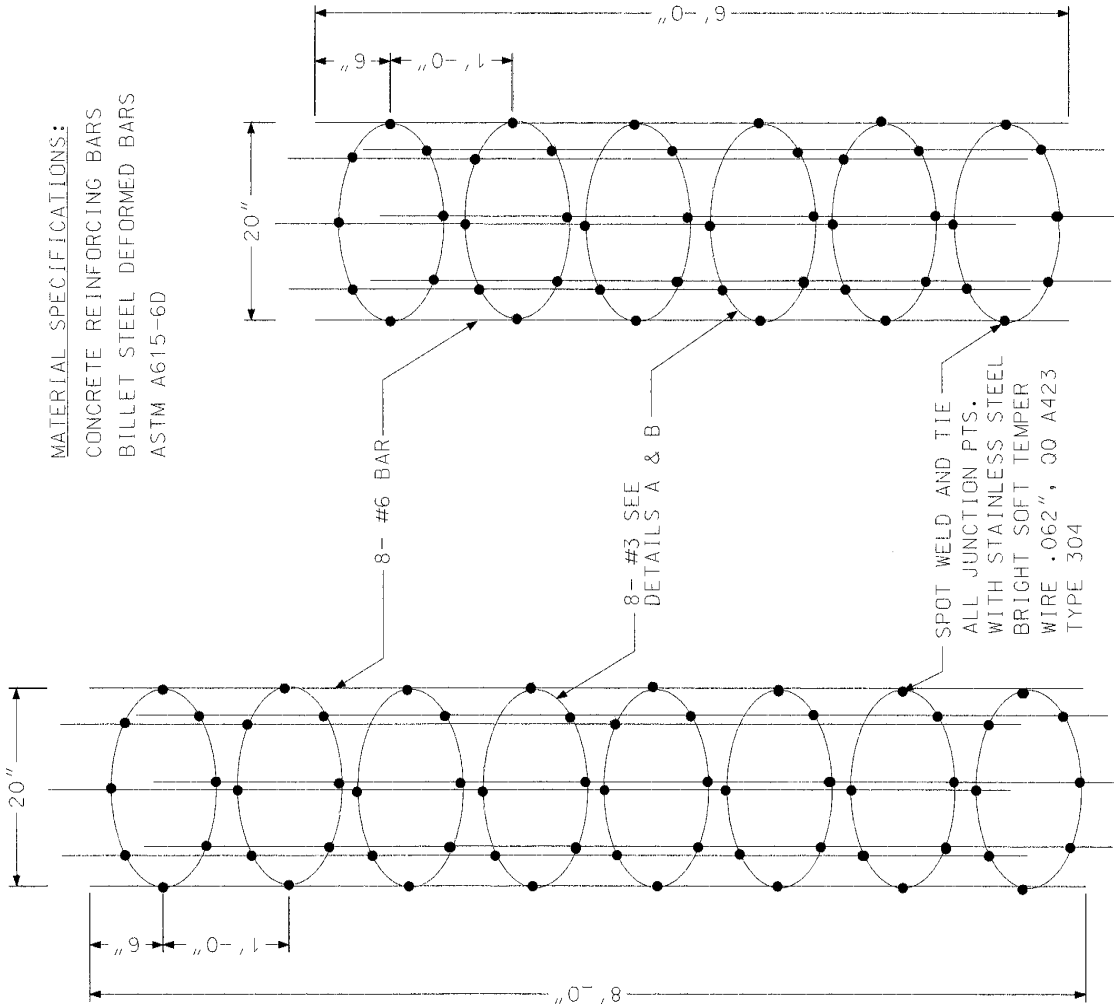
NOTE
THIS DRAWING
REPLACES 11872

BALLAST HOUSING BASE WITH ANCHOR PLATES FOR 10" & 15" BOLT CIRCLE			
REVISED	CITY OF CHICAGO DEPT. OF STREETS & ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
A APR. 1980	ENGINEER	CHECKED	ENGINEER
B OCT. 19, 1981	E. GERULLIS	M. J. SHINE	M. R. GREEN
C MAY 5, 2017			
D			
E			
F			
G			
SIZE 14" X 25"		SCALE 3/4" = 1'-0"	DATE MARCH 29, 1977

785

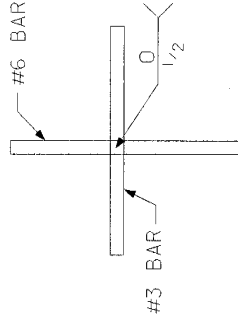
MATERIAL SPECIFICATIONS:
 CONCRETE REINFORCING BARS
 BILLET STEEL DEFORMED BARS
 ASTM A615-6D

CODE	COMMODITY	SIZE	QUANTITY
20-9545-	ROD, WELDING LINCOLN WELD OR EQUAL	#7018	5#
31-	WIRE, TIE STEEL STAINLESS 00 W423 COND. "A" SOFT	.062	1.0#

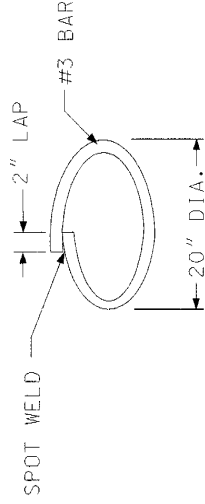


ISOMETRIC VIEW OF
 8' STEEL CAGE

ISOMETRIC VIEW OF
 6' STEEL CAGE



DETAIL "B"



DETAIL "A"

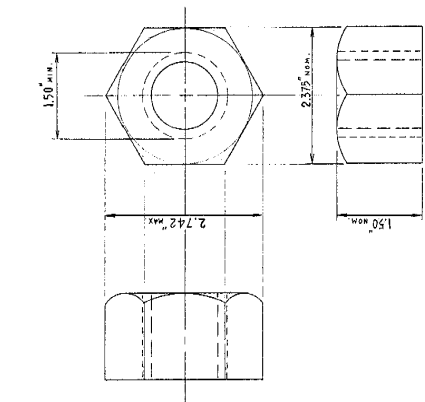
REVISION	DATE
A	

STEEL CAGES FOR
 POLE FOUNDATIONS

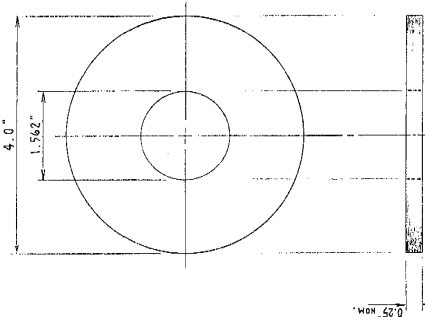
CITY OF CHICAGO
 DEPARTMENT OF PUBLIC WORKS
 DIVISION OF ENGINEERING

DESIGNED BY: [Signature]
 CHECKED BY: [Signature]
 SUPERVISING ENGINEER: [Signature]

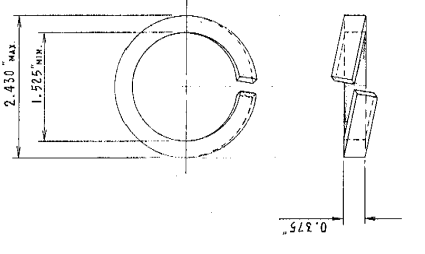
ENGINEER'S SEAL: [Seal]
 DRAWING NO. 793A
 DATE: 10-21-06
 SCALE: NONE



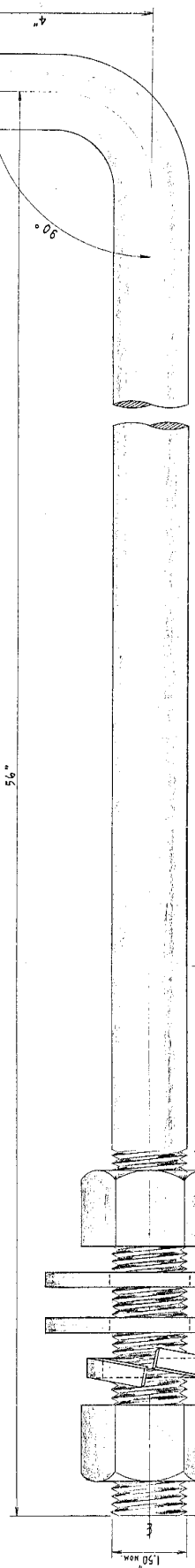
HEXAGON NUT
 AMER. MTL. STD. HEAVY HEX. FLAT NUT
 (ANSI B 18.2.2 - 1972)



FLAT WASHER
 AMER. MTL. STD. TYPE "B"
 SERIES "M"
 (ANSI B 18.21.1 - 1972)



LOCK WASHER
 AMER. MTL. STD. HELICAL SPRING LOCK WASHER
 (ANSI B 18.21.1 - 1972)



M A T E R I A L :

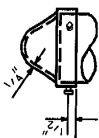
ASTM. A-36 MODIFIED STEEL, 55,000 LBS. MINIMUM YIELD.
 WARDWARE TO BE FURNISHED & ATTACHED IN PLACE ON ROD FOR SHIPPING:
 2 HEX. NUTS, HEAVY, GALV. 1/2"
 2 WASHERS, STEEL, ROUND, GALV., TYPE "B", SERIES "M", 1/2"
 1 WASHER, LOCK, STEEL, GALV., HELICAL SPRING, REGULAR, 1/2"
 (NUTS & WASHERS SHALL HAVE AN AMERICAN STANDARD CLASS 2 OR 3 FIT.
 (NUT IS TAPPED OVERSIZE BY 1/32")

U.S. STANDARD 1/2" - 6 N.C. ROLLED THREAD
 12"
 ZINC COATING OF 0.021 IN THICKNESS
 SHALL BE APPLIED TO ALL SURFACES
 COVERED WITH HEAVY NON-OXID, OR EQUAL,
 RUST INHIBITING COMPOUND

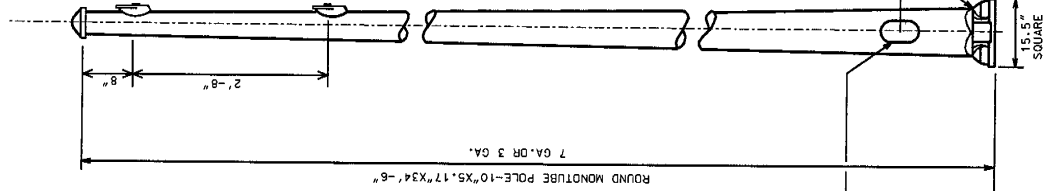
1 1/2" x 60"
STEEL ANCHOR ROD
 COMMODITY CODE 37-8180-0240

REVISED	CITY OF CHICAGO
	DEPT. OF PUBLIC WORKS
	BUREAU OF ELECTRICITY
	DIVISION OF UTILITIES
	DRAWN BY EUGENE GERHART
	CHECKED BY W. S. W. N. E.
	DATE: AUG. 3, 1942

DATE: AUG. 3, 1942



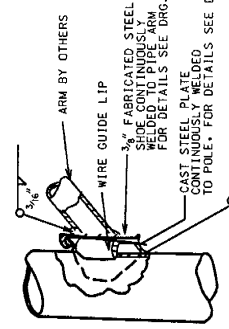
3/8" - 16NCX1" LONG SET SCREWS (3@120°)
POLE CAP
FOR DETAILS SEE DRG. # 11804



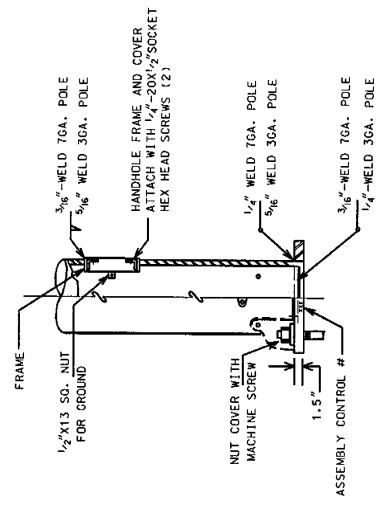
ROUND MONOTUBE POLE-10"x5.17"x34'-6"

SEE DETAIL "D"

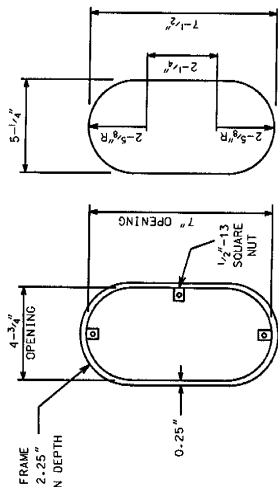
BOLT COVER W/ HEX HD. ST. STL. MACH. SCREWS



SECTION AT POLE PLATE



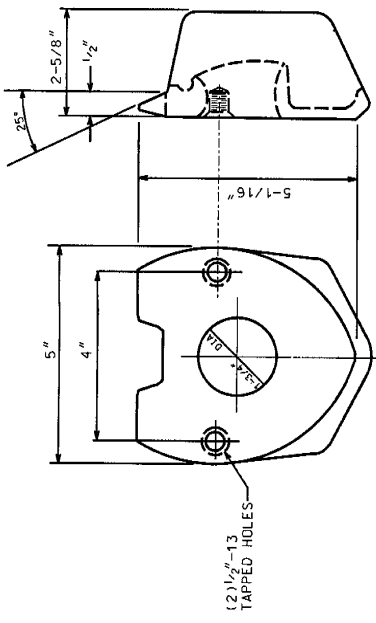
DETAIL "D"



FRAME

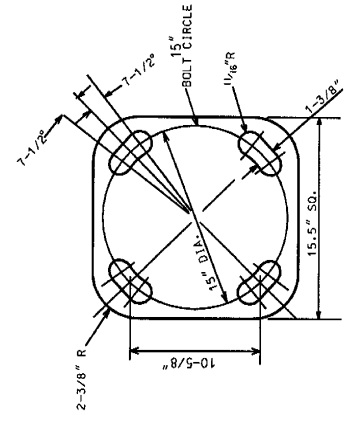
DOOR

HANDHOLE DETAIL



2 BOLT MAST ARM ATTACHMENT

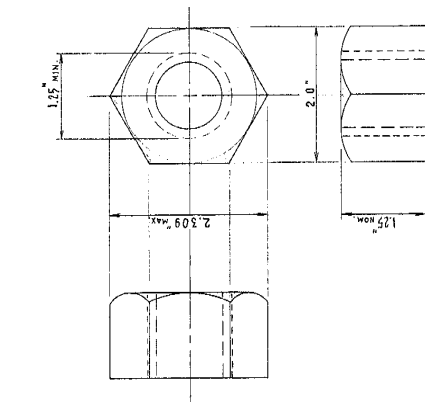
FOR DETAILS SEE DRG. # 659 MATERIAL: CAST STEEL



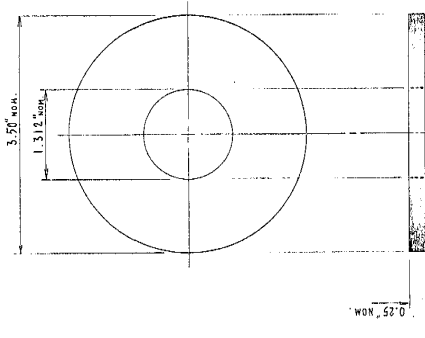
DETAIL "A"
BOLT SLOTS

5.17" X 10.0" STEEL/34' - 6" POLE
7 OR 3 GAUGE

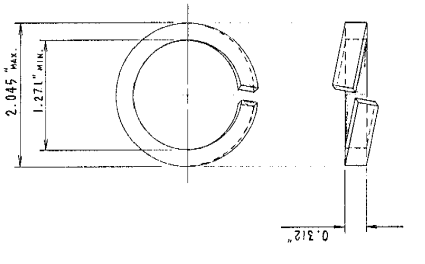
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DESIGNED BY: ROBERT IVY	CHECKED BY: ROBERT CARTER
SUPERVISING ENGINEER	ENGINEER
ENGINEER OF ELECTRICITY	ELECTRICAL DESIGN ENGR.
DEPT. CHIEF OF ELECTRICITY: <i>Blair S. Murphy</i>	DWG. NO. 808
DEPUTY COMMISSIONER	10-03-01



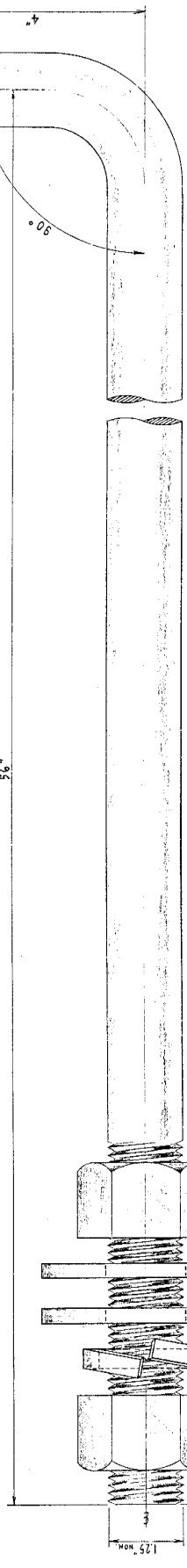
HEXAGON NUT
 AMER. MATT. STD. HEAVY HEX. FLAT NUT
 (ANSI B 18.2.2 - 1972)



FLAT WASHER
 AMER. MATT. STD. TYPE "B"
 SERIES "M"
 (ANSI B 18.22.1 - 1952, R1975)



LOCK WASHER
 AMER. MATT. STD. HELICAL SPRING LOCK WASHER
 (ANSI B 18.21.1 - 1972)



MATERIAL:

- ASTM A400, CLASS R-2, MODIFIED STEEL, 55,000 LBS. MINIMUM YIELD.
- HARDWARE**
- TO BE FURNISHED & ATTACHED IN PLACE ON ROD FOR SHIPPING:
- 2 HEX NUTS, HEAVY, GALV. 1/2"
- 2 WASHERS, STEEL, ROUND, GALV. 1/2"
- 1 WASHER, LOCK, STEEL, GALV., HELICAL SPRING, REGULAR, 1/2"
- 6 NUTS & WASHERS SHALL HAVE AN AMERICAN STANDARD CLASS 2 OR 3 FIT.
- (NUT IS TAPPED OVERSIZE BY 1/32")

U.S. STANDARD 1/4"-7 N.C. ROLLED THREAD
 12"
 A ZINC COATING, 0.0021 INCH IN THICKNESS
 SHALL BE APPLIED OVER THE ENTIRE SURFACE AND
 SHALL BE APPLIED OVER THE ENTIRE SURFACE AND
 RUST INHIBITING COMPOUND

1/4" x 60"
STEEL ANCHOR ROD
 COMMODITY CODE 37-818A-0236

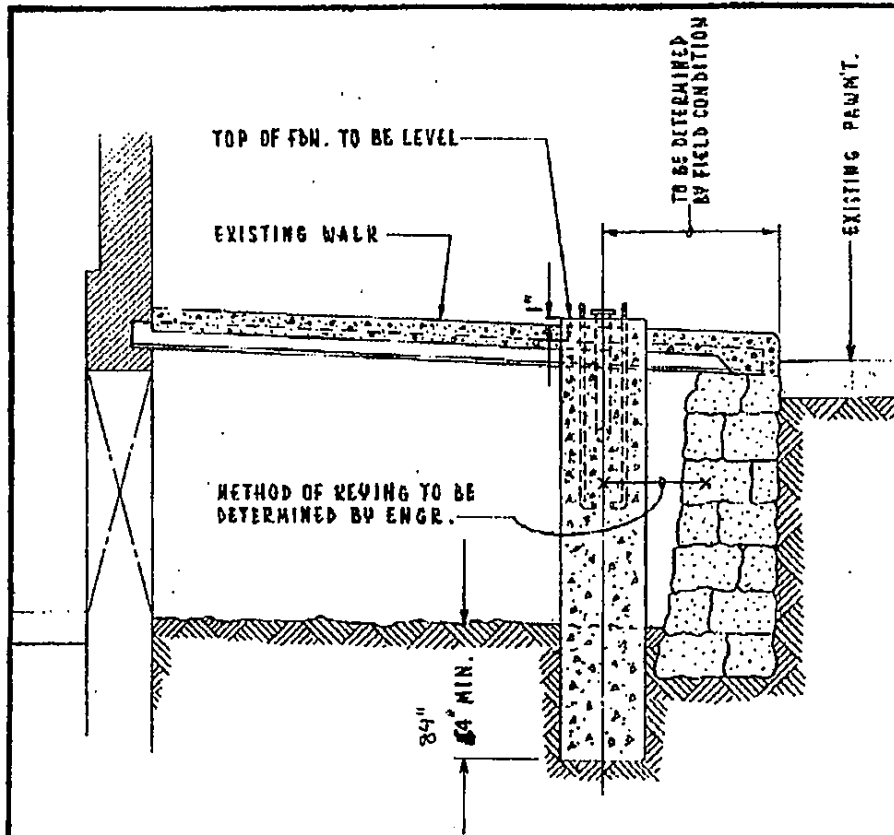
REVISED	A	JAN 25 1982	R. E. D. A. W. H.
B			
C			
D			
E			
F			
G			

CITY OF CHICAGO
 DIST. BUREAU OF ELECTRICITY
 DIVISION OF ELECTRICAL INSULATING
 ENGINEER/INSP. I. HALLER
 DRAWN BY
 CHECKED BY
 APPROVED BY
 DATE 10/1/82

SCALE: 17" x 28"

811

DATE: AUG. 3, 1982

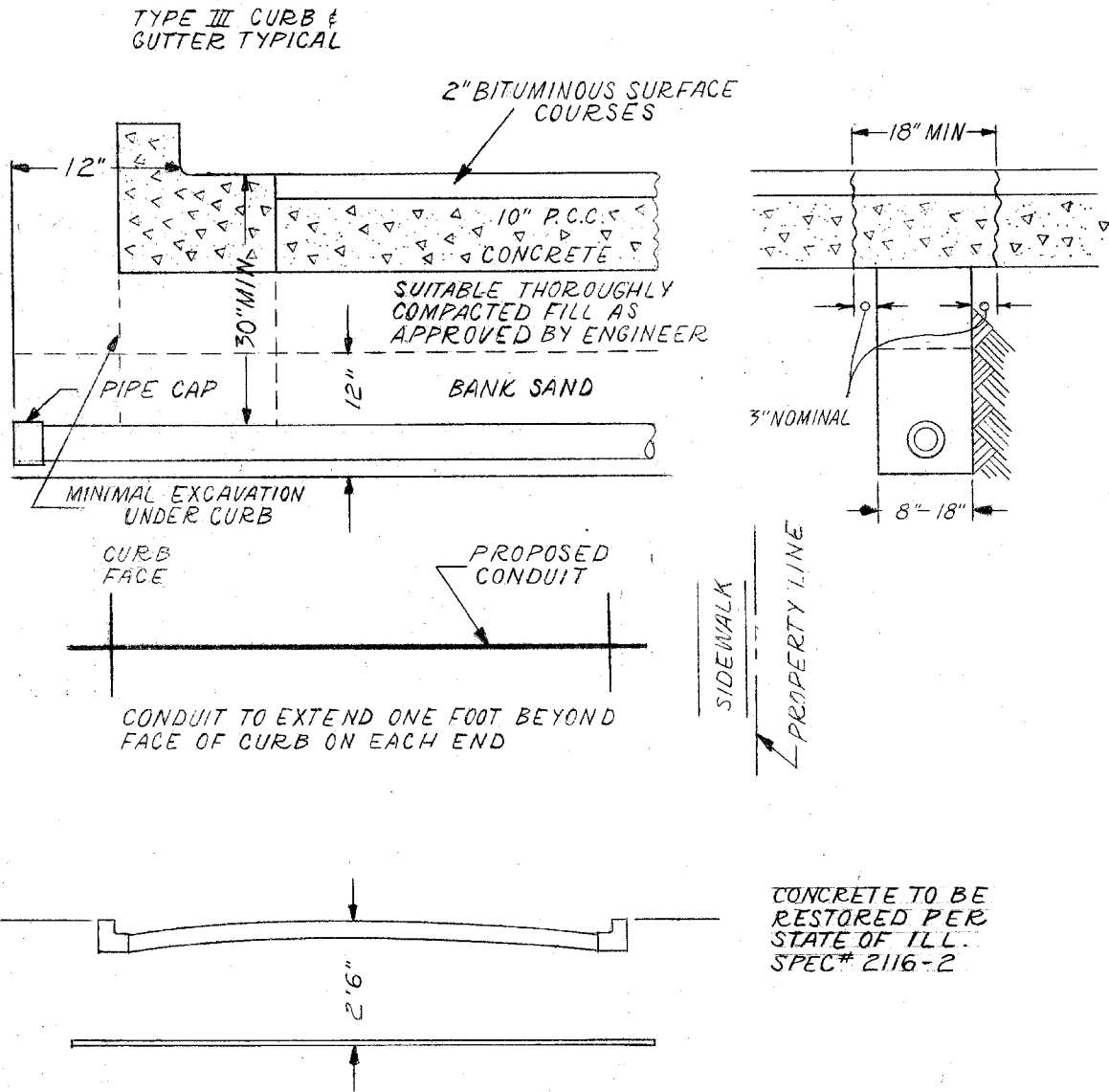


NOTE: DIAMETER OF PROPOSED FOUNDATION-SIZE & LENGTH OF ANCHOR BOLTS & BOLT PROJECTION TO BE SHOWN ON CONSTRUCTION DRAWING.

TYPICAL FOUNDATION FOR VAULTED WALK		
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
DESIGN S. GERULIS	CHECKED R. SYCOWSKI	ENGINEER H. SHINE
<i>Thomas Kalduff</i> <small>ESTIMATEE OF ELECTRICITY</small>		812
<i>Charles E. Bunchley</i> <small>SUPERVISOR</small>		812
SIZE 8 1/2" x 14"	SCALE 1" = 1'-0"	DATE JAN. 21, 1981

Retired
(for reference only)

CONDUIT INSTALLATION UNDER PAVED STREET

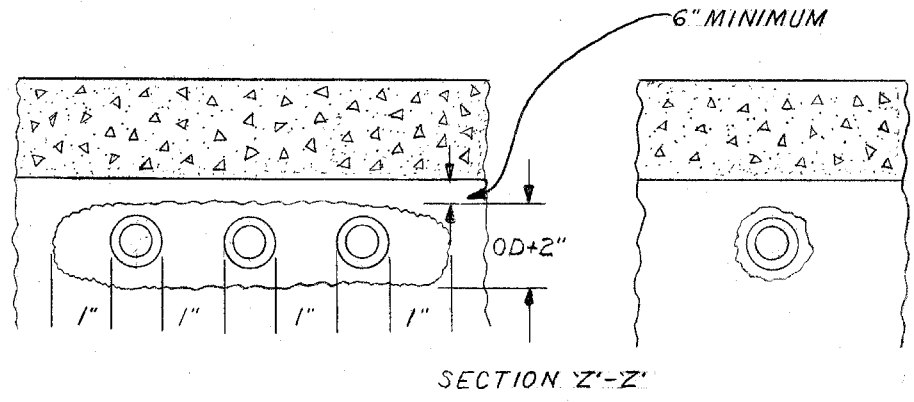
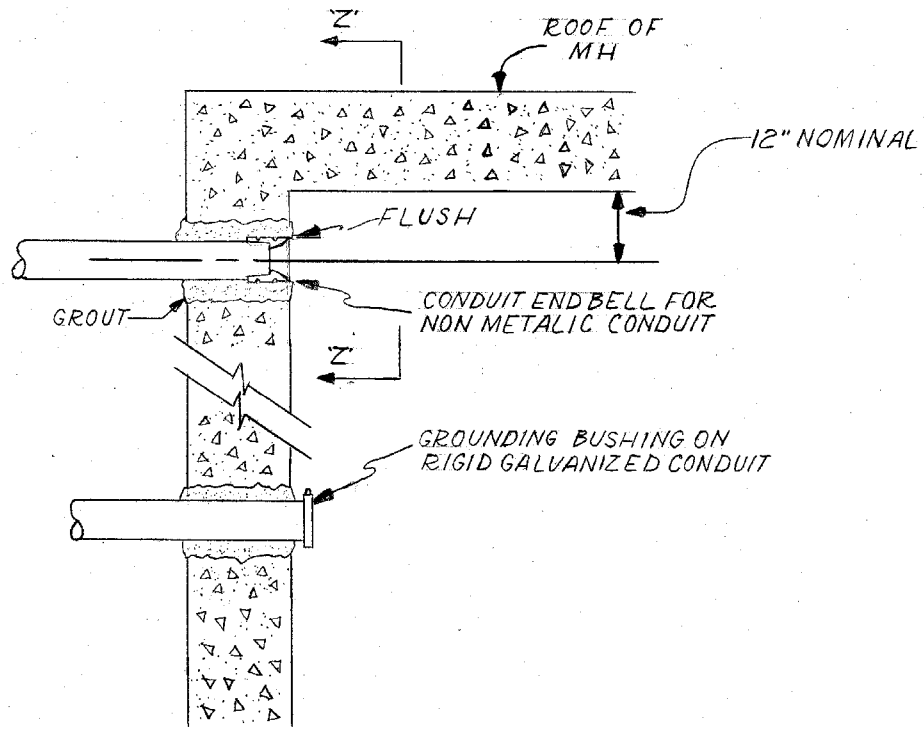


INSTALLATION METHOD OF
INSTALLING CONDUIT UNDER
PAVED ROADWAY

CITY OF CHICAGO
DEPT. OF STREETS AND SANITATION
BUREAU OF ELECTRICITY
DIVISION OF ELECTRICAL ENGINEERING

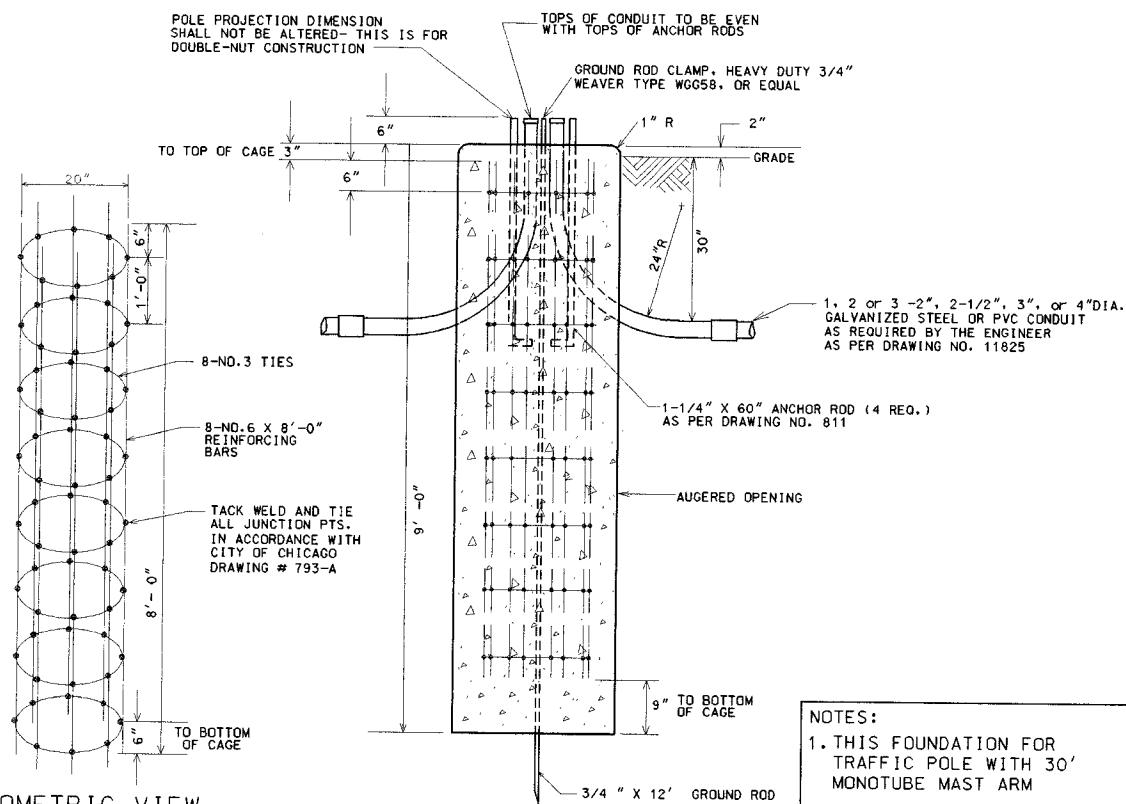
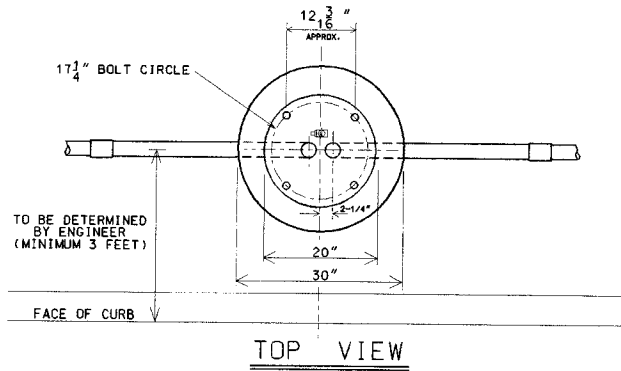
DRAWN A.M. JOHNSON	CHECKED R. SYCKOWSKI	ENGINEER R.L. MARTIN
<i>Thomas W. Kelly</i> ENGINEER OF ELECTRICITY		DRG. NO. 813
<i>Charles E. Buckley</i> DEPUTY CHIEF		DATE 3-13-81
SIZE 8 1/2" X 14"	SCALE N.T.S.	

CONDUIT INSTALLATION THROUGH EXISTING
MANHOLE OR HANDHOLE WALL



OPENING THROUGH WALL TO BE KEPT TO MINIMUM SIZE TO ADMIT CONDUIT AND SUFFICIENT GROUT TO ASSURE SEALING WALL.

INSTALLATION METHOD OF INSTALLING CONDUIT THRU MANHOLE WALL		
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
DRAWN A.M. JOHNSON	CHECKED R. SYCKOWSKI	ENGINEER R.L. MARTIN
 ENGINEER OF ELECTRICITY		DRG. NO. 814
 DEPUTY CHIEF ENGINEER		DEPUTY CHIEF DATE 3-13-81
SIZE 8 1/2" X 14"	SCALE N.T.	DATE



ISOMETRIC VIEW OF STEEL CAGE

ELEVATION

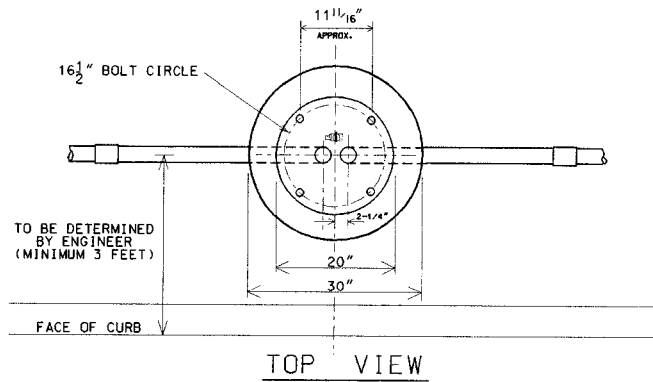
- NOTES:
1. THIS FOUNDATION FOR TRAFFIC POLE WITH 30' MONOTUBE MAST ARM
 2. CONCRETE MUST MEET IDOT REQUIREMENTS FOR PORTLAND CEMENT CLASS SI CONCRETE.
 3. REINFORCING BARS MUST MEET ASTM A-615 GRADE 60.

NOTE:
HOLE FOR FOUNDATION MUST BE AUGERED IN UNDISTURBED SOIL

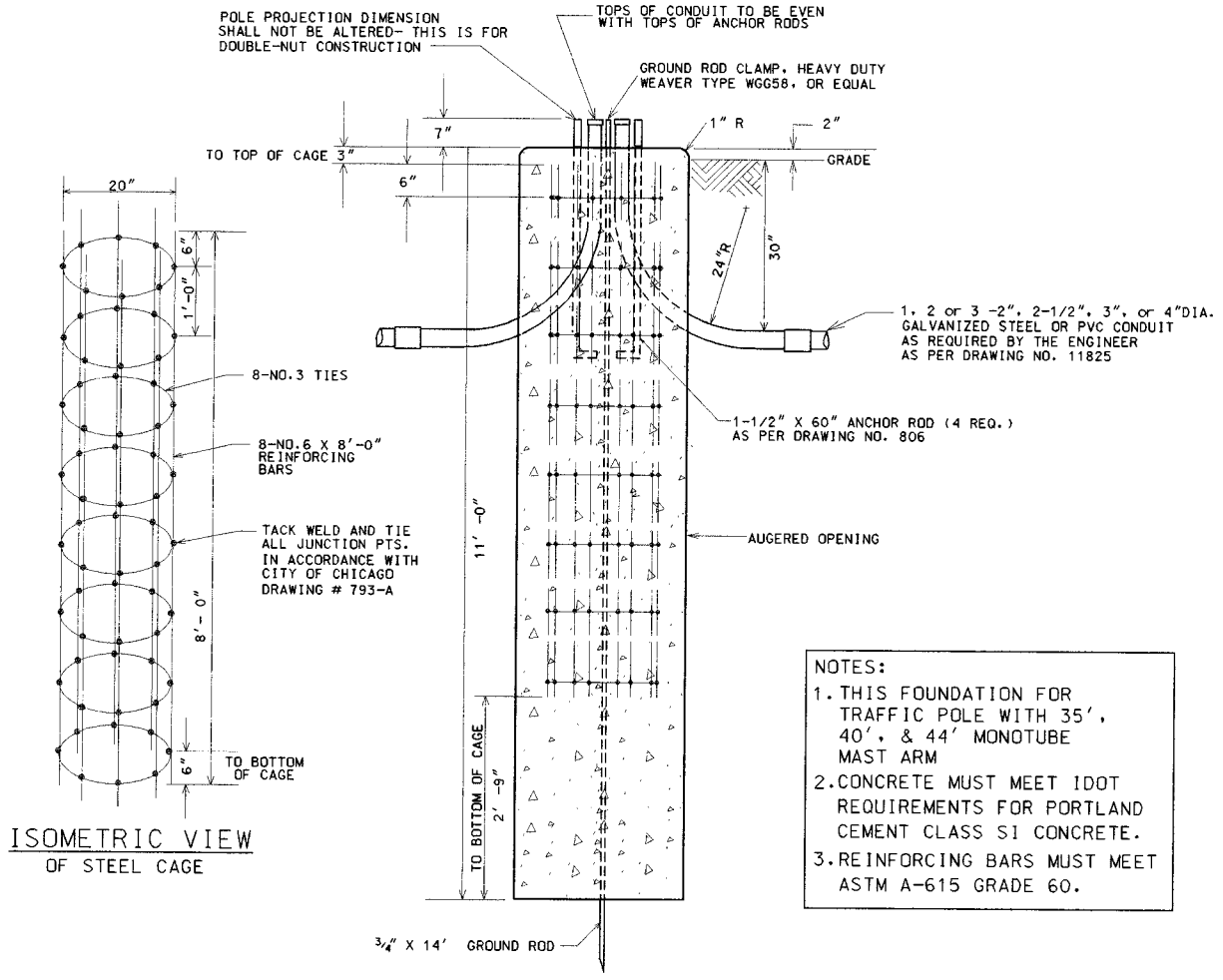
CODE	COMMODITY	SIZE	QUANTITY
05-3267-2940	REDI-MIX CONCRETE	CU. YD.	1.65
09-4001-	ELBOW, LARGE RADIUS	2", 2-1/2", 3", 4"	AS REQUIRED
37-8180-0200	ANCHOR ROD	1-1/4" X 60"	4
05-5054-6910	RE-BAR CAGE	20" X 8'-0"	1
09-7796-3200	GROUND ROD	3/4" X 12'-0"	1
09-2636-3240	GROUND ROD CLAMP	3/4"	1
09-2092-	GROUND BUSHING	2", 2-1/2", 3", 4"	AS REQUIRED

8/21/02	SUPERCEDS DWG #816 DRAWN 9/22/81
DATE	REVISION
FOUNDATION FOR 34'-6" TRAFFIC SIGNAL POLE WITH 17 1/4" BOLT CIRCLE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY	CHIEF DRAFTSMAN: B. CARTER
ELECTRICAL SECTION ENGINEER: [Signature]	ENGINEER: B. GARNSEY
ENGINEER-IN-CHARGE: [Signature]	GENERAL SUPERINTENDENT: [Signature]
DEPUTY COMMISSIONER: [Signature]	DATE: 8/21/02
SIZE: 11" x 17"	SCALE: NONE

816



TOP VIEW



ELEVATION

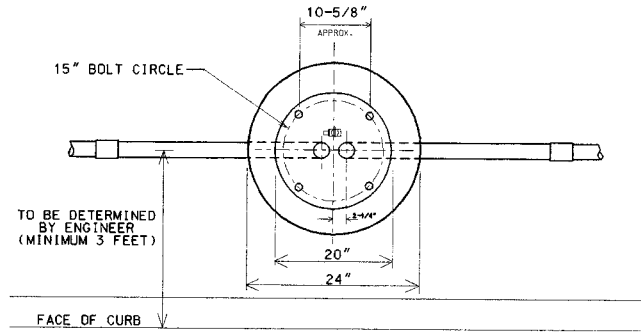
ISOMETRIC VIEW OF STEEL CAGE

- NOTES:**
1. THIS FOUNDATION FOR TRAFFIC POLE WITH 35', 40', & 44' MONOTUBE MAST ARM
 2. CONCRETE MUST MEET IDOT REQUIREMENTS FOR PORTLAND CEMENT CLASS S1 CONCRETE.
 3. REINFORCING BARS MUST MEET ASTM A-615 GRADE 60.

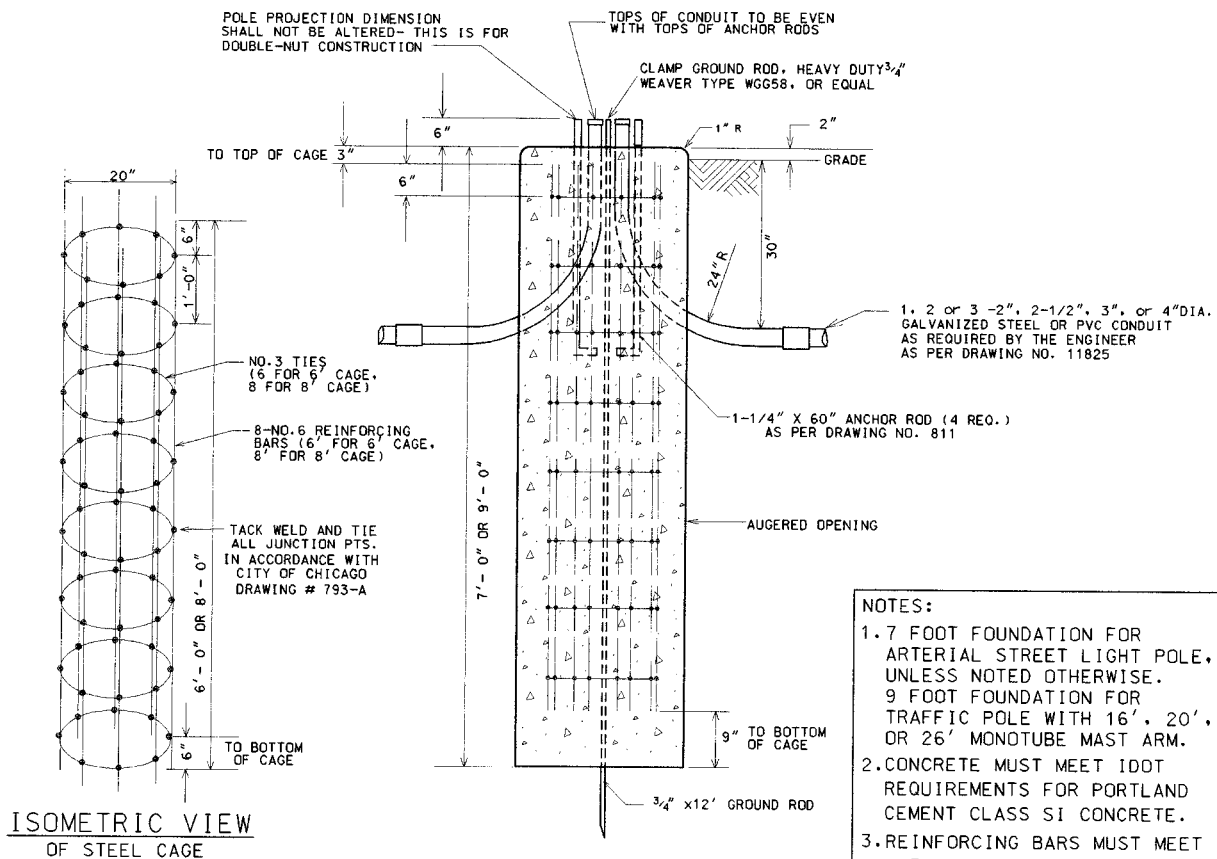
NOTE:
HOLE FOR FOUNDATION MUST BE AUGERED IN UNDISTURBED SOIL

CODE	COMMODITY	SIZE	QUANTITY
05-3267-2940	REDI-MIX CONCRETE	CU. YD.	2.20
09-4001-	ELBOW, LARGE RADIUS	2", 2-1/2", 3", 4"	AS REQUIRED
37-8180-0200	ANCHOR ROD	1-1/2" X 60"	4
05-5054-6910	RE-BAR CAGE	20" Ø X 8'-0"	1
09-7796	GROUND ROD	3/4" X 14'-0"	1
09-2636-	GROUND ROD CLAMP	3/4"	1
09-2092-	GROUND BUSHING	2", 2-1/2", 3", 4"	AS REQUIRED

8/21/02	SUPERCEDES DWG #817 DRAWN 4/20/81
DATE	REVISION
FOUNDATION FOR 34'-8" TRAFFIC SIGNAL POLE WITH 16 1/2" BOLT CIRCLE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY	CHIEF DRAFTSMAN: ENGINEER: R. CARTER B. GARNSEY
ELECTRICAL DESIGN ENGINEER: [Signature]	DRAWING NO. 817
ENGINEER OF ELECTRICITY: [Signature]	
GENERAL SUPERINTENDENT: [Signature]	
DEPUTY COMMISSIONER: [Signature]	
SIZE: 11" x 17"	SCALE: NONE DATE: 8/21/02



TOP VIEW



ISOMETRIC VIEW OF STEEL CAGE

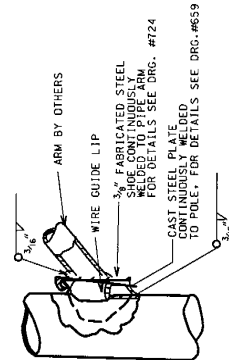
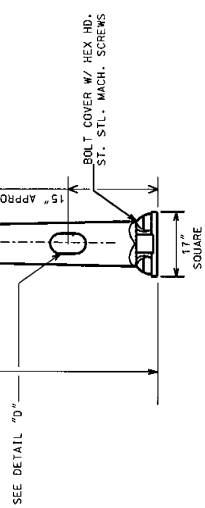
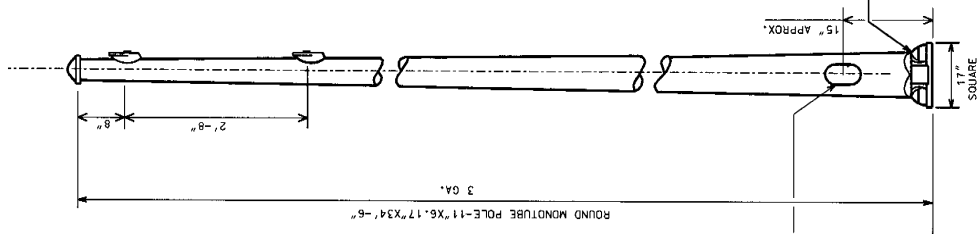
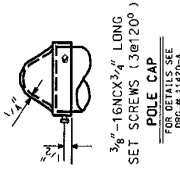
ELEVATION

- NOTES:**
- 1.7 FOOT FOUNDATION FOR ARTERIAL STREET LIGHT POLE, UNLESS NOTED OTHERWISE.
9 FOOT FOUNDATION FOR TRAFFIC POLE WITH 16', 20', OR 26' MONOTUBE MAST ARM.
 - CONCRETE MUST MEET IDOT REQUIREMENTS FOR PORTLAND CEMENT CLASS SI CONCRETE.
 - REINFORCING BARS MUST MEET ASTM A-615 GRADE 60.

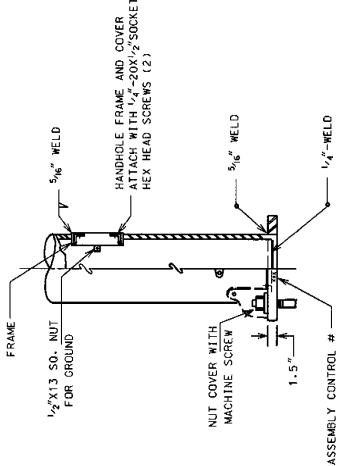
NOTE: HOLE FOR FOUNDATION MUST BE AUGURED IN UNDISTURBED SOIL

CODE	COMMODITY	SIZE	QUANTITY
05-3267-2340	REDI-MIX CONCRETE	CU. YD.	0.82 OR 1.05
09-4001-	ELBOW, LARGE RADIUS	2", 2-1/2", 3", 4"	VARIES
37-8180-0200	ANCHOR ROD	1-1/4" X 60"	4
05-5054-6910	RE-BAR CAGE	20" X 6' (or 8')	1
09-7796-9200	GROUND ROD	3/4" X 12'-0"	1
09-2636-3240	GROUND ROD CLAMP	3/4"	1
09-2092-	GROUND BUSHING	2", 2-1/2", 3" OR 4"	VARIES

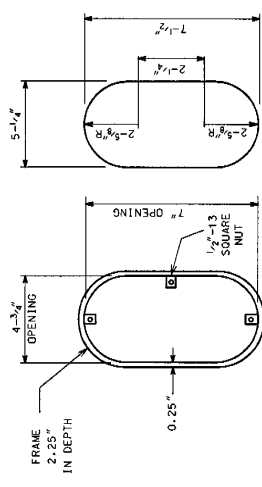
8/21/02	SUPERCEDES DWG #818 DRAWN 4/21/81
DATE	REVISION
FOUNDATION FOR 34'-6" ARTERIAL STREET LIGHT OR TRAFFIC SIGNAL POLE - 3 OR 7 GAUGE WITH 15" BOLT CIRCLE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY	ENGINEER: R. CARTER
ELECTRICAL DESIGN ENGINEER	DRAWING NO.
ENGINEER OF ELECTRICITY	818
GENERAL SUPERINTENDENT	
DEPUTY COMMISSIONER	
SIZE: 11" x 17"	SCALE: NONE
	DATE: 8/21/02



SECTION AT POLE PLATE



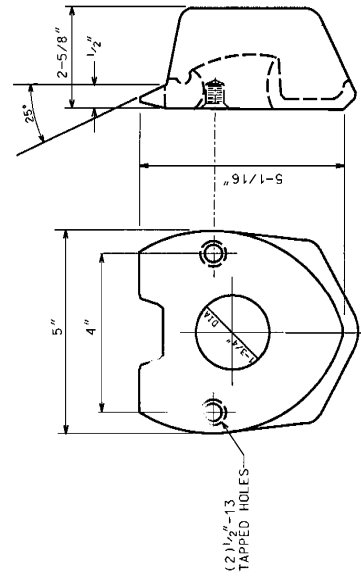
DETAIL "D"



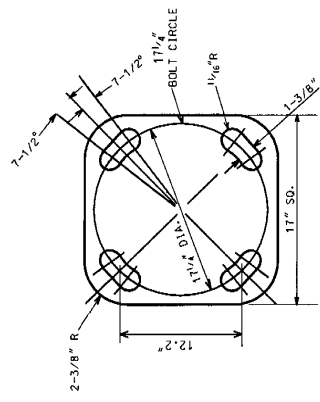
FRAME

DOOR

HANDHOLE DETAIL

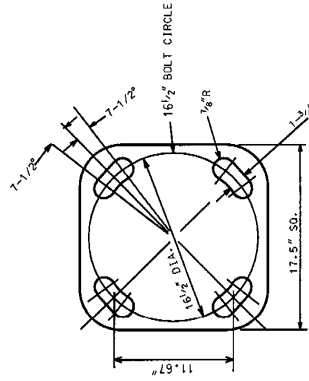
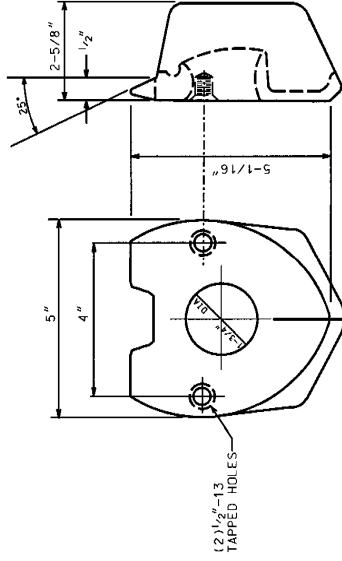
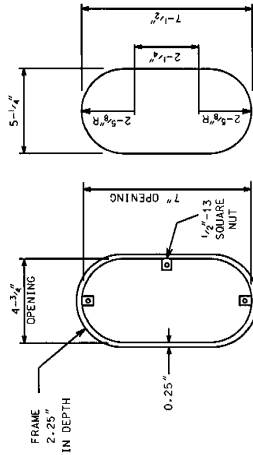
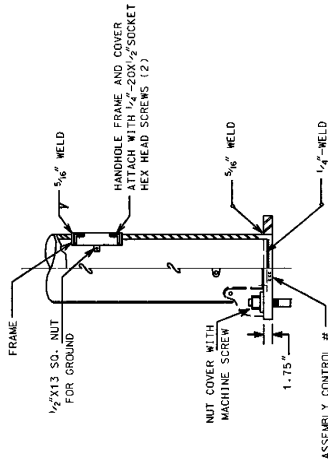
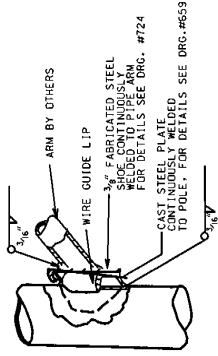
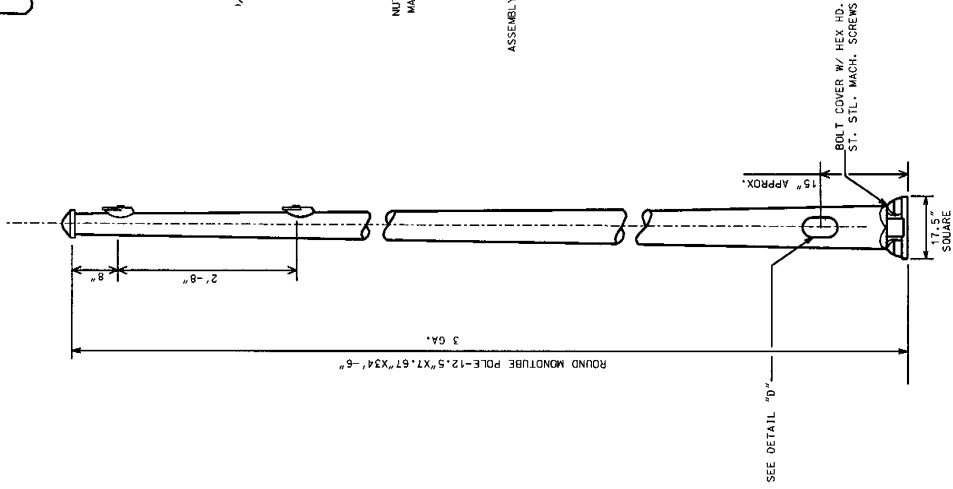
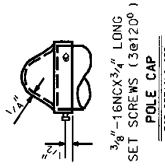


2 BOLT MAST ARM ATTACHMENT
FOR DETAILS SEE DRG.# 659 MATERIAL: CAST STEEL



DETAIL "A"
BOLT SLOTS

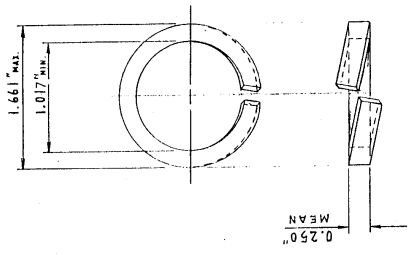
6.17"x11.0" STEEL/34'-6" POLE 3 GAUGE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: ROBERT IVY	ENGINEER: RON POOL
SUPERVISING ENGINEER: ROBERT CARTER	ELEC. DESIGN ENGR. <i>[Signature]</i>
ENGINEER OF ELECTRICITY: <i>[Signature]</i>	DWG. NO. 824
GEN'L. SUPT. OF ELECTRICITY: <i>[Signature]</i>	
DEPUTY COMMISSIONER: <i>[Signature]</i>	
10-03-01	



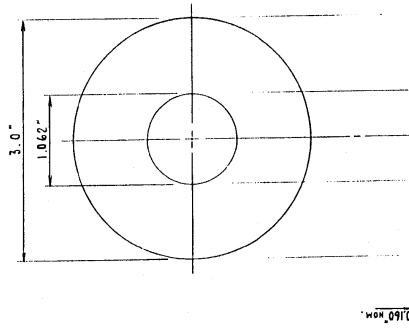
7.67" x 12.5" STEEL / 34' - 6" POLE
3 GAUGE

CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS DIVISION OF ELECTRICAL ENGINEERING		ENGINEER ROBERT IVY SUPERVISING ENGINEER	ENGINEER ROBERT CARTER RON POOL	DWG. NO. 827
		ENGINEER OF ELECTRICAL GEN'L SUPT. OF ELECTRICITY DEPUTY COMMISSIONER <i>Robert J. Murphy</i>		10-03-01

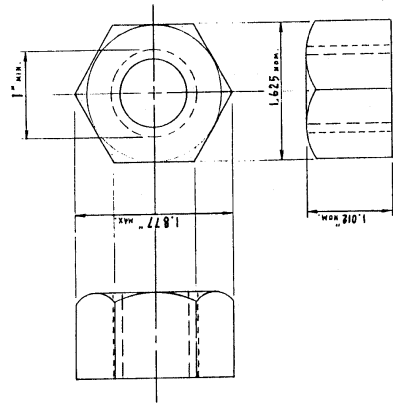
HANDHOLE DETAIL



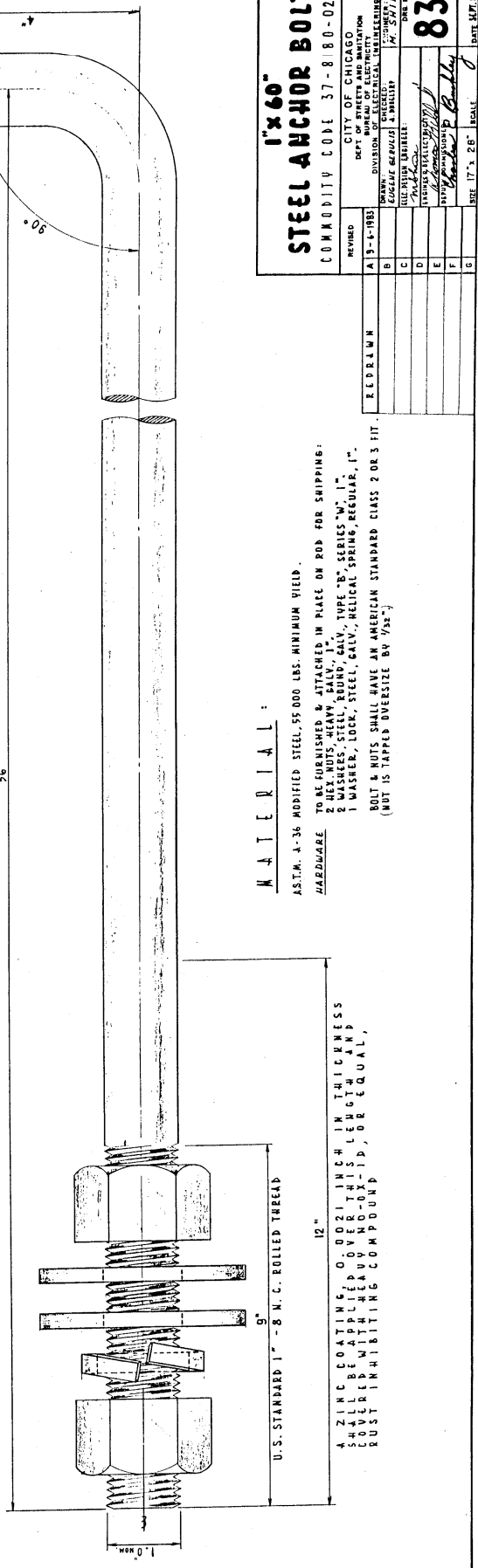
LOCK WASHER
 AMER. METL. STD. HELICAL SPRING LOCK WASHER, REGULAR
 (ANSI B 18.21.1 - 1972)



FLAT WASHER
 AMER. METL. STD. TYPE "B"
 SERIES "W"
 (ANSI B 18.21.1 - 1965, R1975)



HEXAGON NUT
 AMER. METL. STD. HEAVY HEX. FLAT NUT
 (ANSI B 18.2.2 - 1972)



M A T E R I A L :

ASTM. A-36 MODIFIED STEEL, 55 000 LBS. MINIMUM YIELD.
HARDWARE
 TO BE FURNISHED & ATTACHED IN PLACE ON ROD FOR SHIPPING:
 2 HEX. NUTS, HEAVY, GALV., 1"
 2 WASHERS, STEEL, ROUND, GALV., TYPE "B", SERIES "W", 1"
 1 WASHER, LOCK, STEEL, GALV., HELICAL SPRING, REGULAR, 1"
 BOLT & NUTS SHALL HAVE AN AMERICAN STANDARD CLASS 2 OR 3 FIT
 (NUT IS TAPPED OVERSIZE BY 1/64")

U.S. STANDARD 1" - 8 M. C. ROLLED THREAD
 9"
 12"
 4 ZINC COATING, 0.0021 INCH MIN THICKNESS
 COVERED WITH POLYMER LUBRICANT
 COVERED WITH HEAVY POLYURETHANE
 RUST INHIBITING COMPOUND

1" x 60"
STEEL ANCHOR BOLT
 COMMODITY CODE 37-8180-0220

REVISED	A 19-4-1983	REPR. L. W. N.
B		
C		
D		
E		
F		
G		

CITY OF CHICAGO
 DEPT. OF STREETS AND SANITATION
 DIVISION OF PUBLIC UTILITIES
 ENGINEER
 CONTRACTOR
 APPROVED
 DATE: 11/12/83

830

DATE: 11/12/83

DATE OF ISSUE	SECTION	COUNTY	TOTAL SHEETS
FINAL REG. NO.	ILLINOIS PROJECT		

APPROVED AS WORKING PLAN	BY
REVISIONS OF WORKING PLAN	

DATE	DESCRIPTION

DATE	DESCRIPTION

DATE	DESCRIPTION

DATE	DESCRIPTION

DATE	DESCRIPTION

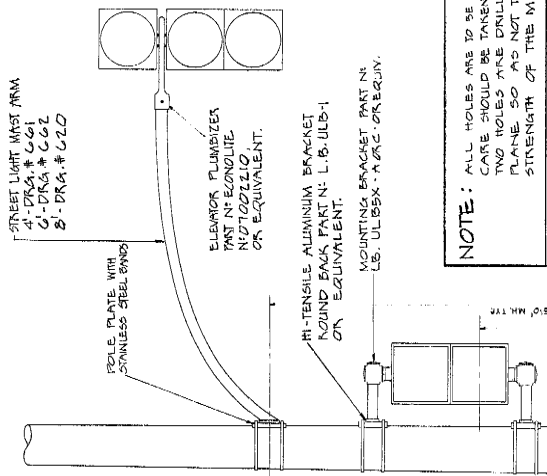
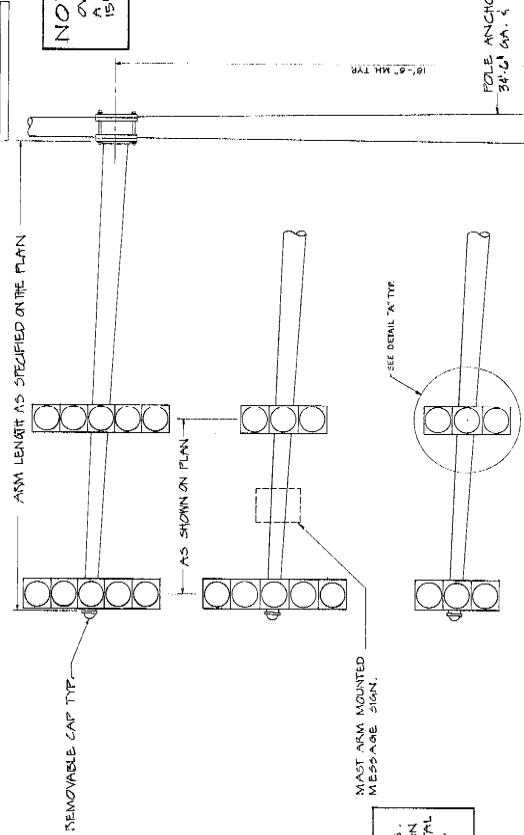
DATE	DESCRIPTION

DATE	DESCRIPTION

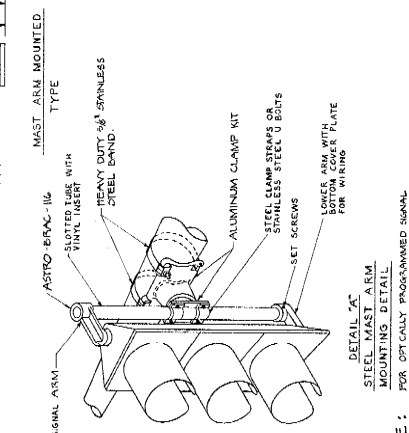
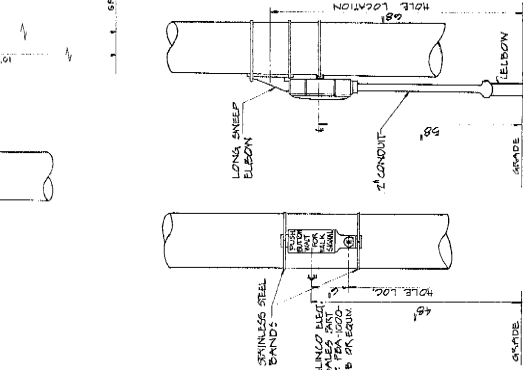
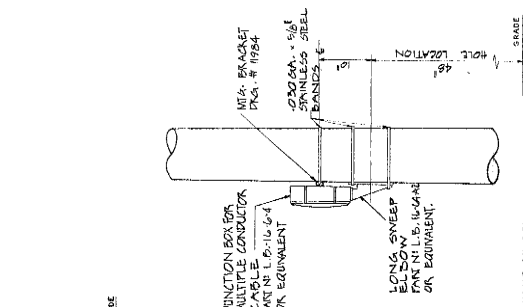
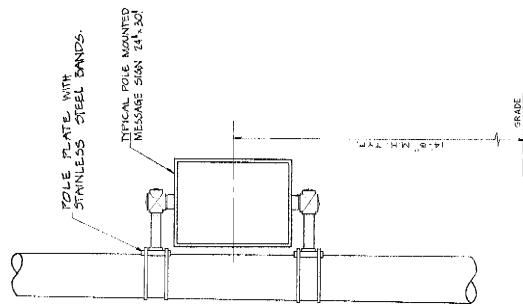
DATE	DESCRIPTION

NOTE:
OVERHEAD SIGNALS SHALL HAVE A MINIMUM CLEARANCE OF 15'-0" ABOVE PAVEMENT GRADE.

POLE ANCHOR BASE STEEL 34" DIA. & DIA. AS SHOWN ON PLANS.



NOTE: ALL HOLES ARE TO BE DRILLED IN POLES OR POSTS. CARE SHOULD BE TAKEN TO SEE THAT NO MORE THAN TWO HOLES ARE DRILLED IN THE SAME HORIZONTAL PLANE SO AS NOT TO WEAKEN THE OVERALL STRENGTH OF THE MATERIAL.



NOTE: LONGER SIGNAL ARMS REQUIRED. (ARC-894 AB-03)

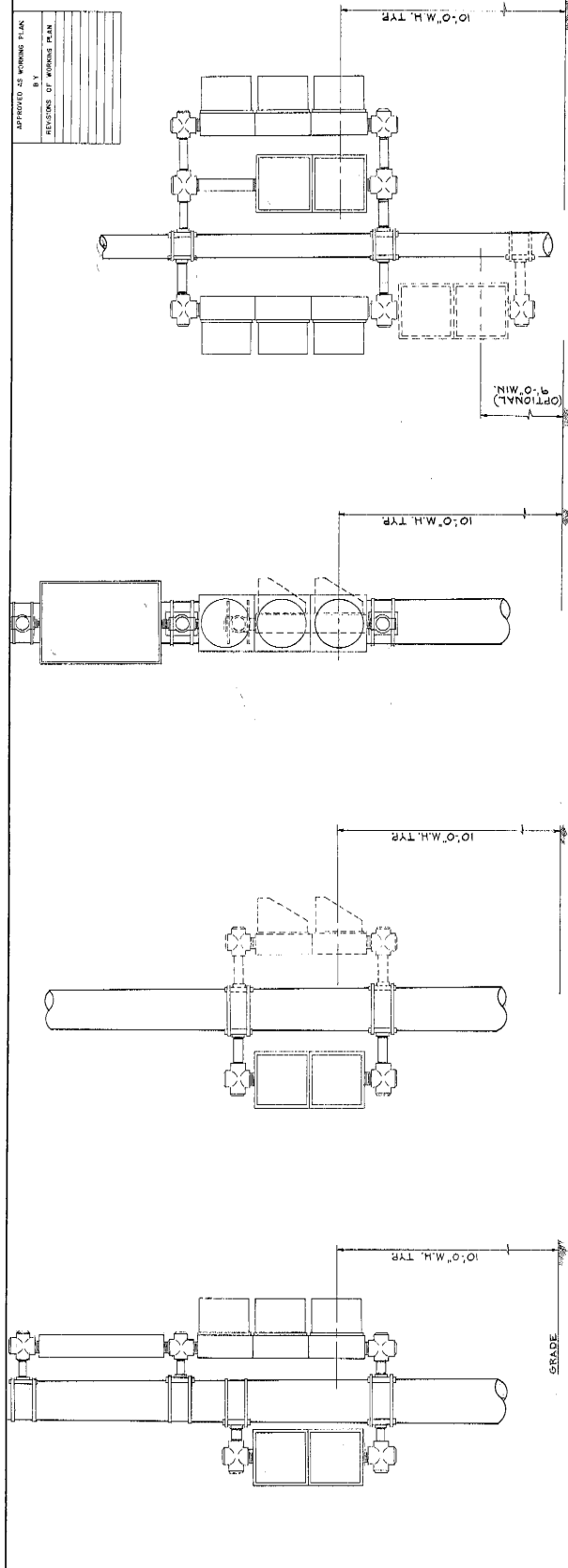
DATE	REVISION
WORK ORDER NO.	COST ALLOCATION ACCOUNT
APPROPRIATION ACCOUNT	MATERIAL
	LABOR

TYPICAL TRAFFIC SIGNAL MOUNTING DETAILS

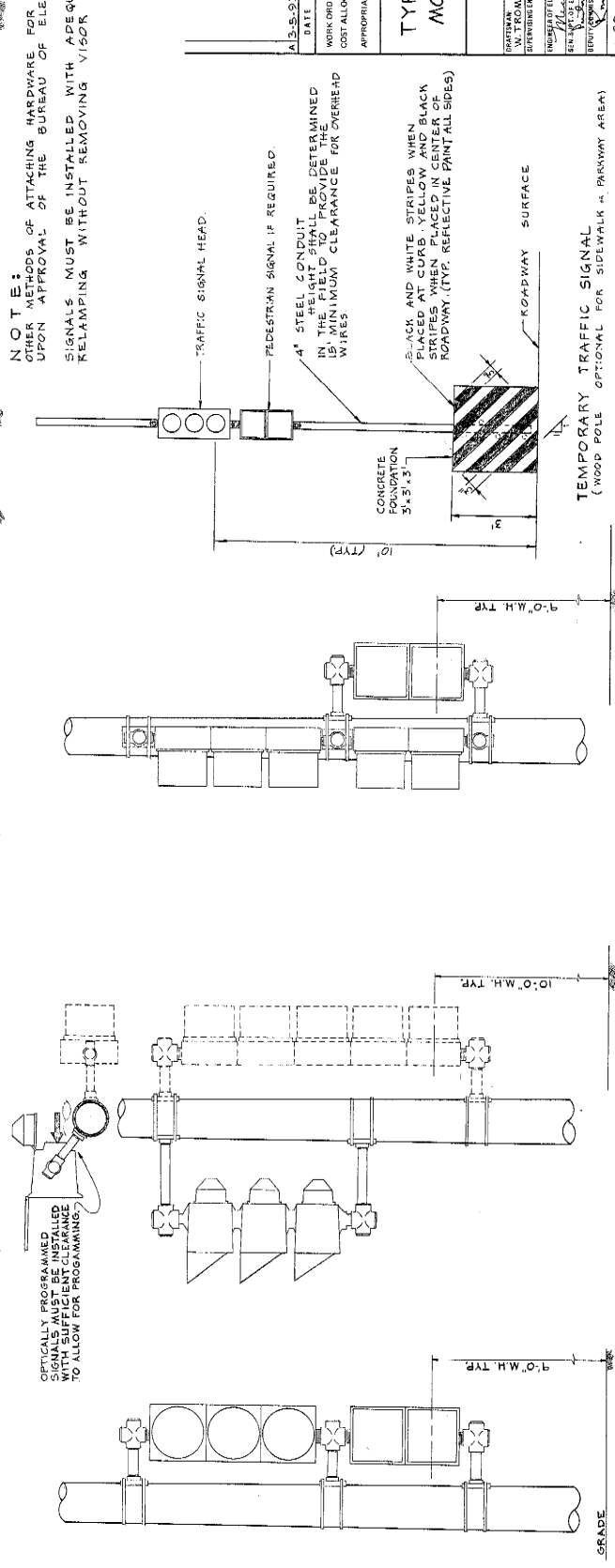
CITY OF CHICAGO	DATE: 12-10-84
DEPARTMENT OF TRANSPORTATION	SCALE: N.T.S.
PROJECT NO. 834	
DESIGNED BY: [Signature]	
CHECKED BY: [Signature]	
DATE: 12-10-84	

SECTION	COUNTY	SHEET
NO.	NO.	NO.
DATE	DATE	DATE
BY	BY	BY
REVISIONS	REVISIONS	REVISIONS
NO.	NO.	NO.
DATE	DATE	DATE
BY	BY	BY
REVISIONS	REVISIONS	REVISIONS
NO.	NO.	NO.
DATE	DATE	DATE
BY	BY	BY

APPROVED AS WORKING PLAN
BY _____
REVISIONS OF WORKING PLAN



OPTICALLY PROGRAMMED SIGNALS MUST BE INSTALLED WITH SUFFICIENT CLEARANCE TO ALLOW FOR PROGRAMMING.



N O T E :
OTHER METHODS OF ATTACHING HARDWARE FOR SIGNAL HEADS MAY BE USED UPON APPROVAL OF THE BUREAU OF ELECTRICITY.
SIGNALS MUST BE INSTALLED WITH ADEQUATE CLEARANCE FOR RELAMPING WITHOUT REMOVING VISOR OR ROTATING SIGNAL.

A.I.S.-231 ASBESTOS TEMP. SIGNAL DETAIL	
DATE	REVISION
WORK ORDER NO.	DATE
COST ALLOCATION ACCOUNT	MATERIAL
APPROPRIATION ACCOUNT	LABOR

TYPICAL TRAFFIC SIGNAL MOUNTING DETAILS

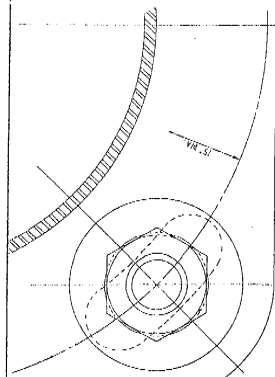
CITY OF CHICAGO	
DEPARTMENT OF TRANSPORTATION	
DESIGNER	ENGINEER
W. TROMPKA	M. D. BARTOLO
R. J. S.	DWG. NO.
15779-102	835
INCHES OF ELECTRICITY	BY
1/4"	W. TROMPKA
SCALE	DATE
AS SHOWN	12/7/56
BY	DATE
W. TROMPKA	12/7/56
BY	DATE
W. TROMPKA	12/7/56

TEMPORARY TRAFFIC SIGNAL
(WOOD POLE OPTIONAL FOR SIDEWALK & PARKWAY AREA)

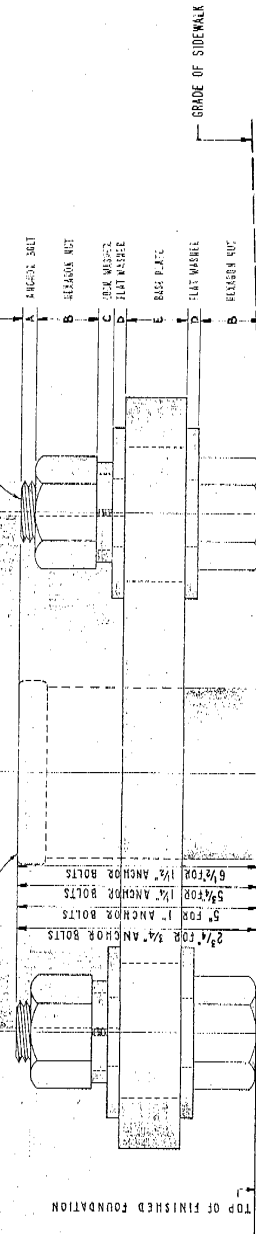
INSTALLATION NOTES

- STEP 1. COAT EXPOSED PORTION OF ANCHOR BOLTS WITH APPROVED ANTI RUSTING GREASE (40-OR-OR EQUAL).
- STEP 2. INSTALL LOWER LEVELLING NUTS & WASHERS, SET AT PROPER GRADE WITH HAND LEVEL. USE TABLE FOR APPROPRIATE DIMENSIONS.
- STEP 3. MOUNT POLE OR PEDESTAL ATTACH TOP WASHERS & NUTS HAND TIGHT.
- STEP 4. PLUMB POLE OR PEDESTAL. AFTER ALL WASTERS, SPACER COUPLERS, TRAFFIC SIGNALS & OTHER ACCESSORIES, ANGLES ARE ATTACHED TO POLE & TIGHTEN ALL NUTS.
- STEP 5. ATTACH NUT COVERS WHERE REQUIRED.
- STEP 6. DO NOT GO OUT IN SPACE BETWEEN BOTTOM OF POLE & TOP OF FOUNDATION. TOP OF FOUNDATION OR SURFACE OF SIDEWALK MUST BE LEFT CLEAN AND SMOOTH.
- STEP 7. POLE OR PEDESTAL IS TO BE PERFECTLY PLUMB. NO "RAKE" IS TO BE LEFT.

NOTE: BOLT COVER NOT SHOWN



ALL MEASUREMENTS ARE TO BE GOVERNED BY REAR BOLT DUE TO POSSIBLE SLOPE OF SIDEWALK



REAR NUT TO BE SET TO GRADE OF SIDEWALK OR TOP OF FOUNDATION

16" x 21"

T A B L E

ANCHOR BOLT SIZE	POLE GAUGES		ALOK. PER.
	1"	1 1/2"	
I	7/16"	3/4"	
N	7/16"	3/4"	
Z	7/16"	3/4"	
D	7/16"	3/4"	
A	7/16"	1 1/8"	7/8"
B	1"	1 1/4"	1 1/2"
C	1 1/4"	1 5/8"	1 3/4"
D	1 5/8"	1 7/8"	1 3/4"
E	1"	1 1/4"	1 1/2"

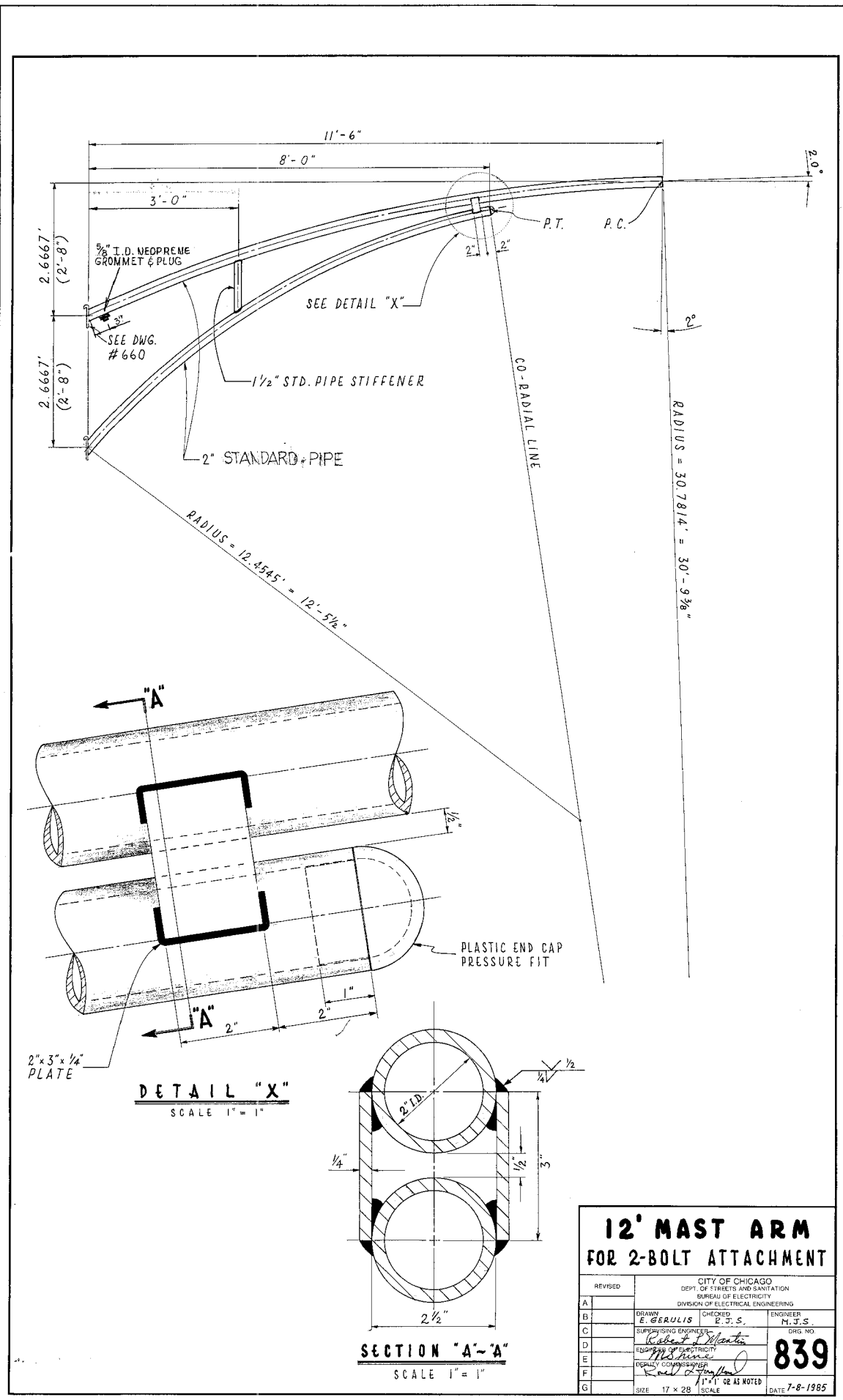
IF NECESSARY, TO BE TRIED WITH SAW CUT END OF BOLT TO BE SET TO GRADE WITH HAND LEVEL. USE TABLE FOR APPROPRIATE DIMENSIONS OF ANCHOR BOLT COAT ANCHOR BOLT WITH RUST-OLEUM HARD GAT ZINC RICH COMPOUND.

CONSTRUCTION METHOD FOR "DOUBLE-NUT" INSTALLATION OF POLES AND PEDESTALS

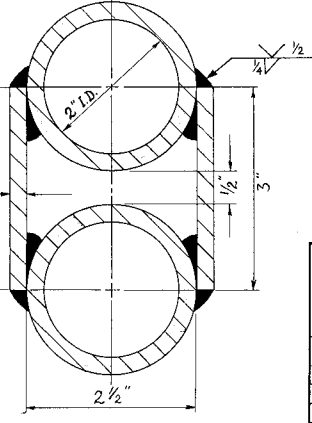
CITY OF CHICAGO
 DEPARTMENT OF PUBLIC WORKS
 DIVISION OF STREET LIGHTS
 PROJECT NO. 887
 DATE: 11-1-11
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]
 APPROVED BY: [Signature]

887

REV. 6-7-85



DETAIL "X"
SCALE 1" = 1"

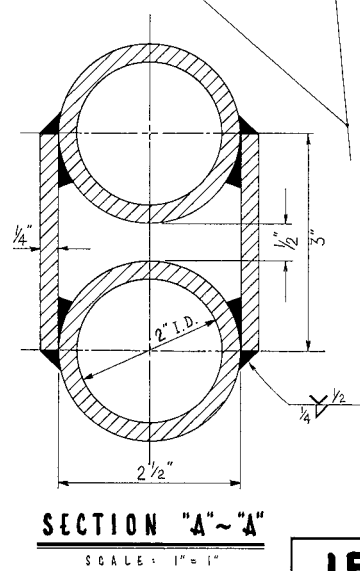
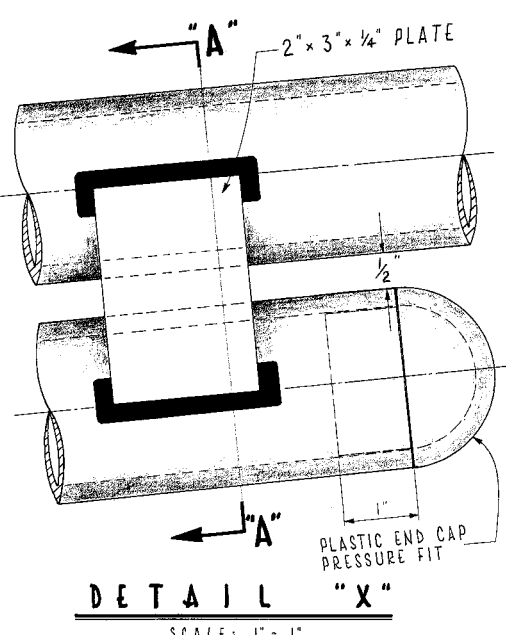
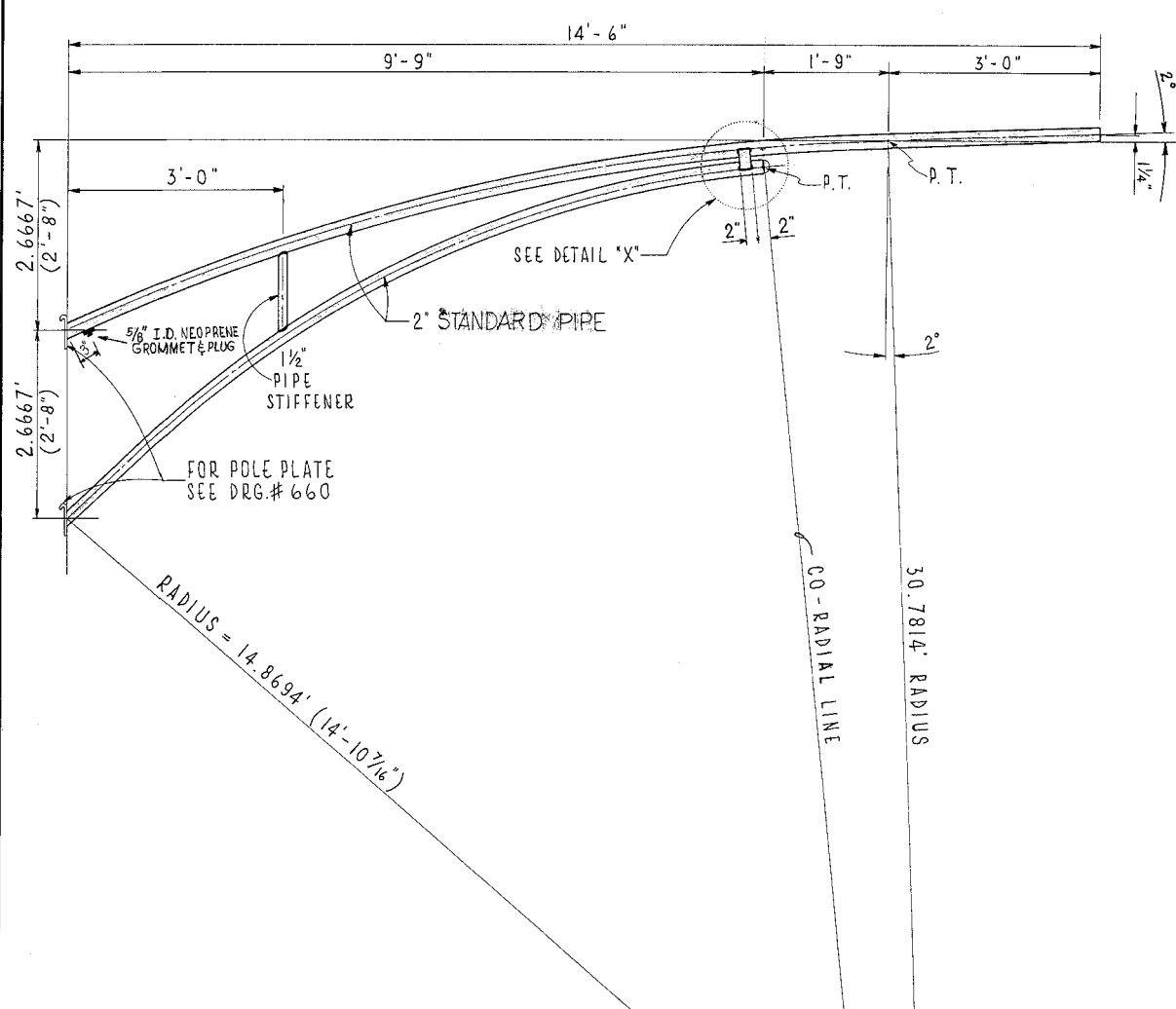


SECTION "A-A"
SCALE 1" = 1"

**12' MAST ARM
FOR 2-BOLT ATTACHMENT**

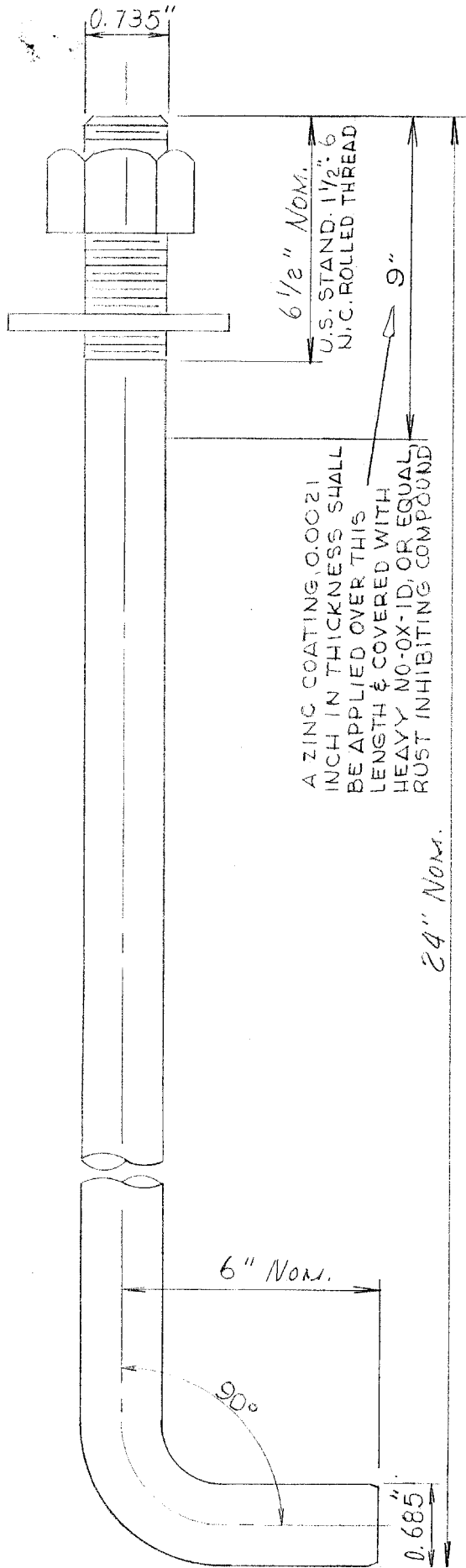
REVISED		CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
A		DRAWN BY E. GERULIS	CHECKED BY R. J. S.
B		ENGINEER M. J. S.	
C		SUPERVISING ENGINEER <i>Robert J. Menta</i>	
D		EQUIPMENT ENGINEER <i>W. J. S.</i>	
E		DETAILS ENGINEER <i>Paul J. Simpson</i>	
F		SIZE 17 x 28 SCALE 1" = 1" OR AS NOTED	
G		DATE 7-8-1985	

839



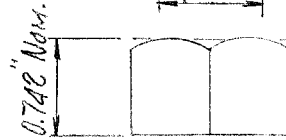
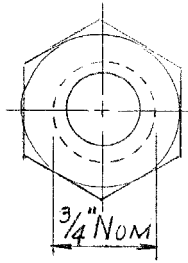
**15' MAST ARM
FOR 2-BOLT ATTACHMENT**

REVISED	CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
A	DRAWN	CHECKED	ENGINEER
B	EDUENE GERULIS	R. J. S.	M. J. S.
C	SUPERVISING ENGINEER		DRG. NO.
D	ENGINEER OF ELECTRICITY		840
E	DEPT. COMM. ENGINEER		
F	DATE		JULY 8, 1985
G	SIZE 17 X 28	SCALE	DATE



A ZINC COATING, 0.0021 INCH IN THICKNESS SHALL BE APPLIED OVER THIS LENGTH & COVERED WITH HEAVY NO-OX-ID, OR EQUAL, RUST INHIBITING COMPOUND

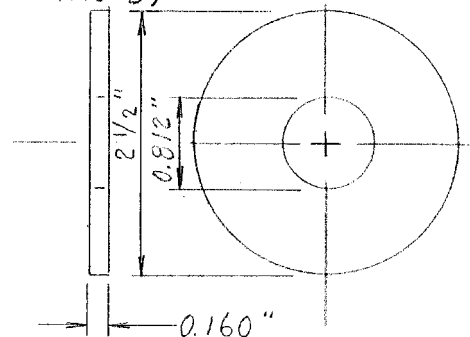
24" Nom.



1.231" Nom.

HEXAGON NUT

AMER. NAT'L. STD. HEAVY HEX. FLAT NUT (ANSI B18.22.1-1965, R1975)

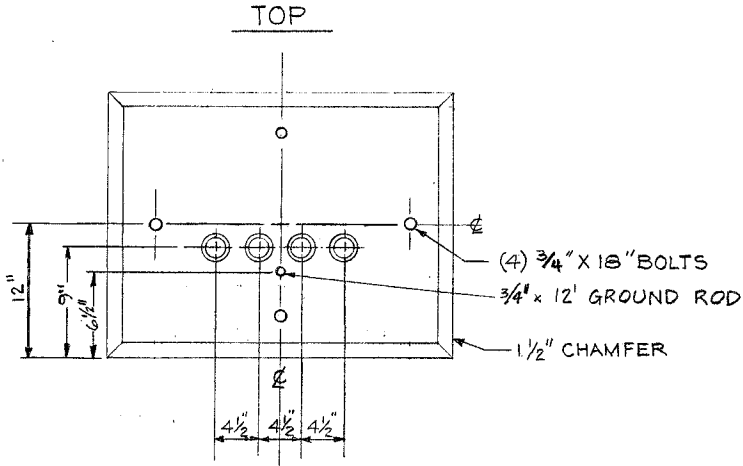


FLAT WASHER

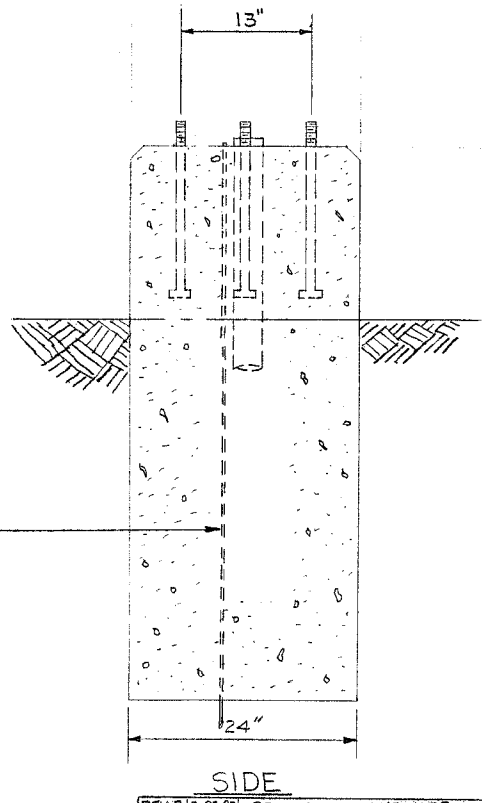
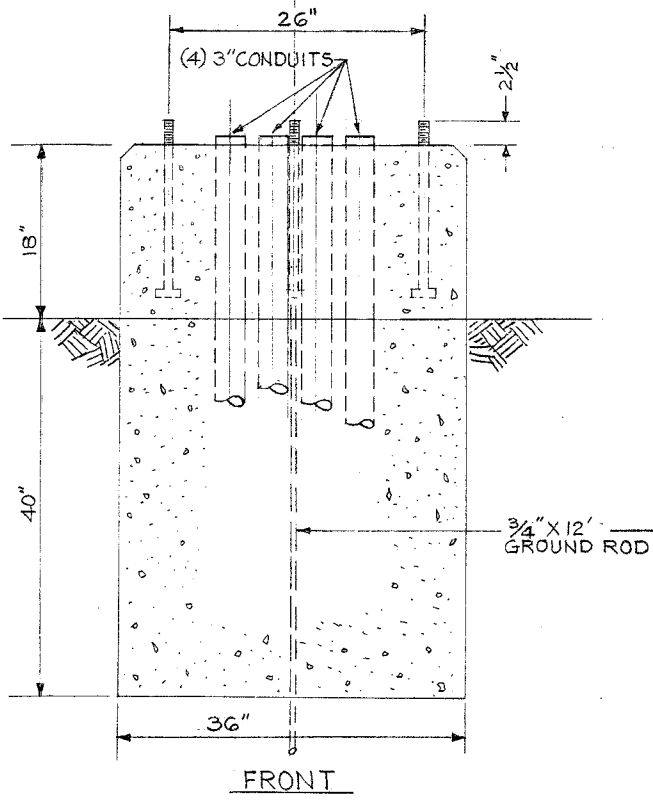
MATERIAL

A.S.T.M. A-36 MODIFIED STEEL, 55,000 LBS MINIMUM YIELD. HARDWARE TO BE FURNISHED & ATTACHED IN PLACE ON ROD FOR SHIPPING; 1 HEX NUT HEAVY GALV. 1 1/2". 1 WASHER, STEEL, ROUND GALV., TYPE "B", SERIES "W", 1 1/2" BOLT & NUT SHALL HAVE AN AMERICAN STANDARD CLASS 2 OR 3 FIT. (NUT IS TAPPED OVERSIZE BY 1/32")

3/4" x 30"		
STEEL ANCHOR ROD		
COMMODITY CODE 37-8180-0130		
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
DRAWN RESPI NO	CHECKED R.J.S.	ENGINEER A. DUKELSKY
Michael J. Shine ENGINEER OF ELECTRICITY		DRG. NO. 844
GEN'L. SUPT. OF ELECTRICITY		
SIZE 8 1/2 x 14	DEPUTY COMM. SCALE	DATE 10-31-85



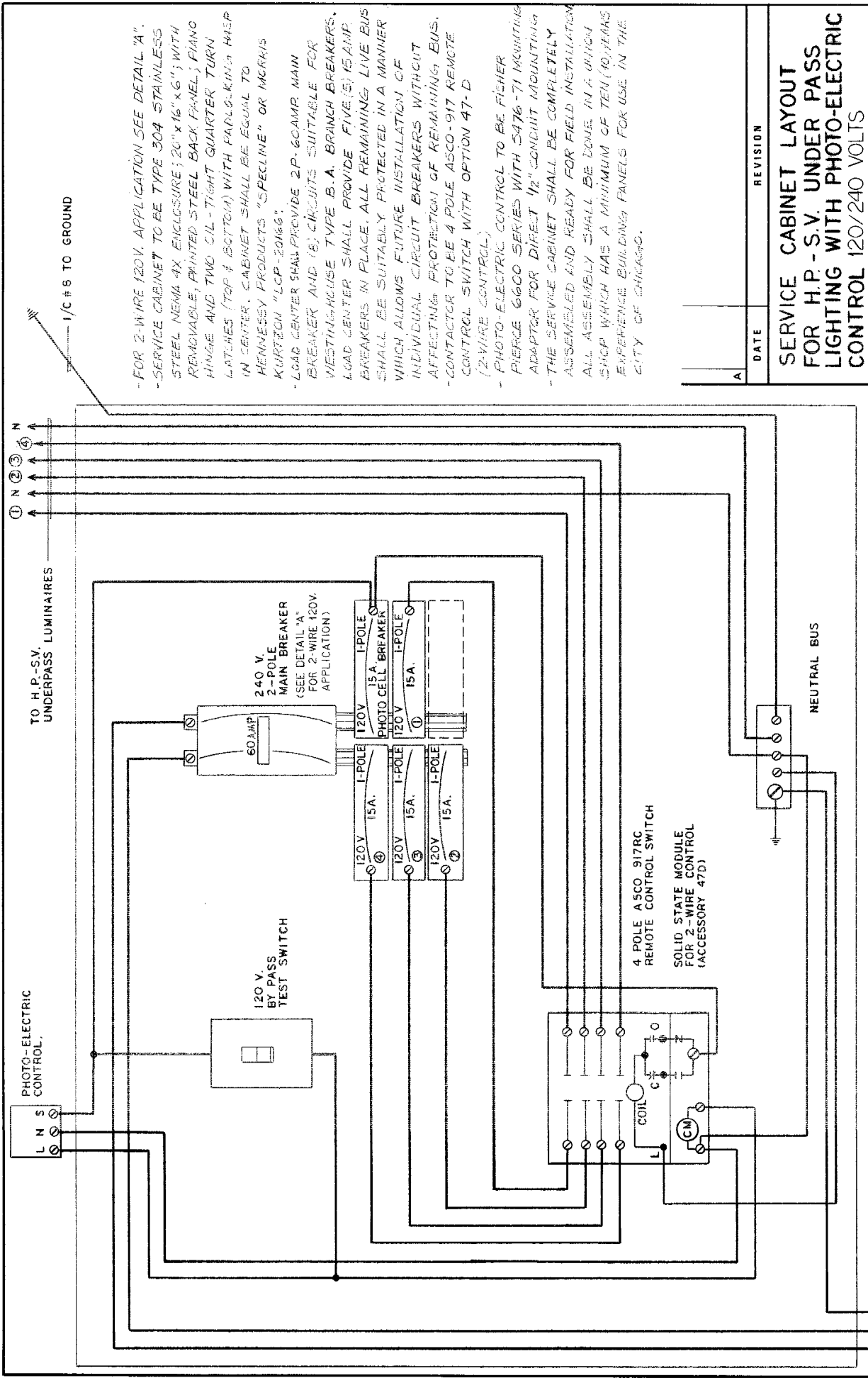
DIMENSIONS FOR LOCATION OF ANCHOR BOLTS TO BE STRICTLY ADHERED TO.



REV. B 9-23-93 RELOCATE CONDUITS
 REV. A 9-1-93 CHANGE ANCHOR BOLT SIZE FROM 1/2" TO 3/4"

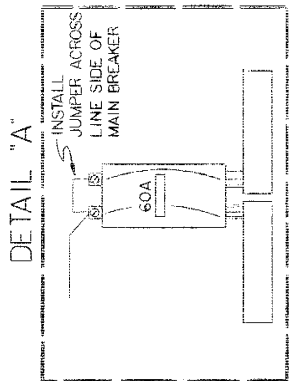
FOUNDATION
 TYPE "M" BASE MOUNT
 TRAFFIC SIGNAL CONTROL CABINET

REVISED		CITY OF CHICAGO	
		DEPT. OF STREETS AND SANITATION	
		BUREAU OF ELECTRICITY	
		DIVISION OF ELECTRICAL ENGINEERING	
A		DRAWN	ENGINEER
B		R.L.J.	W. TRÖMPKA
C		CHECKED	DRG. NO.
D		A. Dubelsky	
E		ENGINEER OF ELECTRICITY	
F		854	
G		DEPT. OF COM. DEPUTY COMM.	
	SIZE 17 x 21	SCALE	DATE 9-19-89



- FOR 2-WIRE 120V. APPLICATION SEE DETAIL "A".
- SERVICE CABINET TO BE TYPE 304 STAINLESS STEEL NEMA 4X ENCLOSURE; 20" x 16" x 6" WITH REMOVABLE, PAINTED STEEL BACK PANEL; FLANG HINGE AND TWO CIL - TIGHT QUARTER TURN LATCHES (TOP & BOTTOM) WITH PADLOCKING HAP IN CENTER. CABINET SHALL BE EQUAL TO HENNESSY PRODUCTS "SPECLINE" OR MERRIS KURTTON "LCP-2016".
- LOAD CENTER SHALL PROVIDE 2P-60AMP MAIN BREAKER AND (6) CIRCUITS SUITABLE FOR WRESTINGHOUSE TYPE B. A. BRANCH BREAKERS. LOAD CENTER SHALL PROVIDE FIVE (5) 15AMP. BREAKERS IN PLACE. ALL REMAINING LIVE BUS SHALL BE SUITABLY PROTECTED IN A MANNER WHICH ALLOWS FUTURE INSTALLATION OF INDIVIDUAL CIRCUIT BREAKERS WITHOUT AFFECTING PROTECTION OF REMAINING BUS.
- CONTACTOR TO BE A POLE ASCO-917 REMOTE CONTROL SWITCH WITH OPTION 47-D (2-WIRE CONTROL)
- PHOTO-ELECTRIC CONTROL TO BE FISHER PIERCE 6600 SERIES WITH 5476-71 MOUNTING ADAPTOR FOR DIRECT 1/2" CONDUIT MOUNTING
- THE SERVICE CABINET SHALL BE COMPLETELY ASSEMBLED AND READY FOR FIELD INSTALLATION
- ALL ASSEMBLY SHALL BE DONE IN A UTILITY SHOP WHICH HAS A MINIMUM OF TEN (10) YEARS EXPERIENCE BUILDING PANELS FOR USE IN THE CITY OF CHICAGO.

DATE	REVISION
SERVICE CABINET LAYOUT FOR H.P. - S.V. UNDER PASS LIGHTING WITH PHOTO-ELECTRIC CONTROL 120/240 VOLTS	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: SHA KIL AHMED	ENGINEER: S. KIRSHNER
CHIEF DRAFTSMAN: C. R.	DWG. NO. 861
SUPERVISING ENGINEER: DENG CHEN	
ENGINEER OF ELECTRICITY: Al D. [Signature]	
SUPV. OF CONSTRUCTION: [Signature]	
DEPUTY COMMISSIONER: [Signature]	
SIZE: 16" x 21"	SCALE: NONE
	DATE: 10-01-90



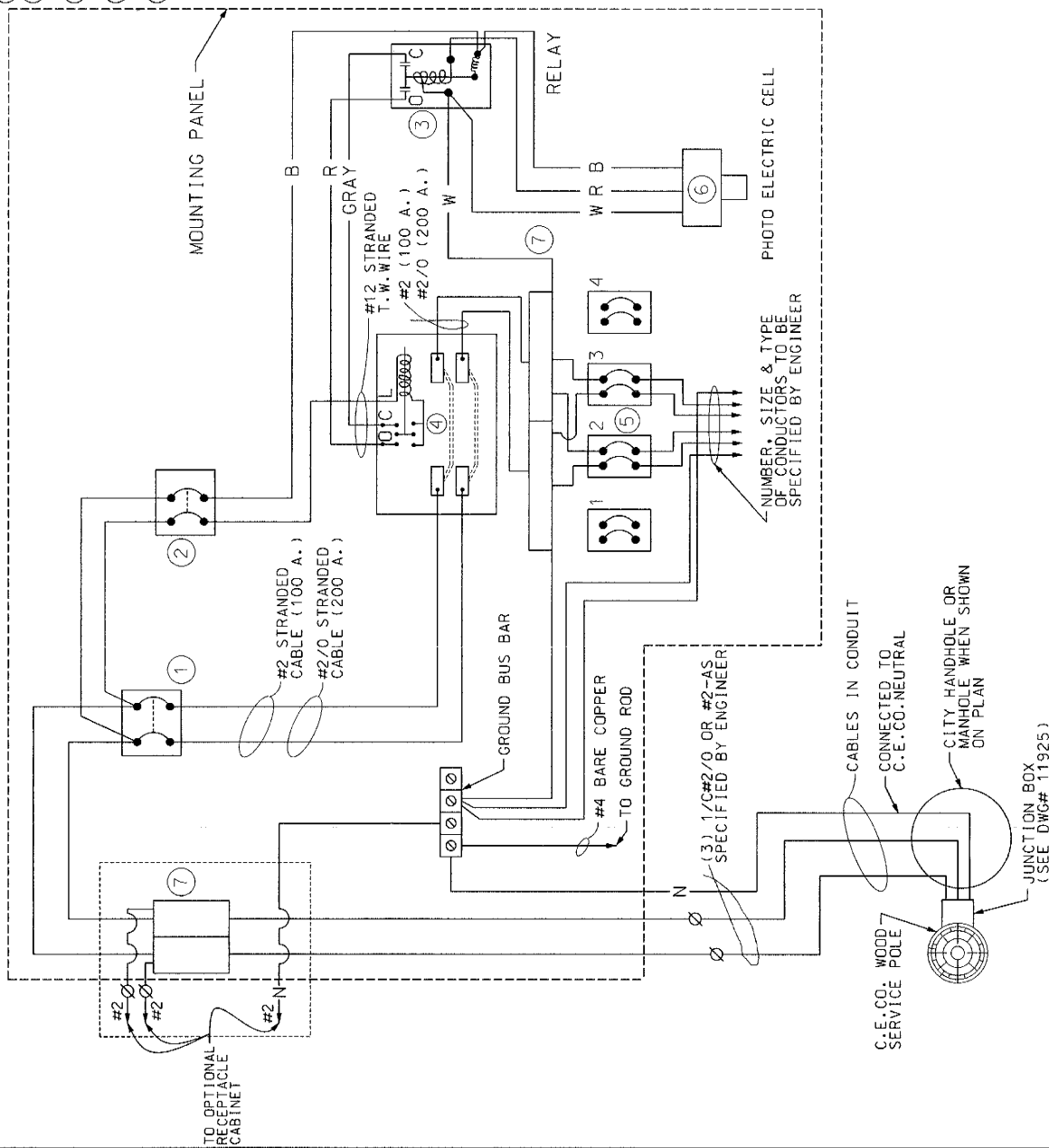
TO C. E. CO. 120 / 240 V SERVICE

- ① - CIRCUIT BREAKER-2 POLE, 100A "FDB" FRAME OR 2 POLE, 200A, "JDB" FRAME (WESTINGHOUSE CO.)
- ② - MANUAL STARTER-2 POLE, 5.3A, THERMAL OVERLOAD (SQUARE D, CLASS 2510, TYPE FO-2)
- ③ - RELAY (POTTER-BRUNFIELD PRD 5AYO-120)
- ④ - REMOTE CONTROL SWITCH-2 POLE, 100A, OR 2 POLE, 200A, 240V. A.C. COIL (AUTOMATIC SWITCH CO.)
- ⑤ - BRANCH CIRCUIT BREAKER-2 POLE, 50A., OR 70A. "EHD" FRAME, (WESTINGHOUSE CO.)
- ⑥ - PHOTO ELECTRIC CELL (FISHER PIERCE "NIGHTLICHTER", MODEL FA105, 1000 WATT.)
- ⑦ - POWER DISTRIBUTION BLOCKS

NOTES :

- 1. MOUNT PHOTOCCELL IN BOTTOM OF CABINET AT RIGHT SIDE. BOTTOM OF PHOTOCCELL TO BE FLUSH OR SLIGHTLY ABOVE OUTSIDE EDGE OF CABINET.
- 2. GROUND BUS TO BE MOUNTED ON LEFT SIDE WALL OF CABINET (SEE DETAIL DRG. NO. 883 AND 884)
- 3. SEE DRG. NO. 883 FOR DETAIL OF MOUNTING PANEL.
- 4. SEE DRG. NO. 884 FOR DETAIL OF MOUNTING PANEL.

SEE DRG. # 876 FOR CABINET ASSEMBLY (100 AMP.)
SEE DRG. # 880 FOR CABINET ASSEMBLY (200 AMP.)



A	DATE	REVISION

WIRING DIAGRAM FOR 100/200 AMP. SINGLE PHASE 240V. STREET LIGHTING CONTROLLER WITH PHOTO CELL (120V.)

CITY OF CHICAGO
Department of Transportation
Division of Street Lighting

CHIEF DESIGNER: ENGINEER

CAMPADYAR

SUPERVISOR: ELECT. DESIGN ENGR.

ENGINEER OF ELECTRICITY IN CHARGE

DESIGNED BY: ELECTRICIAN

DRAWN BY: ELECTRICIAN

DATE: 5/31/13

SCALE: NONE

DWG. NO. 862

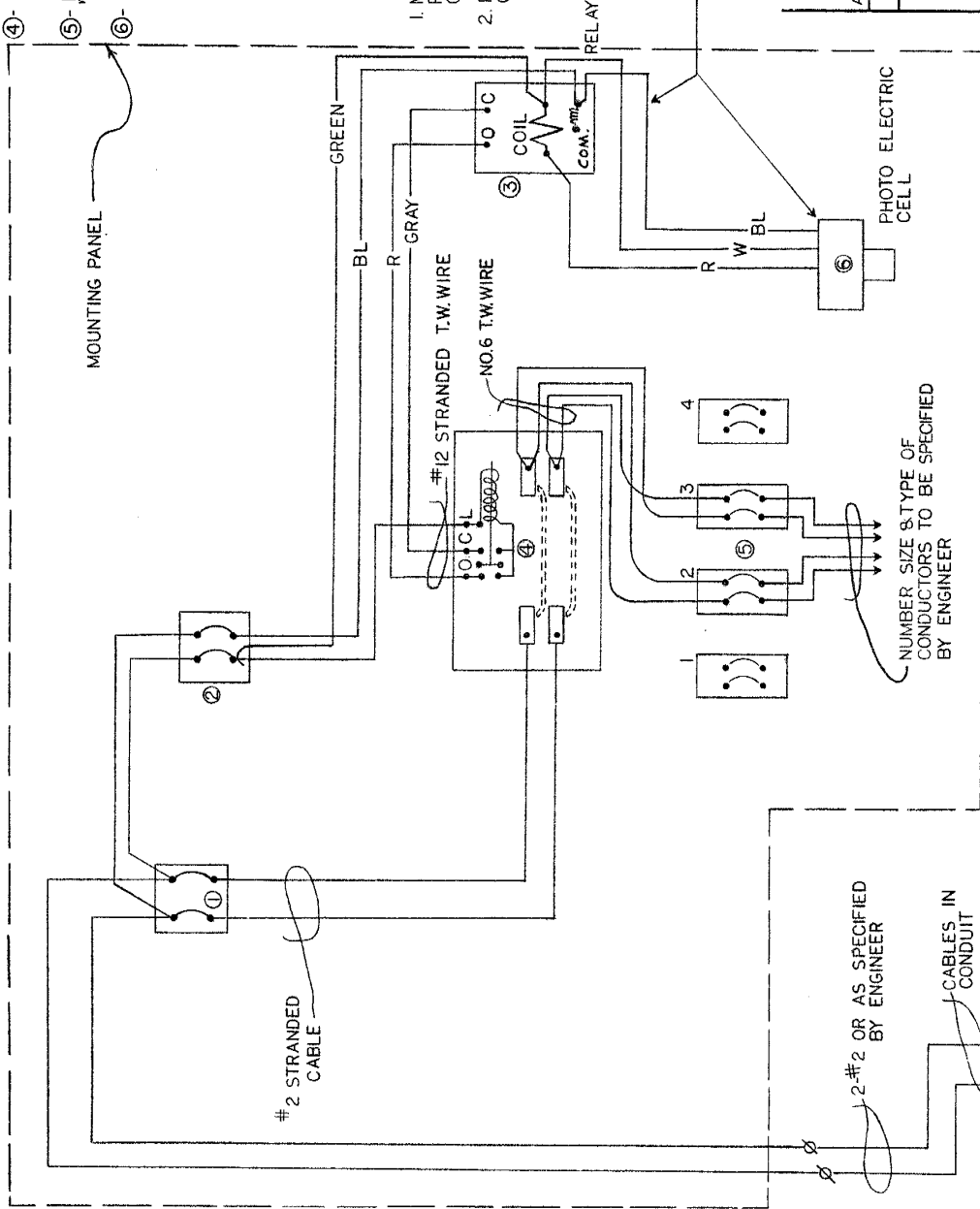
- ① - CIRCUIT BREAKER-2 POLE, 100A. "FD5" FRAME (W.E.CO.)
- ② - CIRCUIT BREAKER-2 POLE, 5.3A THERMAL MAGNETIC
- ③ - RELAY (POTTER BRUMFIELD PRD 5A50-240)
- ④ - REMOTE CONTROL SWITCH -2 POLE, 100A 240V. A. C. COIL (AUTOMATIC SWITCH CO.)
- ⑤ - BRANCH CIRCUIT BREAKER-2 POLE, 50A., OR 70A. "EHD" FRAME (W.E. CO.)
- ⑥ - PHOTO ELECTRIC CELL (FISHER PIERCE "NIGHT LIGHTER" MODEL FA105 FOR 240 VOLTS 1000 WATTS.

SEE DRG. #11883 FOR CABINET DRAWING

NOTES

- 1. MOUNT PHOTOCELL IN BOTTOM OF CABINET AT RIGHT SIDE. BOTTOM OF PHOTOCELL TO BE FLUSH OR SLIGHTLY ABOVE OUTSIDE EDGE OF CABINET.
- 2. PRD RELAY TO BE MOUNTED ON RIGHT SIDE WALL OF CABINET.

WHITE PAINT APPLIED TO SIDE OF RELAY & PHOTO-CELL INDICATES 240 V. APPLICATION.



REVISION	
DATE	
A	

WIRING DIAGRAM FOR 100 AMP SINGLE PHASE 240V. STREET LIGHTING CONTROLLER WITH PHOTO CELL (240V)

CITY OF CHICAGO
DEPT. OF STREETS AND SANITATION
DIVISION OF ELECTRICAL ENGINEERING

DRAFTSMAN: BOB IVY | CHIEF DRAFTSMAN: W. TROMPKA
ENGINEER: C. RESPINO | D.W.G. NO. 863

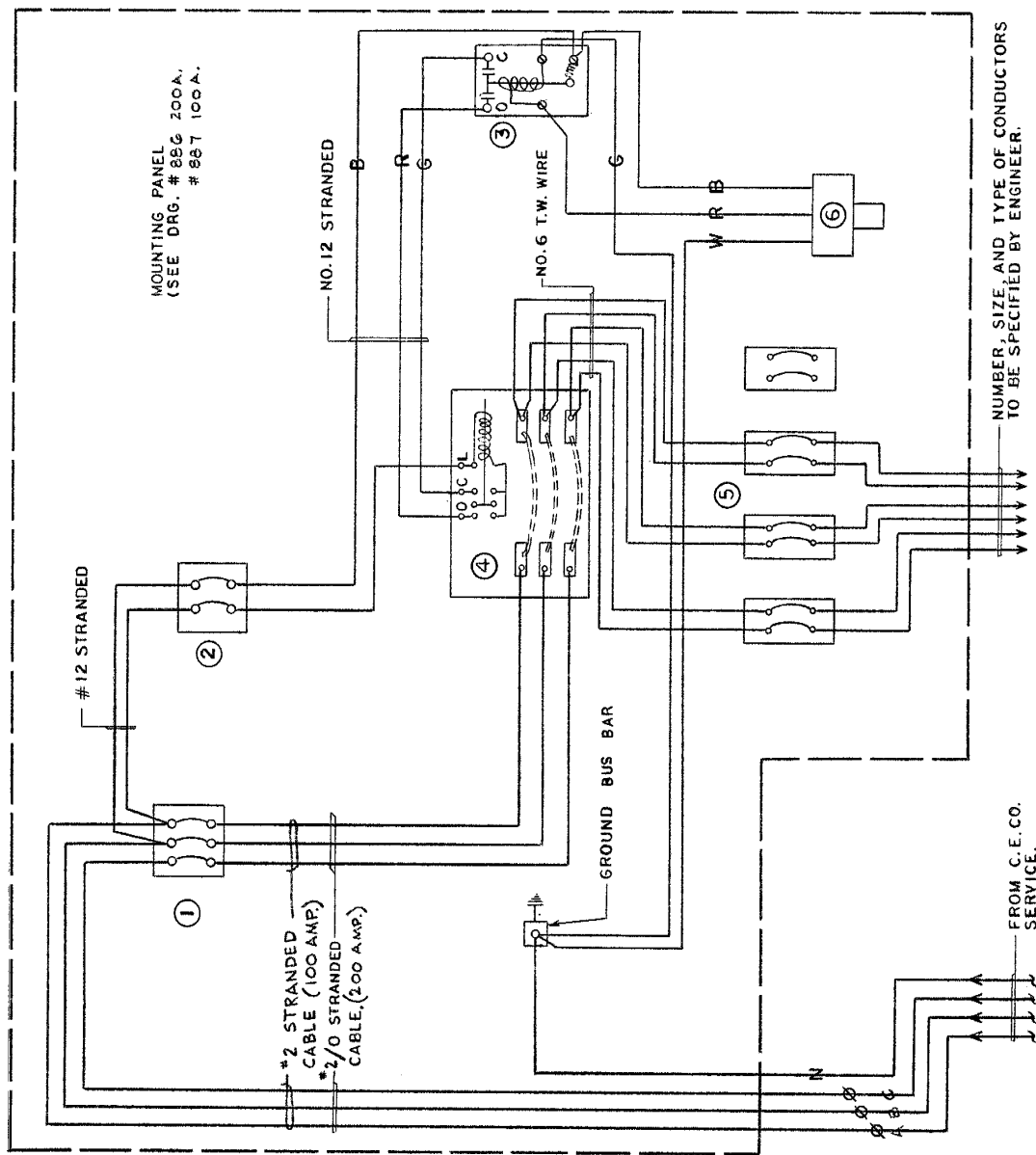
SUPERVISING ENGINEER: A. Danekelsky

ENGINEER OF ELECTRICITY: A. Danekelsky
SUPT. OF CONSTRUCTION: A. Danekelsky
DEPUTY COMMISSIONER: A. Danekelsky

SIZE: 16X21 | SCALE: NONE | DATE: 10-14-90

- ① CIRCUIT BREAKER - 3 POLE, 100A, "FDB" FRAME OR 200A, "LDB" FRAME (WESTINGHOUSE CO.)
- ② - MANUAL STARTER - 2 POLE, 5-3A, THERMAL OVERLOAD (SQUARE D CLASS 2510, TYPE FO-2)
- ③ - RELAY (POTTER BRUMFIELD PRD 54Y0-120)
- ④ - REMOTE CONTROL SWITCH - 3 POLE, 100A, OR 200A, 240V, AC, COIL, AUTOMATIC SWITCH CO.)
- ⑤ - BRANCH CIRCUIT BREAKER - 2 POLE, 50A, OR 70A, "END" FRAME, (WESTINGHOUSE CO.)
- ⑥ - PHOTO ELECTRIC CELL DARK TO LIGHT MODEL DB120 - 1.5HT 105 - 130 VAC 60HZ.

- SEE DRG. NO. 876 FOR CABINET ASSEMBLY.
- MOUNT PHOTO-CELL IN BOTTOM OF CABINET AT RIGHT SIDE, BOTTOM OF PHOTO-CELL TO BE FLUSH OR SLIGHTLY ABOVE OUTSIDE EDGE OF CABINET.
- GROUND BUS TO BE MOUNTED ON LEFT SIDE WALL OF CABINET (SEE DETAIL DRG. # 887 DRG. # 886)



NUMBER, SIZE AND TYPE OF CONDUCTORS TO BE SPECIFIED BY ENGINEER.

FROM C. E. CO. SERVICE.

DATE REVISION

WIRING DIAG. FOR 100/200 AMP. THREE PHASE 120/208V. STREET LIGHTING CONTROLLER WITH PHOTO-CELL CONTROL.

CITY OF CHICAGO
DEPT. OF PUBLIC UTILITIES
BUREAU OF ELECTRICAL ENGINEERING

DRAFTSMAN: SHAKIL AHMED
CHIEF DRAFTSMAN: CARMEN RESPIN
ENGINEER: W. TROMKA

SUPERVISING ENGINEER: [Signature]
ELEC. DESIGN ENGR.
ENGINEER OF ELECTRICITY: [Signature]

GEN'L. SUPT. OF ELECTRICITY: A. Dukelsky
DEPUTY COMMISSIONER: [Signature]

DWG. N.O. 864

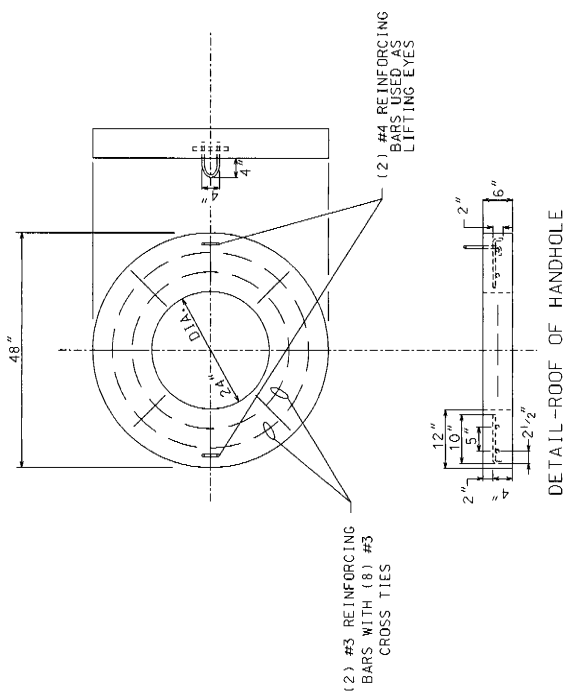
SIZE: 17 x 22

SCALE: NONE

DATE: 10/14/90

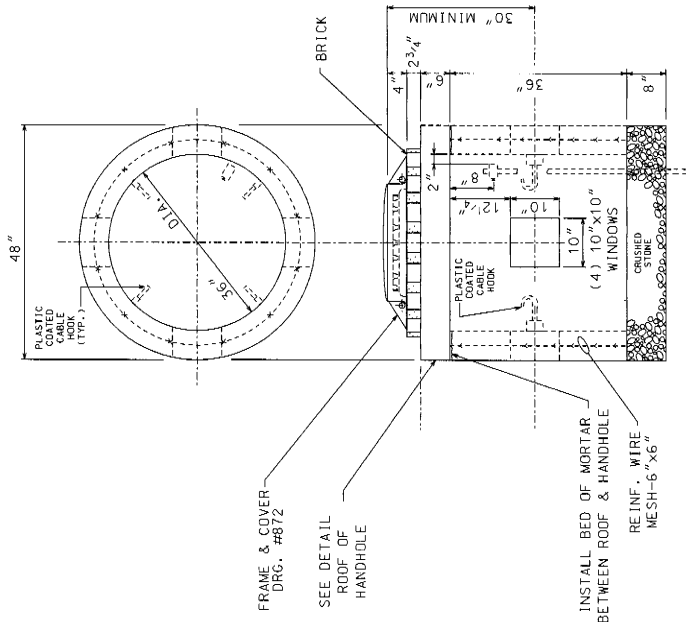
COMPLETE COMMODITY CODE NO. 05-6610-5310M

CODE NO.	MATERIALS	SIZE	QUAN.
05-6610-5312	PRE-CAST HANDHOLE	36" x 36"	
05-6610-5312	PRE-CAST ROOF	SEE DETAIL	1
05-9075-5470	STORED, CRUSHED SCREENINGS	BAG	5
05-1452-9720	BRICK		24
02-4299-5524	FRAME, MANHOLE	24"	1
02-4574-5624	COVER, MANHOLE	24"	1
09-7796-9312	GROUND ROD	3/4" x 12'	1
09-2636-3240	GROUND CLAMP		1
05-5082-5330	SONO TUBE	36"	1
05-5082-5342	SONO TUBE	48"	1
05-3267-2940	CONC. RED-MIX	CU. YD.	3/4
20-5472-9630	REINFORCING BAR	#3 (3/8")	20'
20-5472-9630	REINFORCING BAR	#3 (3/8")	8'
20-5472-9640	REINFORCING BAR	#4 (1/2")	4'
57-0770-0000	WESH (6" X6")	36" X 11'	1



DETAIL - ROOF OF HANDHOLE

TOP VIEW
FRAME, COVER & TOP
OF HANDHOLE REMOVED



SIDE ELEVATION

CONSTRUCTION NOTES:

- 1 - 8" BED OF STONE FOR DRAINAGE.
- 2 - ALL METALLIC CONDUIT(S) ENTERING HANDHOLE SHALL EXTEND MIN. 1" & MAX. OF 3" INSIDE INNER WALL & BE EQUIPPED WITH AN APPROVED TYPE THREADED GROUNDING BUSHING.

(1) PRE-CAST HANDHOLE SHALL INCLUDE CABLE HOOPS AND CONDUIT KNOCK-OUTS.
 (2) PRE-CAST ROOF SHALL INCLUDE LIFTING EYES.
 (3) THESE ITEMS ARE FOR POURED-IN-PLACE HANDHOLES ONLY.

DATE	REVISION
8/1/2008	ADD CABLE HOOPS AND CONDUIT KNOCK-OUTS
8/1/2008	REVISION (ADD.)

36" DIA. HEAVY DUTY
CONCRETE HANDHOLE
WITH 24" FRAME &
COVER

CITY OF CHICAGO
DEPARTMENT OF PUBLIC WORKS
DIVISION OF STREET AND SANITATION
OFFICE OF THE SUPERVISOR

DESIGNED BY: M. PATTON
CHECKED BY: B. CLAYTON
SUPERVISING ENGINEER: ELLIOTT DESIGN GROUP, INC.
ENGINEER OF RECORD: ELLIOTT DESIGN GROUP, INC.
DATE OF PRELIMINARY: 8/1/2008
DATE OF REVISION: 8/1/2008
SCALE: 1" = 1'-0"

DWG. NO. 866

DATE: 1-12-96

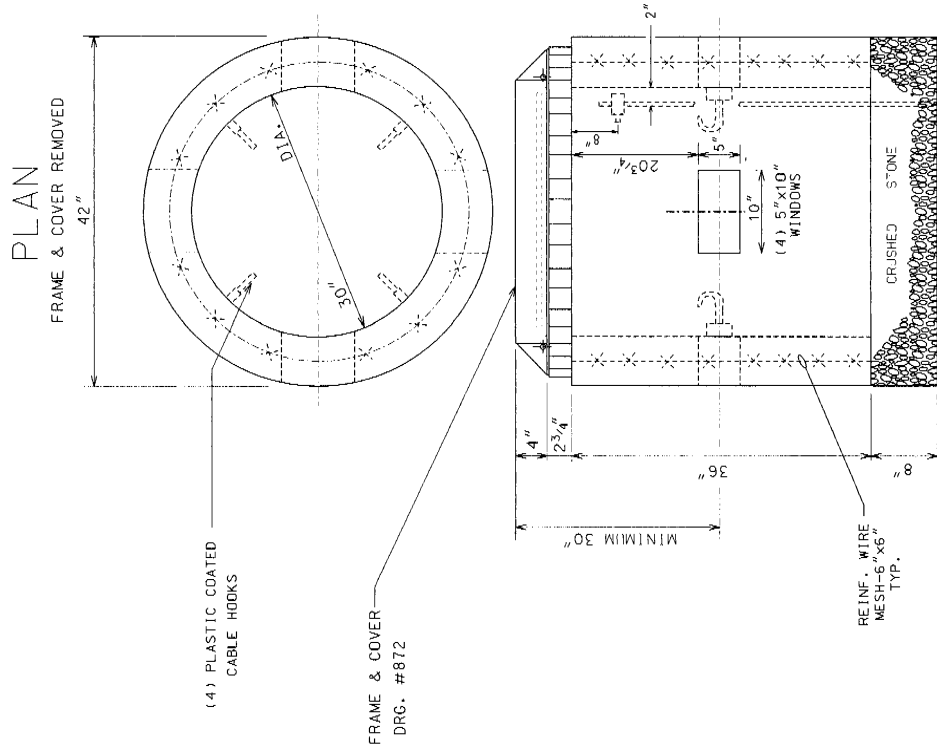
COMPLETE COMMODITY CODE NO. 05-6610-5310M

CODE NO.	MATERIALS	SIZE	QUAN.
(1) 05-6610-5310	PRE-CAST HANDHOLE	30" X 36"	1
(2) 05-9075-5470	STONE 3/4" CRJSHED	BAG	5
(2) 05-5082-5330	SOND TUBE	30"	1
(2) 05-5082-5342	SOND TUBE	42"	1
(2) 05-3267-2940	CONC. REDI-MIX	CU. YD.	1/2
(2) 57-0770-0000	6" X 6" MESH	36" X 10'	1
05-1452-9720	BRICK		24
02-4299-5524	FRAME MANHOLE	24"	1
02-4574-5040	COVER, MANHOLE	24"	1
09-7796-9312	GROUND ROD	3/4" X 12'	1
09-2630-3240	GROUND CLAMP		1

- (1) PRE-CAST HANDHOLE SHALL INCLUDE CABLE HOOKS AND CONDUIT KNOCKOUTS.
- (2) THESE ITEMS ARE FOR POURED-IN-PLACE HANDHOLES ONLY.

CONSTRUCTION NOTES:

- 1. 8" BED OF STONE FOR DRAINAGE.
- 2. ALL METALLIC CONDUITS ENTERING HAND-HOLE SHALL EXTEND MINIMUM 1" & MAXIMUM 3" INSIDE INNER WALL AND BE EQUIPPED WITH AN APPROVED TYPE OF THREADED GROUNDING BUSHING.



30" DIA.
CONCRETE HANDHOLE

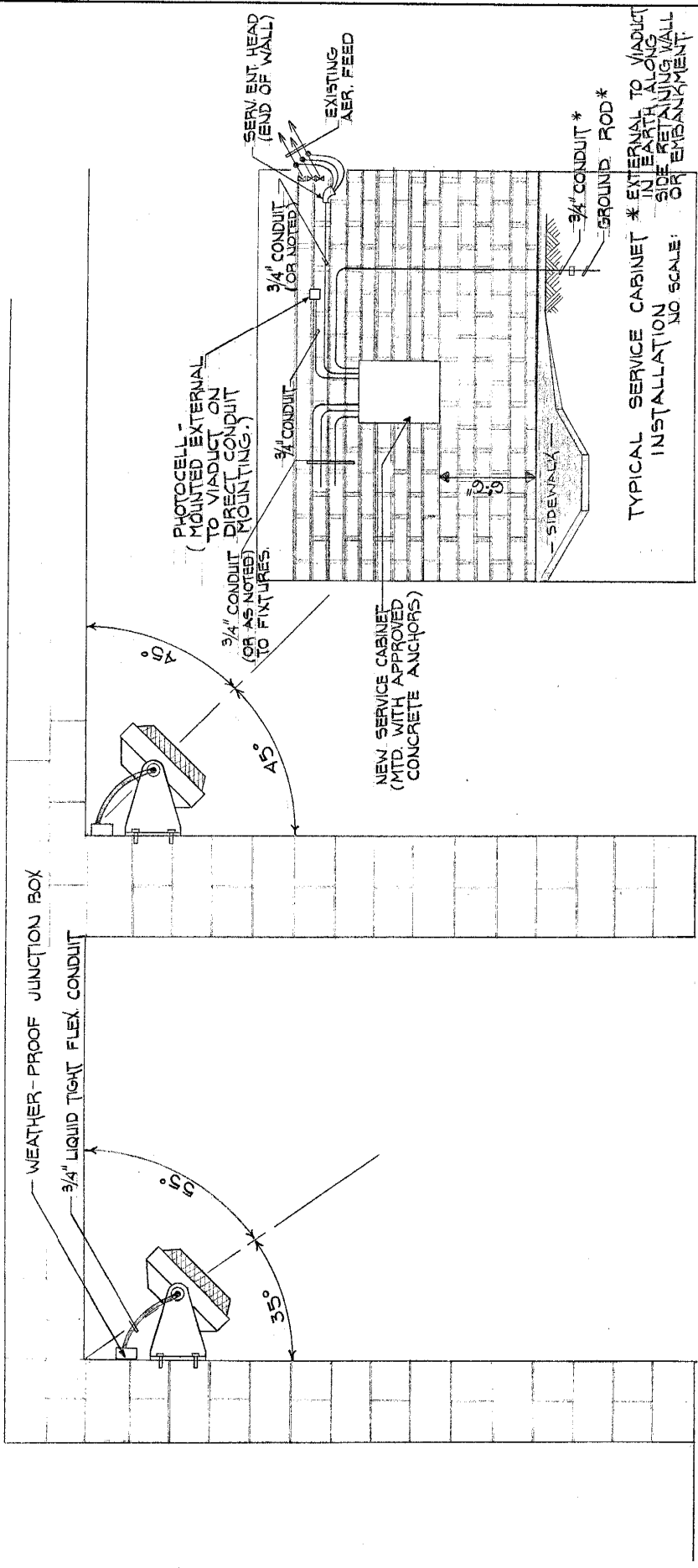
CITY OF CHICAGO

DATE: _____ REVISION: _____

BY: _____ CHECKED: _____

DATE: _____

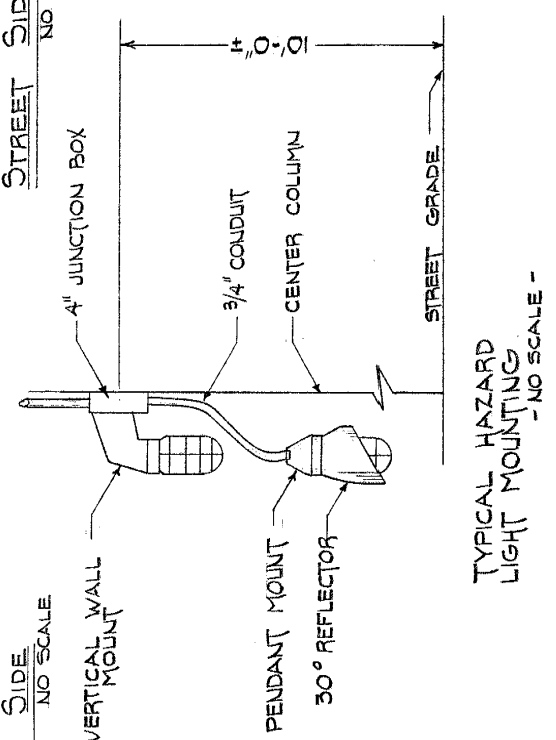
867



TYPICAL SERVICE CABINET * EXTERNAL TO VIADUCT IN EARTH ALONG SIDE RETAINING WALL OR EMBANKMENT.
 NO SCALE

SIDEWALK SIDE
 NO SCALE

STREET SIDE
 NO SCALE



VIADUCT LIGHTING
 TYPICAL DETAILS

A		DATE	REVISION
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICAL ENGINEERING			
URAC SWAN R. CARTER	DEPT. SWAN C. RESPINO	ENGINEER ELEC. DESIGN ENGR.	DWG. NO. 869
ENGINEER OF ELECTRICITY GEN. L. SUPT. OF ELECTRICITY		A. D. D. D. D.	
DEPUTY COMMISSIONER		DATE: 8-1-91	
SIZE: 16" x 21"		SCALE: NONE	

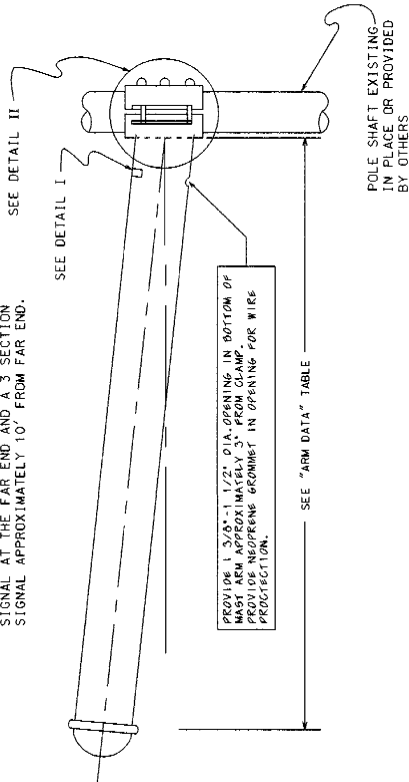
ARM DATA

CLAMP RANGE (INCHES)	POLE END (INCHES)	SIGNAL END (INCHES)	LENGTH (FEET)	GAUGE	WEIGHT (POUNDS)	TEST LOAD (POUNDS)	MAX. DEFLECTION (INCHES)
7.45-7.95	7.0	4.76	16	7	241	1700	6.5
7.45-7.95	7.0	4.20	20	7	274	1300	12.0
7.45-7.95	7.0	3.36	26	7	315	1000	24.0
8.45-8.95	8.0	3.80	30	7	409	1100	29.0
9.95-10.45	9.0	4.10	35	7	529	1200	36.0
9.95-10.45	9.0	3.40	40	7	559	1000	52.0
9.95-10.45	10.0	3.84	44	7		1200	57.0

NOTES:

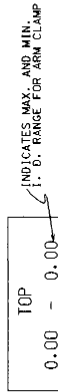
- TRAFFIC SIGNAL ARM SHAFT ASTM DESIGNATION: A595 GRADE C, 60,000 PSI MINIMUM YIELD STRENGTH WITH A LINEAR TAPER -0.14"/FT.
- TRAFFIC SIGNAL ARM END CAP SECURED IN PLACE WITH 3 SET SCREWS AND 1 THRU ARM END BOLT. (PLATED HARDWARE)
- ALL THREADED FASTENERS TO BE GALVANIZED TO ASTM DESIGNATION: A153
- ALL VEHICULAR AND/OR PEDESTRIAN SIGNAL LIGHTS AND NECESSARY HARDWARE FOR ATTACHMENT TO BE FIELD LOCATED AND FURNISHED BY OTHERS.
- ALL ARM END CAPS AND ARM CLAMPS TO BE FULLY ASSEMBLED AND ATTACHED TO THE ARM PRIOR TO SHIPPING.
- ARM ASSEMBLY TO BE DEGREASED, CLEANED, CHEMICALLY PRETREATED; GIVEN AN EXTERIOR THERMOSETTING POLYESTER POWDER COAT; AND AN INTERIOR THERMOPLASTIC HYDROCARBON RESIN POWDER COAT.
- ALL PAINTING TO BE IN ACCORDANCE WITH SPECIFICATION 1454, SECTION 8.
- MAST ARM SHALL BE TESTED IN ACCORDANCE WITH SPECIFICATION 1454, SECTION 9 WITH TEST VALUES AS SHOWN ON THE "ARM DATA" TABLE.
- HOLE IN CLAMP TO BE 4.0" (MIN.). HOLE TO BE GROUND SMOOTH AND DEBURRED TO PROVIDE A SMOOTH WIRE ENTRY FROM POLE TO MAST ARM.

PROVIDE SUFFICIENT MAST ARM RISE (3" MIN.) SUCH THAT MAST ARM REMAINS SLIGHTLY ABOVE SIGNAL FROM THE TOP OF SECTION 1 AND 2. SIGNAL AT THE FAR END AND A 3 SECTION SIGNAL APPROXIMATELY 10' FROM FAR END.



PROVIDE 1 3/8" - 1 1/2" DIA. OPENING IN BOTTOM OF MAST ARM APPROXIMATELY 3" FROM CLAMP. PROVIDE NEOPRENE GROMMET IN OPENING FOR WIRE PROTECTION.

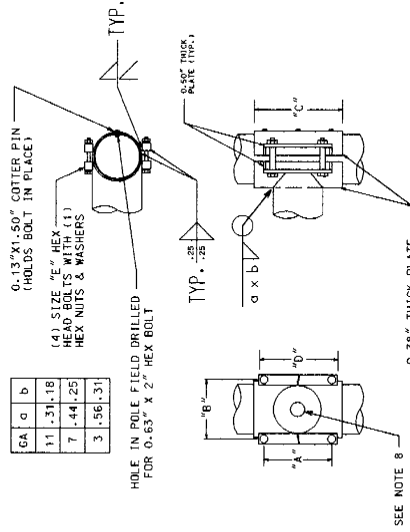
SEE "ARM DATA" TABLE



1. D. TAG TO BE MOUNTED ON THE TOP OF THE POLE AS INDICATED. USING 2 "CRIP-MAIL" FASTENERS.

DETAIL I
I. D. TAG

CLAMP RANGE	"A"	"B"	"C"	"D"	"E"
7.45" - 7.95"	7.25"	9.92"	10.80"	10.32"	1.00" X 7.50"
8.45" - 8.95"	9.00"	10.66"	13.06"	12.50"	1.00" X 8.00"
9.95" - 10.45"	10.25"	12.66"	15.30"	13.50"	1.25" X 8.50"



DETAIL II
ARM ATTACHMENT

15 10-10-02-RESERVED FOR 464
A 8-4-02 870 OPERATING MAST ARM
DATE
REVISED

STEEL TRAFFIC SIGNAL
MAST ARM-MONOTUBE

CITY OF CHICAGO
DEPT. OF PUBLIC WORKS
215 N. WABASH ST. CHICAGO, ILL. 60601

DESIGNED BY
R. IVY ROBERT CARTER, RON POOL

870

DATE 08/20/02
SCALE

COMPLETE COMMODITY CODE NO. 05-6610-5310M

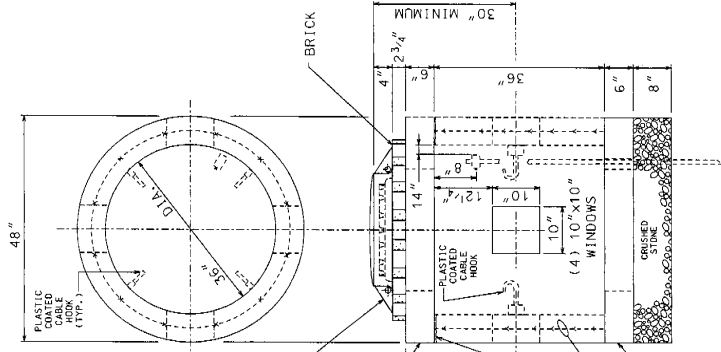
CODE NO.	MATERIALS	SIZE	QUAN.
(1) 05-6610-5312	PRE-CAST HANDHOLE	36" X 36"	1
(2) 05-6610-5312	PRE-CAST ROOF & FLOOR	SEE DETAIL	2
05-9075-5470	STONE 3/4"	CRUSHED BAG	5
05-1452-9720	BRICK		24
02-4299-5524	FRAME, MANHOLE	30"	1
02-4574-5624	COVER, MANHOLE	30"	1
09-7796-9312	GROUND ROD	3/4" X 12'	1
09-2636-3240	GROUND CLAMP		1
(3) 05-5082-5330	SOND TUBE	36"	1
(3) 05-5082-5342	SOND TUBE	48"	1
(3) 05-3267-2940	CONC. REDI-MIX	CU. YD.	1
(3) 20-5472-9630	REINFORCING BAR	#3 (3/8")	40'
(3) 20-5472-9630	REINFORCING BAR	#3 (3/8")	16'
(3) 20-5472-9640	REINFORCING BAR	#4 (1/2")	8'
(3) 57-0770-0000	(MESH (6" X 6"))	36" X 11'	1

- (1) PRE-CAST HANDHOLE SHALL INCLUDE CABLE HOOKS AND CONDUIT KNOCK-OUTS.
- (2) PRE-CAST ROOF & FLOOR SHALL INCLUDE LIFTING EYES.
- (3) THESE ITEMS ARE FOR POURED-IN-PLACE HANDHOLES ONLY.

CONSTRUCTION NOTES:

- 1 - 8" BED OF STONE FOR DRAINAGE.
- 2 - ALL METALLIC CONDUIT(S) ENTERING HANDHOLE SHALL EXTEND MIN. 1" & MAX. OF 3" INSIDE INNER WALL & BE EQUIPPED WITH AN APPROVED TYPE THREADED GROUNDING BUSHING.

TOP VIEW
FRAME, COVER & TOP
OF HANDHOLE REMOVED



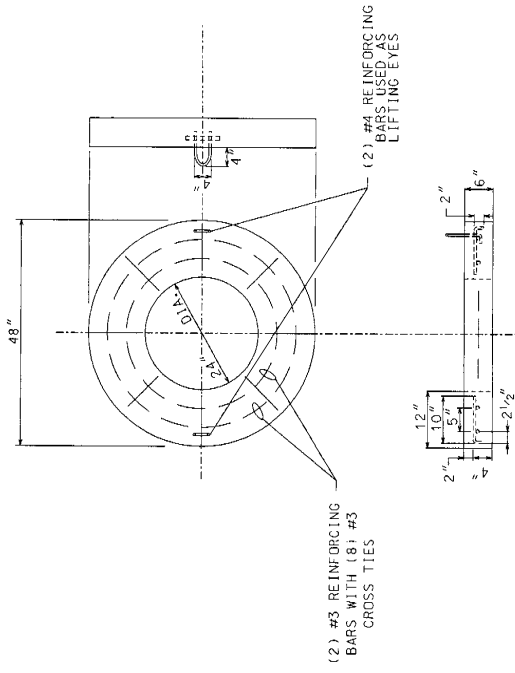
FRAME & COVER
DRG. #874 & 10927

SEE DETAIL
ROOF OF
HANDHOLE

INSTALL BED OF MORTAR
BETWEEN ROOF & HANDHOLE

REINF. WIRE
MESH-6" X 6"

SEE DETAIL
FLOOR OF
HANDHOLE



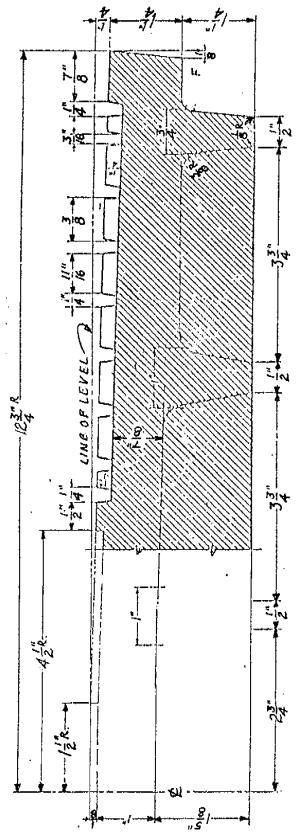
(2) #3 REINFORCING
BARS WITH 18" #3
CROSS TIES

(2) #4 REINFORCING
BARS WITH
LIFTING EYES

DETAIL-ROOF & FLOOR OF HANDHOLE

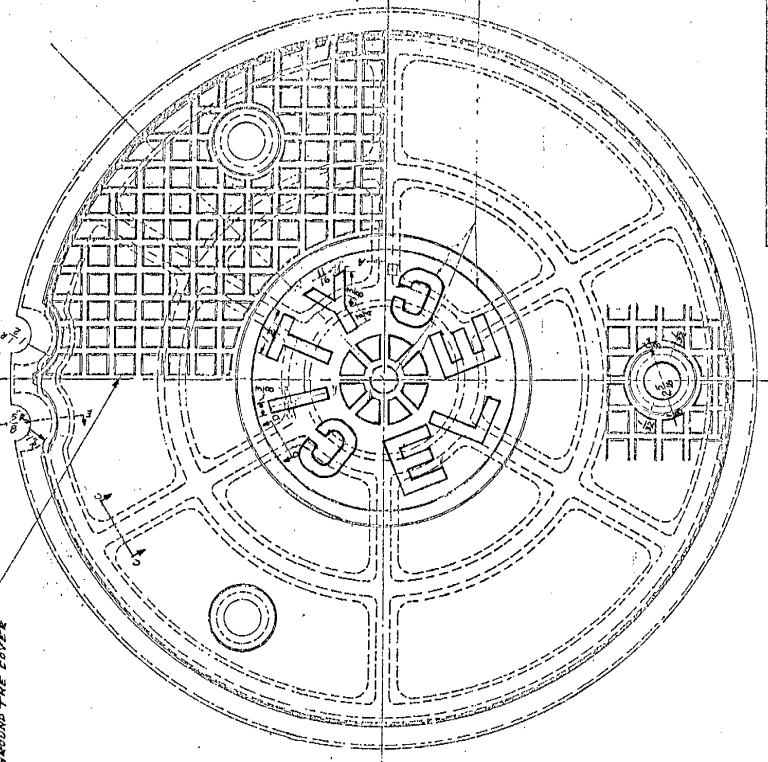
DATE	REVISION
8/1/20/00	ADDED CABLE HOOKS FOR CONDUIT ENTRY
8/1/20/00	REVISION (CADD)
8/1/20/00	36" DIA. HEAVY DUTY CONCRETE HANDHOLE WITH 30" FRAME & COVER FOR STREET INSTALLATION CITY OF CHICAGO DIVISION OF STREET AND SANITATION DIVISION OF ELECTRICAL ENGINEERING
DESIGNED BY M. PATTON	CHECKED BY B. CARTER
APPROVED FOR C. B. CARTER	DESIGNED BY N. DEBARTOLO
DATE OF RECORD 8/1/20/00	DATE OF RECORD 8/1/20/00
PROJECT NO. 871	PROJECT NO. 871
SHEET 171	SHEET 270
DATE 1-12-96	DATE 1-12-96

NOTE - THE TOP SURFACE OF THE 3 CIRCLES AND ALL OF THE LETTERS TO BE RAISED 1/8" ABOVE THE SURFACE WITHIN THE 9" DIAMETER WITH 1/4" DRAFT ANGLE.



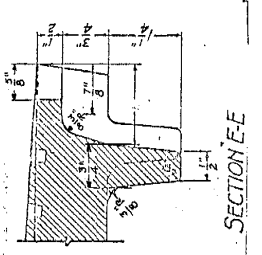
SECTION A-A

NOTE - GRID CHECKING TO RUN ENTIRELY AROUND THE COVER.

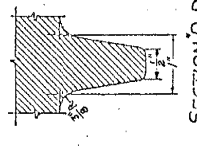


COVER (PLAN)
CAST IRON
APPROX. WEIGHT 205 LBS.

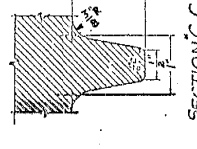
FRAME (QUARTER PLAN)
CAST GRAY IRON ASTM
A-48, CLASS 35 B
APPROX. WEIGHT 205 LBS.



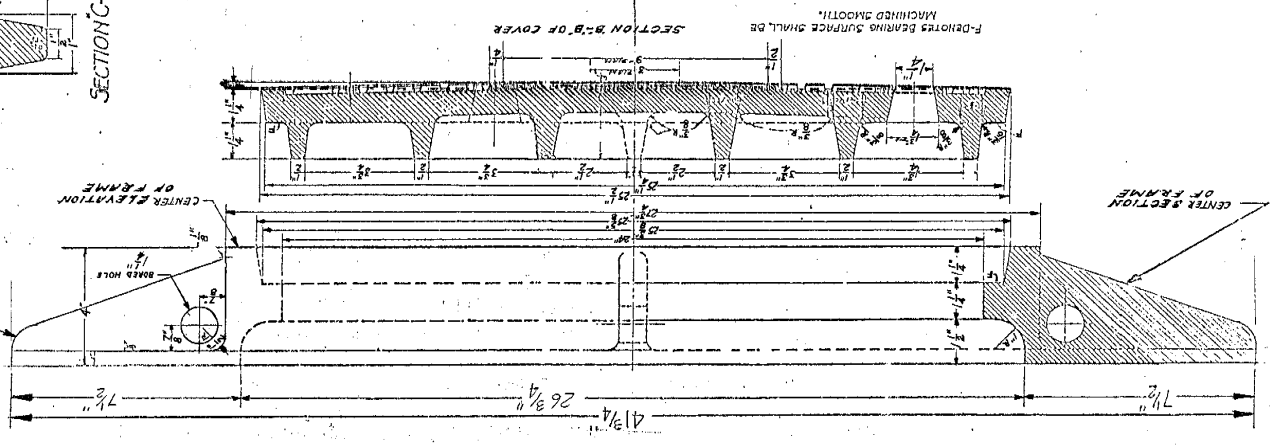
SECTION E-E



SECTION D-D



SECTION C-C



SECTION B-B OF COVER

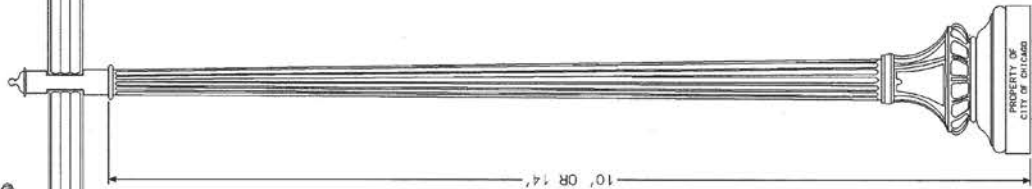
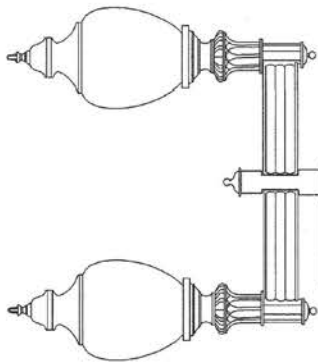
CENTER SECTION OF FRAME

CENTER ELEVATION OF FRAME

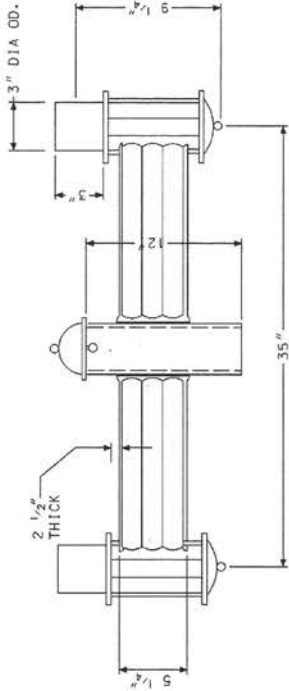
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL AND MECHANICAL SERVICES	
DESIGNED BY A. JOHNSON	CHECKED BY C. RESPIANO
SUPERVISING ENGINEER M. DE BARTOLO	
ENGINEER OF ELECTRICAL D. H. C. H. O'NEILL	
DRAWN BY ELECTRICIAN R. J. MURPHY	
DATE 4-24-32	
NO. 872	
SCALE 5/8"	

COMMODITY CODE
FRAME
COVER - 02 4574 - 5040

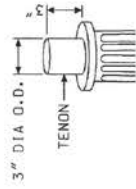
SUPERSEDES DWG# 10797
DATED 2-10-35



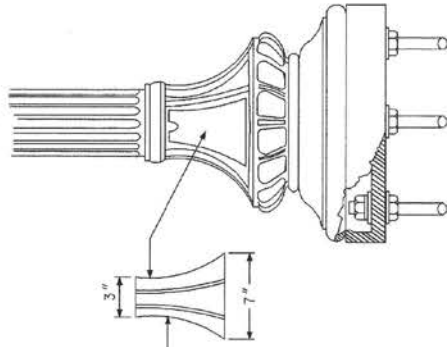
NOTE:--
THIS POLE CAN BE USED TO TENON MOUNT
1 LUMINAIRE OR 2 LUMINAIRES ON THE
TWIN ARM



TWIN ARM DETAIL

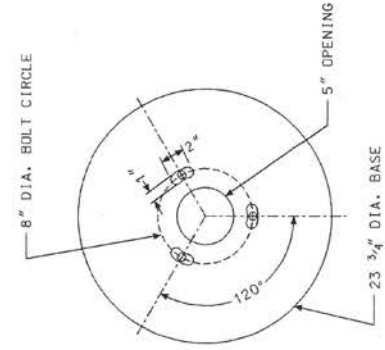


POLE TOP

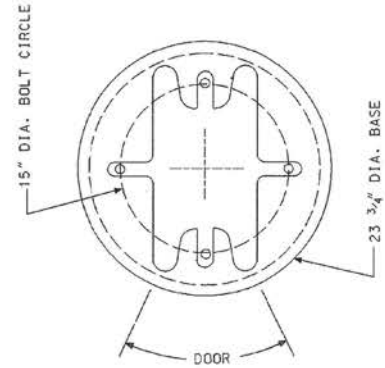


(4) 1 1/4\"/>

ANCHOR BOLT/BASE DETAIL

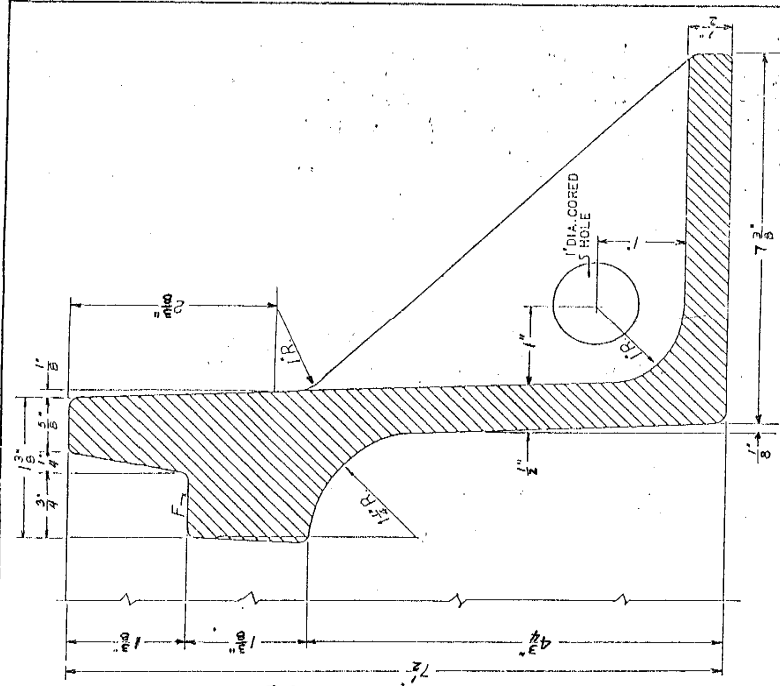


BASE PLAN DETAIL
FOR 10' POLE



BASE PLAN DETAIL
FOR 14' POLE

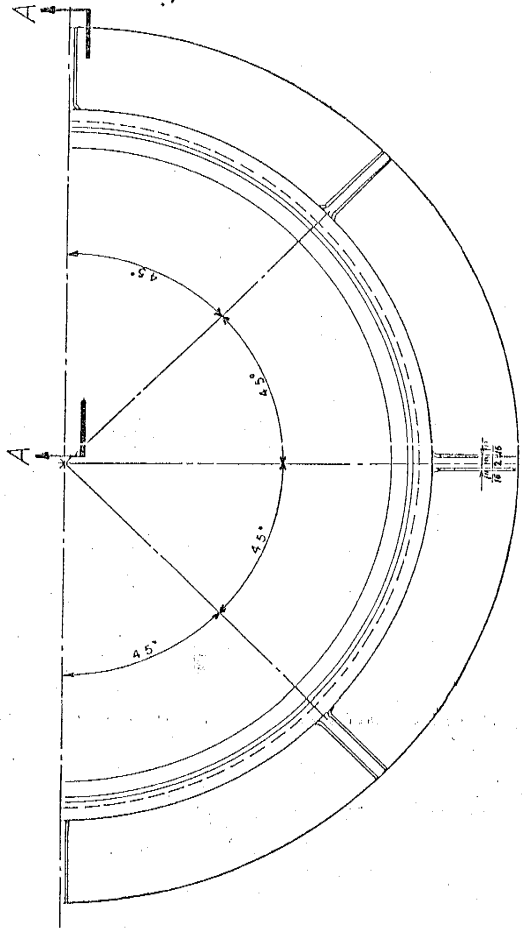
REVISION	DATE
ORNAMENTAL FLORENTINE STREET LIGHT POLE	
CITY OF CHICAGO DIVISION OF INFRASTRUCTURE DIVISION OF MAINTENANCE	
DESIGNED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE
PROJECT NO.	DWG. NO.
	873
 Brian J. Murphy PROJECT MANAGER	



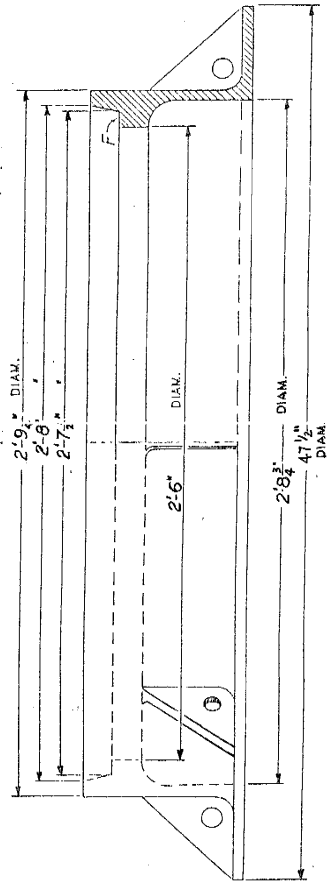
TYPICAL SECTION
THRU FRAME

MATERIAL - CAST IRON
ESTIMATED WEIGHT APP. 250 LB.

F - DENOTES BEARING SURFACE SHALL BE MACHINED SMOOTH.



HALF PLAN



HALF ELEVATION

HALF SECTION A-A

COMMODITY CODE
NO.

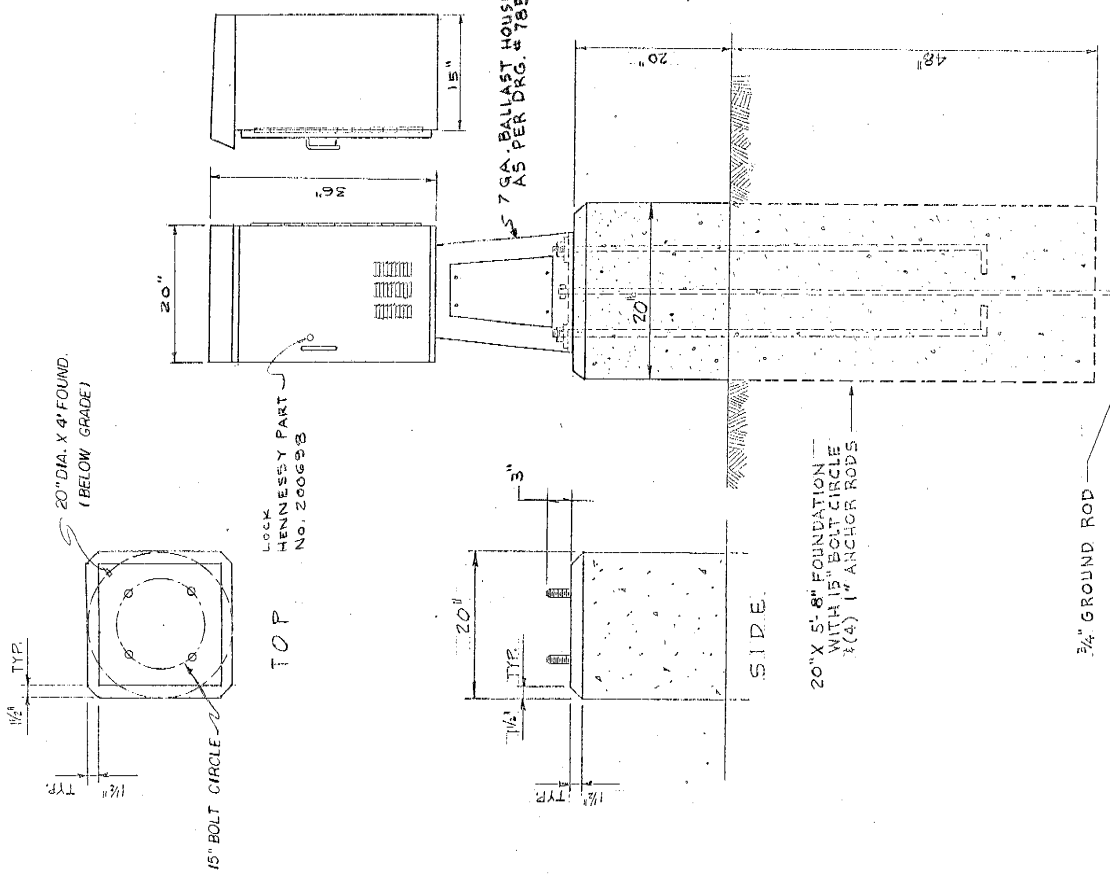
30" CIRCULAR STREET MANHOLE FRAME	
CITY OF CHICAGO	DEPT. OF STREETS AND SANITATION
BUREAU OF ELECTRICITY	DIVISION OF ELECTRICAL ENGINEERING
DESIGNED BY	W. S. SUDAN
CHECKED BY	R. S. SUDAN
DATE	5-5-92
DRAWN BY	B. SUDAN
APPROVED BY	W. S. SUDAN
DATE	5-5-92
NO.	874
ISSUED	5-5-92
REVISIONS	
A	
B	
C	
D	
E	
F	
G	
SUPERSEDES DGS # 1092 G	
DATED 4-6-35	

CODE	DES.	MATERIAL	SIZE	QUANT.
05-3062-5221		FIBER FORM	20" ϕ	4
05-3261-2240		CONCRETE	CU. YD.	0.7
37-2180-0152	311	ANCHOR ROD	1" x 60"	4
09-7796-9100		GROUND ROD	$\frac{3}{4}$ " x 10'	1
09-2639-3240		CLAMP, GROUND ROD	$\frac{3}{4}$ "	1
		CABINET ALUMINUM	36" x 20" x 15"	1
37-2130-4280	785	BALLAST HOUSING BS	1'-4" x 1'-8"	1

NOTE:

HENNESSY "3B" CABINET # 212373 OR U.L. APPROVED EQUIVALENT.

- SEE DRAWING # 883 FOR ELECTRICAL PANEL DETAILS.
- SEE DRAWINGS # 862 & 864 FOR WIRING DIAGRAM.
- DRILL (4) $\frac{1}{2}$ " DIA. HOLES IN BOTTOM OF CABINET & TOP OF BALLAST HOUSING BASE. BOLT CABINET TO B.H.B USING (4) $\frac{3}{8}$ " x $\frac{1}{2}$ " BOLTS.
- OPENINGS IN BOTTOM OF CABINET & TOP OF B.H.B. MAY BE ENLARGED TO A MAX. OF 5" x 10" TO FACILITATE ADDITIONAL WIRING.
- NUMBER & SIZE OF CONDUITS TO BE SHOWN ON CONNECTION DIAG.

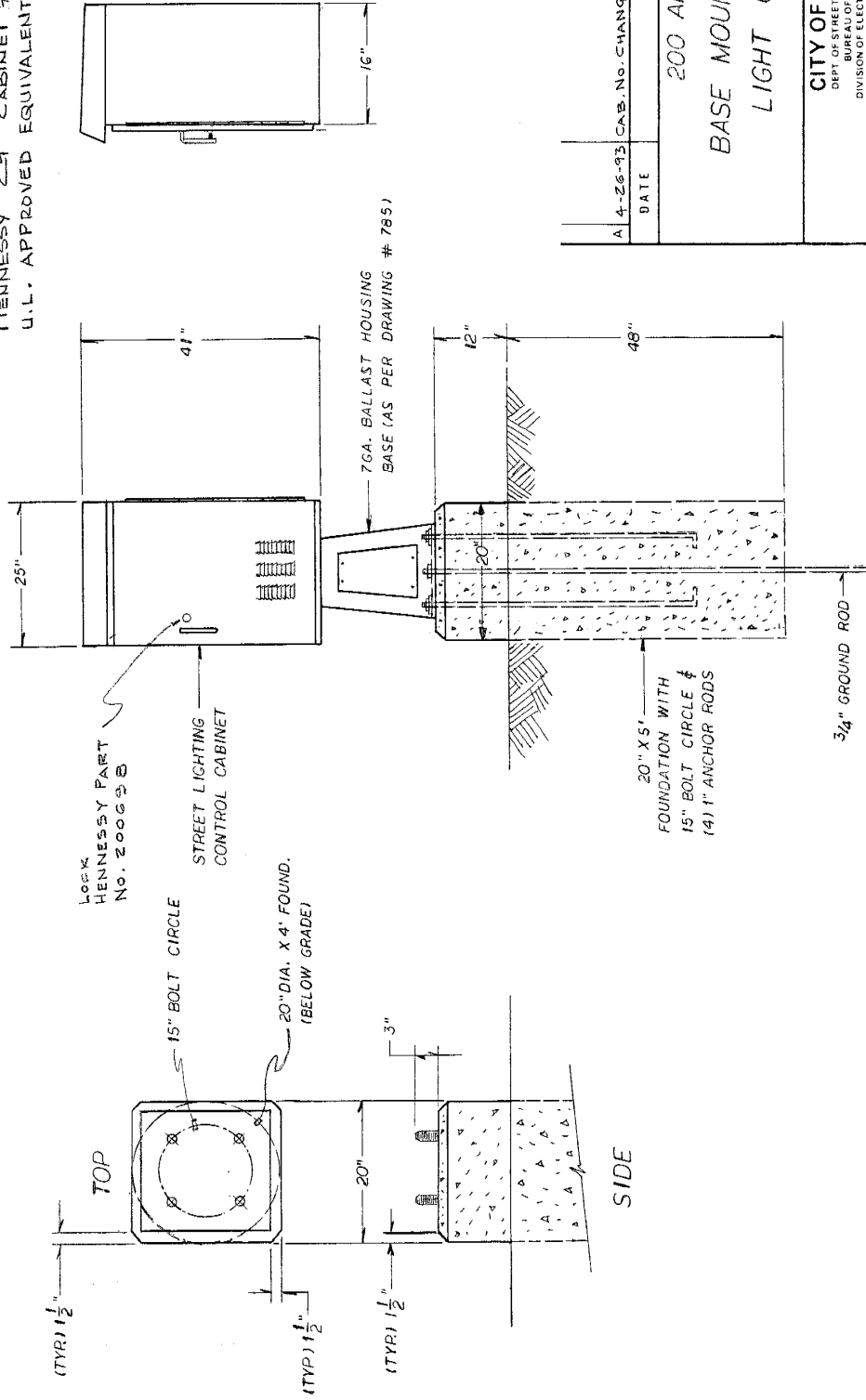


DATE	A-4-26-95	CAB. NO. CHANGED - CITY NAME REMOVED
REVISION		
100 AMP. STREET BASE MOUNTED LIGHT CONTROLLER		
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING		
DRAFTSMAN: M. TROMPRA	ENGINEER: J.A. DEBARTOLO	DATE: 876
SUPERVISING ENGINEER: D. C. V. [Signature]	C.E.R.	SCALE: 1" = 1'-0"
ENGINEER OF ELECTRICITY: A. DeBartolo	ELEC. DESIGN ENGR.	DATE:
GEN'L. SUPT. OF ELECTRICITY: [Signature]		
QUALITY ASSURANCE: [Signature]		
SHEET 16	21	DATE:

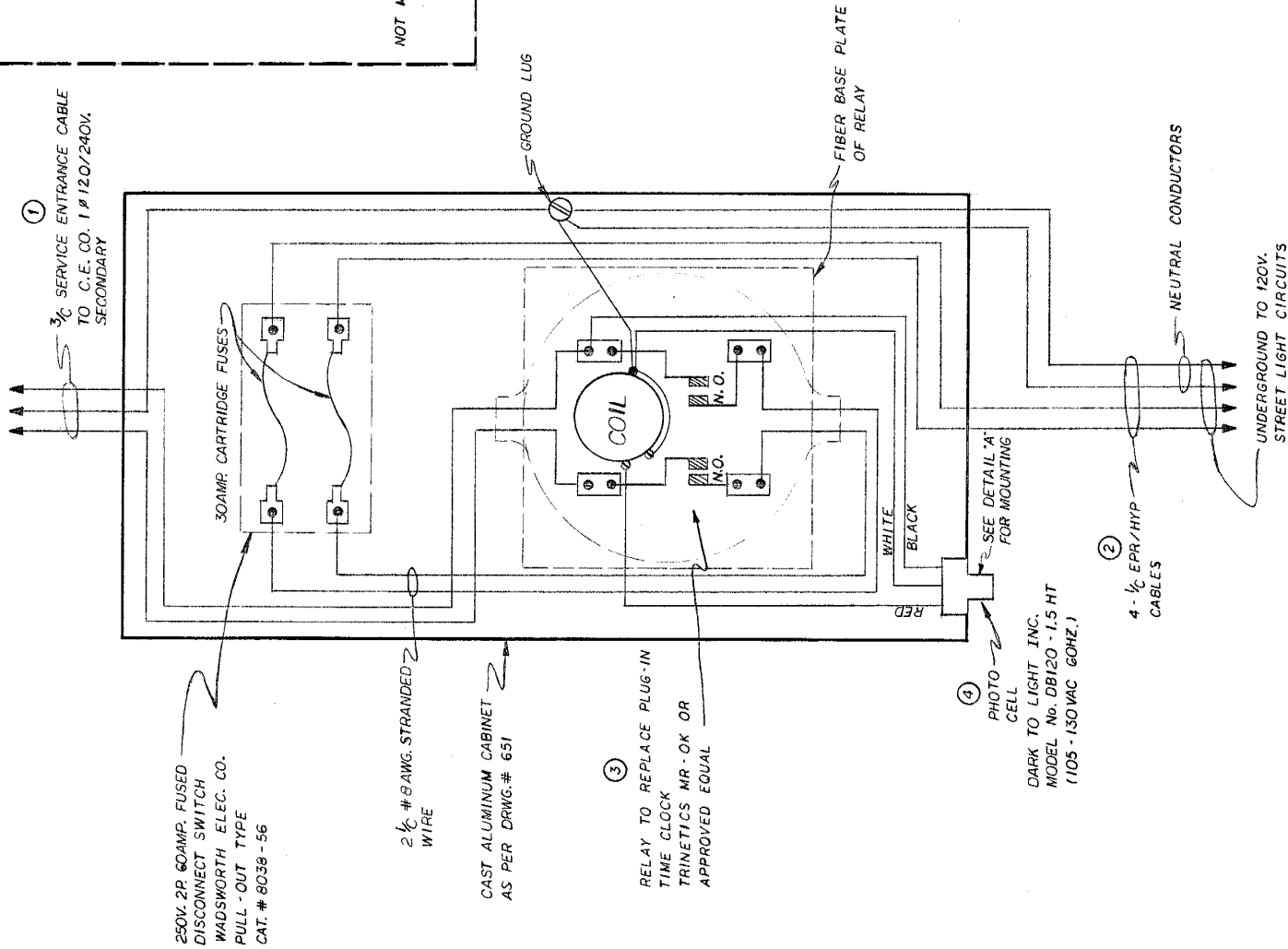
- DRILL (4) 1/2" DIA. HOLES IN BOTTOM OF CABINET & TOP OF BALLAST HOUSING BASE. BOLT CABINET TO B.H.B. USING (4) 3/8" X 2 1/2" BOLTS.
- OPENINGS IN BOTTOM OF CABINET & TOP OF B.H.B. MAY BE ENLARGED TO A MAX. OF 5" X 10" TO FACILITATE ADDITIONAL CABLE.
- NUMBER & SIZE OF CONDUITS TO BE SHOWN ON CONSTRUCTION DRAWINGS.
- SEE DRAWING # 884 FOR ELECTRICAL PANEL DETAILS.
- SEE DRAWINGS # 862 & 864 FOR WIRING DIAGRAM.

CODE	DRWG.	MATERIAL	SIZE	QUANT.
05-5082-5324	—	FIBER FORM	20" Ø	4'
05-3267-2940	—	CONCRETE	CU. YD.	0.7
37-8180-0236	811	ANCHOR ROD	1" X 60"	4
09-7796-9200	—	GROUND ROD	3/4" X 10'	1
09-2636-3240	—	CLAMP, GROUND ROD	3/4"	1
09-3592-7850	—	CABINET ALUMINUM	41" X 25" X 16"	1
37-2130-4280	785	BALLAST HOUSING BS	1'4" X 1'-8"	1

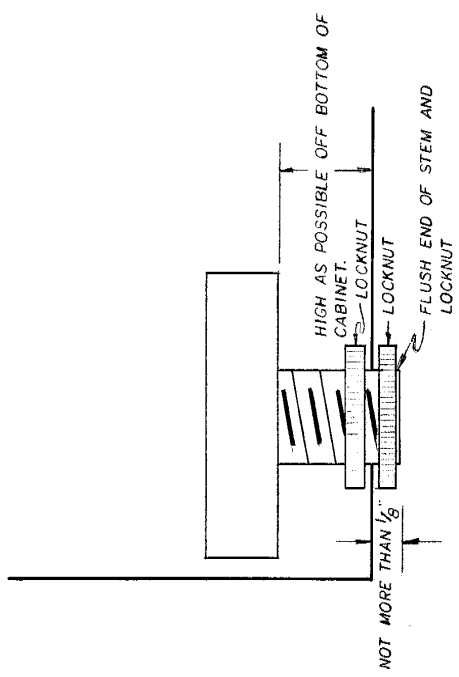
NOTE:
HENNESSY "G" CABINET # 212374 OR U.I.L. APPROVED EQUIVALENT.



A 4-26-93	CAB. NO. CHANGED CITY NAME REMOVED
DATE	REVISION
200 AMP. BASE MOUNTED STREET LIGHT CONTROLLER	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: ARMANDO VIVIANO	ENGINEER: CAEMEN RESPINO M. DE BARTOLO
SUPERVISING ENGINEER: D. CALZADA	ELEC. DESIGN ENGR.
ENGINEER OF ELECTRICITY: R. D. H. S. H.	DWG. NO. 880
DEPUTY COMMISSIONER: Hennessy	SCALE: 16 21
DATE:	DATE:



DETAIL "A"



- NOTES
- ① SPEC 1457
 - ② SPEC 1440
 - ③ SPEC 1427
 - ④ SPEC 1471

DATE	REVISION
A 10-6-74	REVISE PHOTO CELL

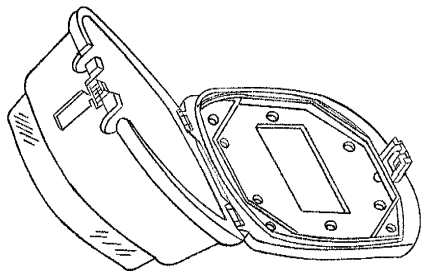
WIRING DIAGRAM OF SERVICE AND CONTROL CABINET FOR 120VOLT. RESIDENTIAL STREET LIGHTING WITH PHOTO-ELECTRIC CONTROL

CITY OF CHICAGO
DEPT. OF STREETS AND SANITATION
BUREAU OF ELECTRICITY
DIVISION OF ELECTRICAL ENGINEERING

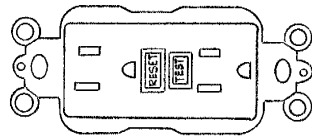
DRAFTSMAN: *Viviano*
SUPERVISING ENGINEER: *Armen Respingo*
ENGINEER: *W. Triampala*
ELEC. DESIGN ENGR. *W. Triampala*
D.W.G. NO. **881**

ENGINEER OF ELECTRICITY: *A. Dukalsky*
GEN'L. SUPT. OF ELECTRICITY
DEPUTY COMMISSIONER

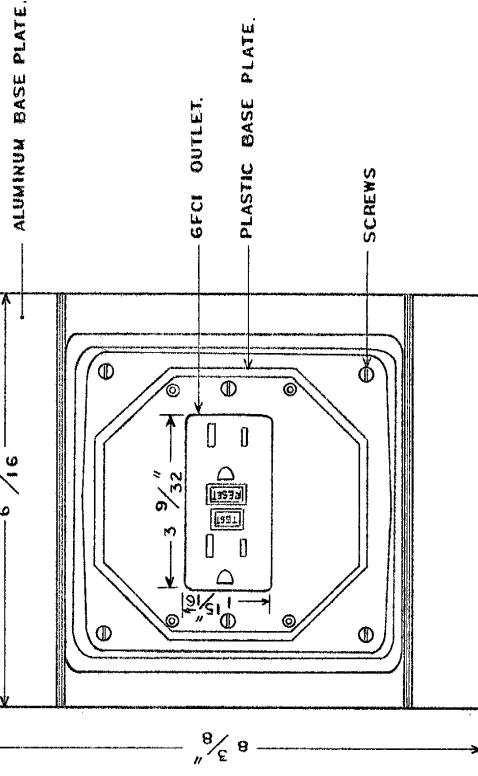
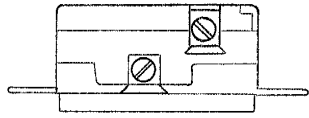
SIZE: 16" | 21" | SCALE: *1/8"* | DATE: *March 3, 1973*



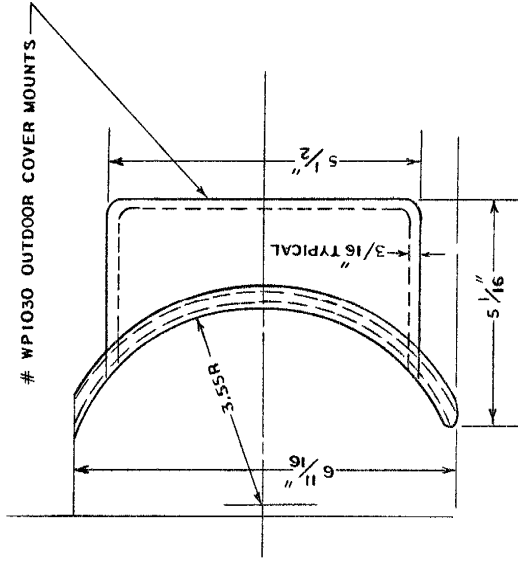
PLASTIC OUTLET COVER



GFCI OUTLET



GROUND FAULT CIRCUIT INTERRUPTER DUPLEX RECEPTACLE
(GFCI) W/ ALUMINUM BASE AND COVER DETAILS

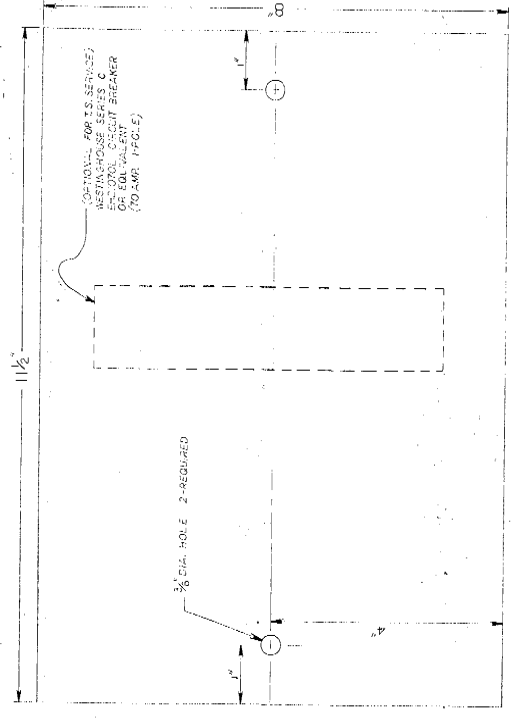


GFCI DUPLEX RECEPTACLE HOLDER
NO SCALE

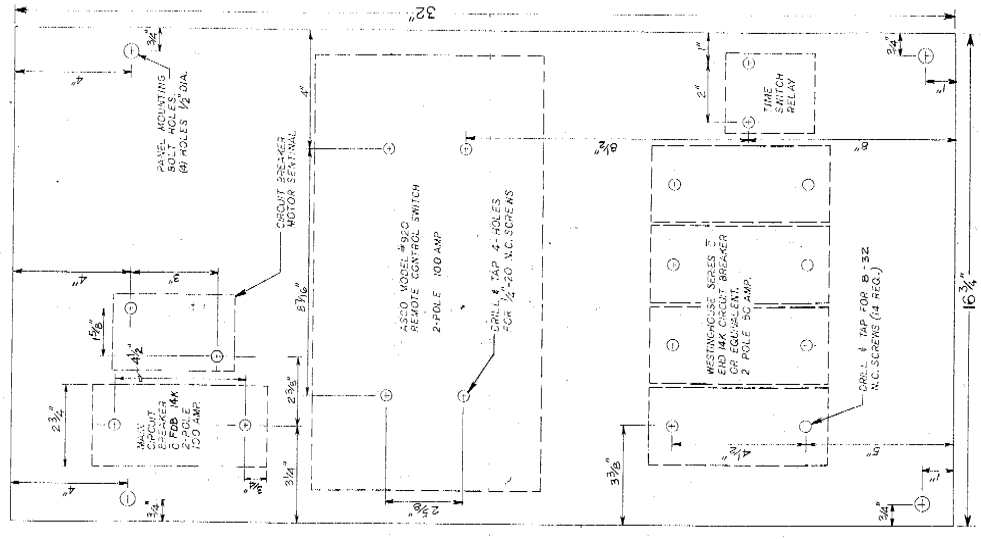
A		DATE	REVISION
GROUND FAULT CIRCUIT INTERRUPTER DUPLEX RECEPTACLE W/ALUM. BOX			
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING			
DRAWN BY:	CHIEF DRAFTSMAN:	ENGINEER:	D.W.G. NO.
SHAKIL AHMED	C. RESPINO	F. KARAGIANES	882
SUPERVISING ENGINEER:	ELEC. DESIGN ENGR.		
ENGINEER-IN-CHARGE GEN. MGR. ELECTRICITY DEPT. OF STREETS AND SANITATION CITY OF CHICAGO			
<i>[Signature]</i> DEPUTY COMMISSIONER			
SIZE: 16"	SCALE: 22"	NO SCALE	DATE: 3-2-93

APPROVED AS WORKING PLAN		SECTION	COUNTY	SUBJECT
BY				
REVISIONS OF WORKING PLAN		PLAN NO.	ILLINOIS	SUBJECT

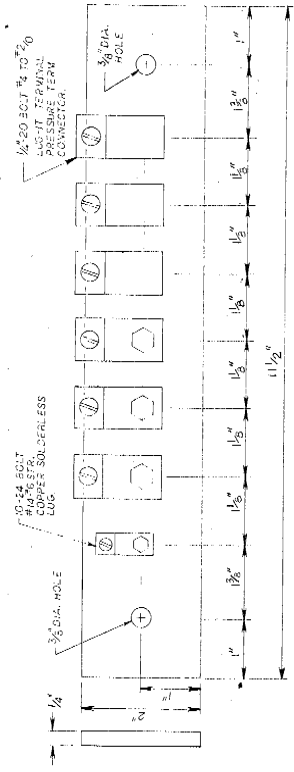
SEE DRG. #876 FOR CABINET DETAILS.
SEE DRG. #852 FOR WIRING DIAGRAM.



(OPTIONAL) PANEL FOR TRAFFIC SIGNAL SERVICE
1/2" THICK PHENOLIC LINE BASE
TO BE MOUNTED ON UPPER LEFT SIDE OF CABINET

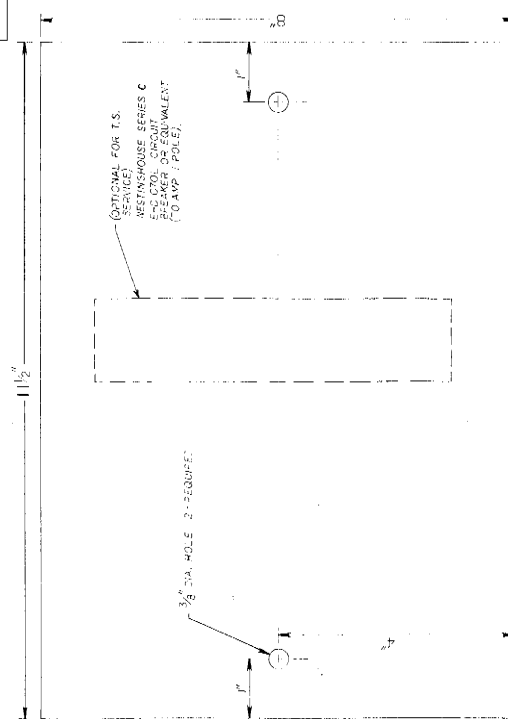


BACK PANEL
1/2" THICK PHENOLIC LINE
BASE

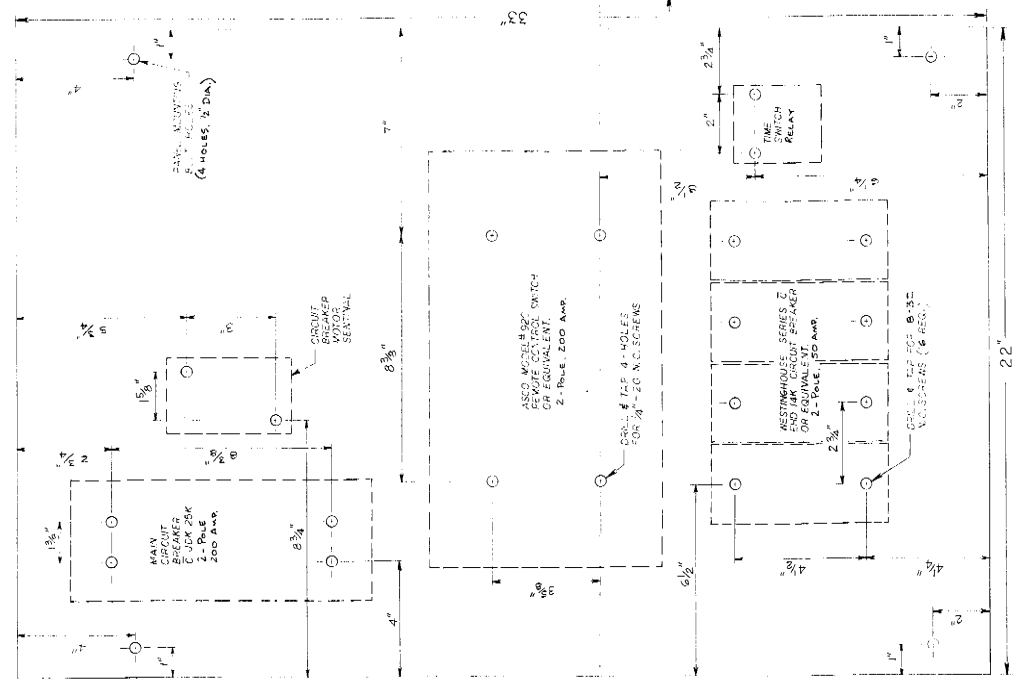
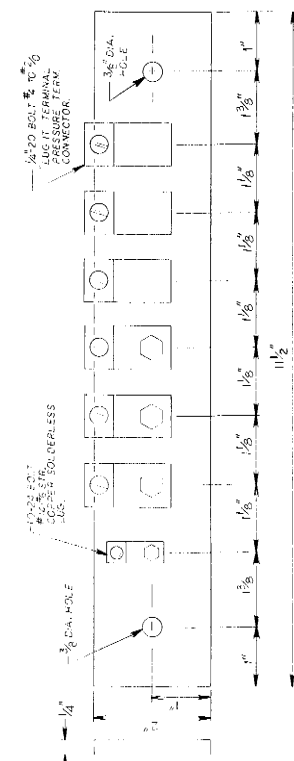


1/2" THICK COPPER BUS BAR
TO BE MOUNTED ON LOWER
LEFT SIDE OF CABINET.

A	DATE	REVISION
WORK ORDER NO. _____ DATE _____		
COST ALLOCATION ACCOUNT _____ MATERIAL _____		
APPROPRIATION ACCOUNT _____ LABOR _____		
PANELS FOR 100 AMPERE 2-POLE SWITCHING EQUIPMENT IN STREET LIGHT CONTROL CABINET		
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION CONSTRUCTION MATERIALS DIVISION STATIONERY DIVISION SUPPLY FACILITY UNIT CITY STORES PROPERTY CLERK GENL. SUPV. OF ELECTRICITY SUPERVISOR		
DATE 3/10/70		
883		



(OPTIONAL) PANEL FOR TRAFFIC SIGNAL SERVICE
 1/2" THICK PHENOLIC LINEN BASE
 TO BE MOUNTED ON UPPER LEFT SIDE OF CABINET



- SEE DRG. # 880 FOR CABINET DETAILS.
 - SEE DRG. # 862 FOR WIRING DIAGRAM.

DATE	REVISION

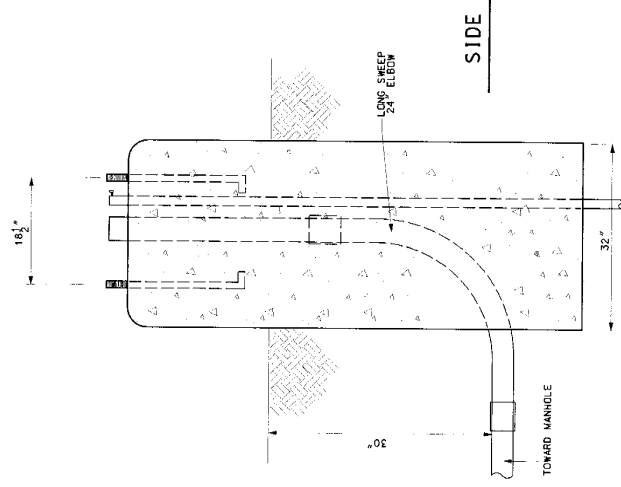
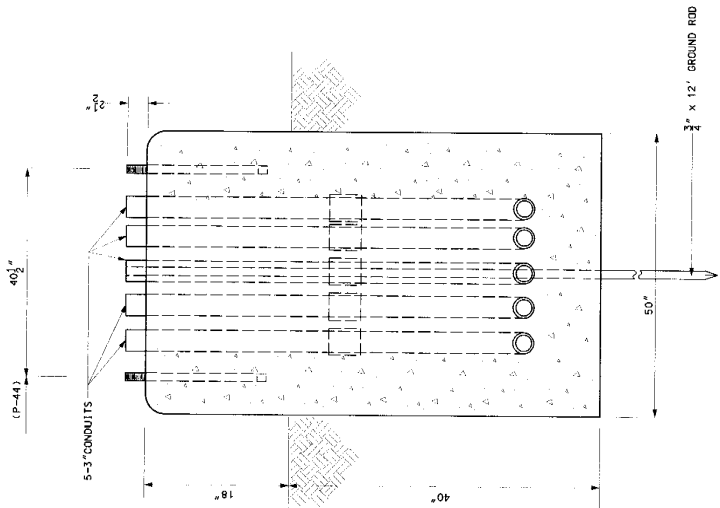
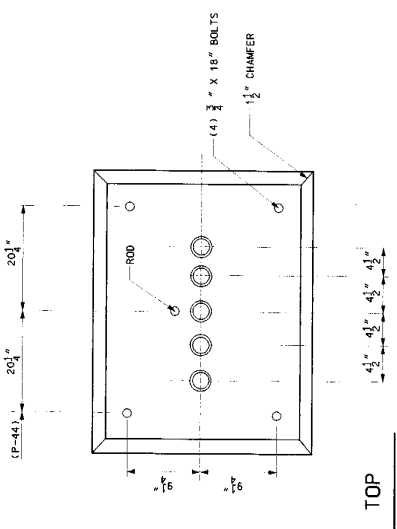
WORK ORDER NO. _____ DATE _____
 COST ALLOCATION ACCOUNT _____ MATERIAL _____
 APPROPRIATE ON ACCOUNT _____ LABOR _____

PANELS FOR 200 AMPERE 3-POLE SWITCHING EQUIPMENT IN STREET LIGHT CONTROL CABINET

CITY OF CHICAGO
 OFFICE OF THE CITY ENGINEER
 DIVISION OF ELECTRICAL UTILITIES

DRAWN BY	B. IVY	CHECKED BY	M. DEBACCO
DESIGNED BY	C. GEEBING	DATE	884
PROJECT NO.		DATE	
DATE		DATE	

DIMENSIONS FOR LOCATIONS OF ANCHOR BOLTS TO BE STRICTLY ADHERED TO.



TYPE "P" FOUNDATION
 FOR BASE MOUNTED
 TRAFFIC SIGNAL CONTROL CABINET

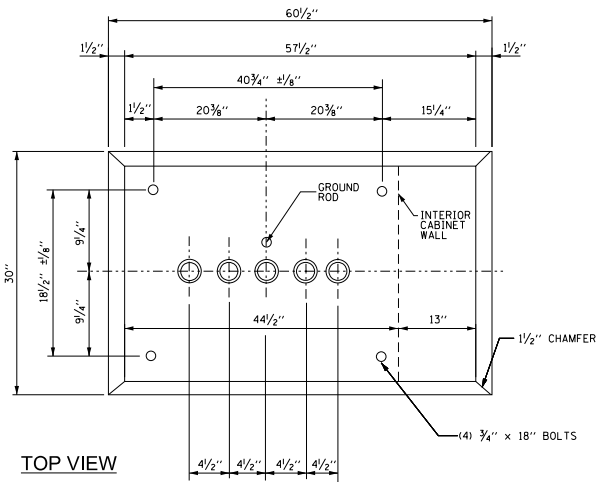
REVISIONS
 SUPERSEDES D.C. # 888 DATED 0-23-1993

CITY OF CHICAGO
 DEPT. OF STREETS AND SANITATION
 DIVISION OF ELECTRICAL ENGINEERING

DRAFTSMAN: [Signature]
 CHIEF DRAFTSMAN: [Signature]
 ENGINEER: [Signature]
 SUPERVISING ENGINEER: ELEC. DESIGN ENGR. [Signature]
 ENGINEER OF ELECTRICALITY: [Signature]
 GEN'L. SUPV. OF ELECTRICALITY: [Signature]
 DEPUTY COMMISSIONER: [Signature]

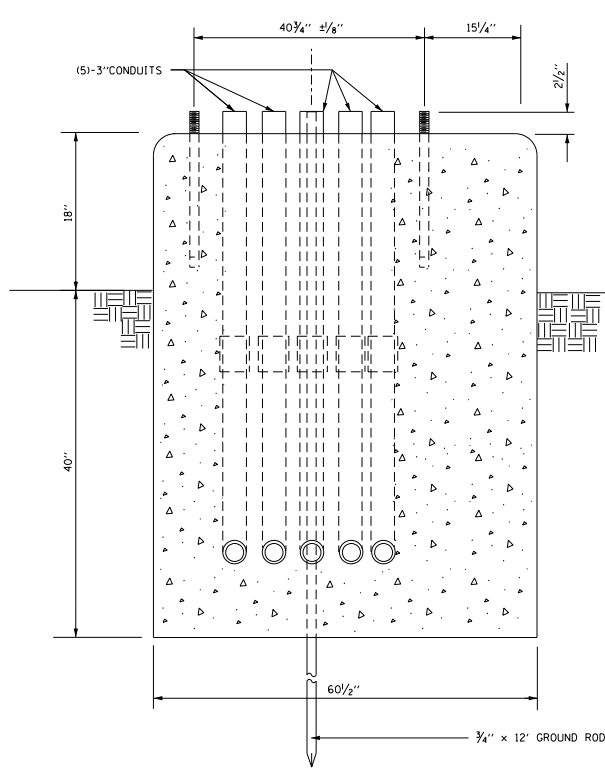
DWG. NO. **888**

SCALE: 1" = 1'-0"
 DATE: 6-11-93

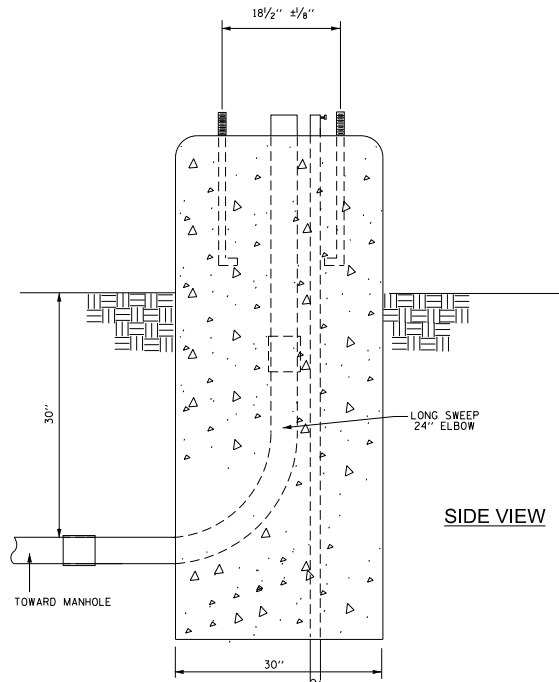


DIMENSIONS FOR LOCATIONS OF ANCHOR BOLTS TO BE STRICTLY ADHERED TO.

TOP VIEW



FRONT VIEW



SIDE VIEW

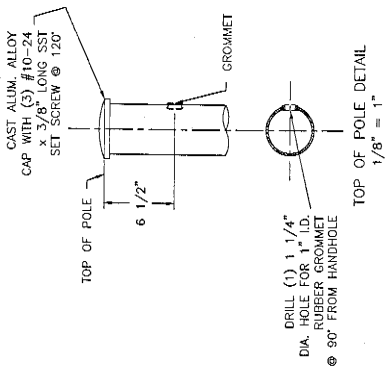
TYPE SUPER "P" FOUNDATION

FOR BASE MOUNTED
TRAFFIC SIGNAL CONTROL CABINET

SUPERSEDES DWG. # 888 DATED 6-23-1993

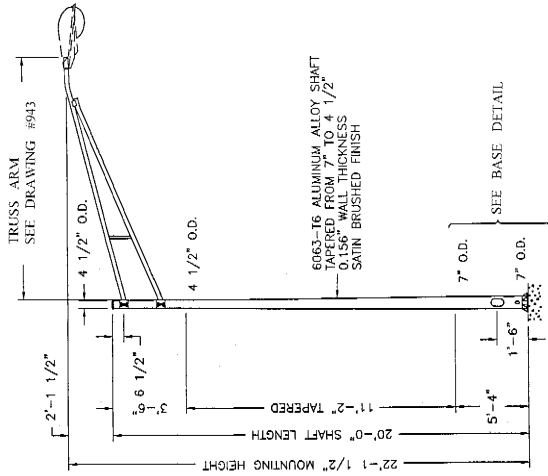
CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING

D	2-28-22	CORRECTED GROUND ROD LENGTH	DRAFTSMAN:	A. MAROTTA	DWG. NO.
C	10-09-20	ADJUSTED ANCHOR ROD SPACING	ENGINEER:	J. VONDRA	
B	6-10-05	LENGTH OF BASE TO 60 1/2"	ENGINEER OF ELECTRICITY:	J. ZHANG	888A
A	5-24-96	BOLT DIMENSIONS FOR P-38 & P-44 CABINETS	DEPUTY COMMISSIONER:		
REV	DATE	DESCRIPTION	SIZE:	16" 21"	SCALE: NONE
					DATE: 1/28/21



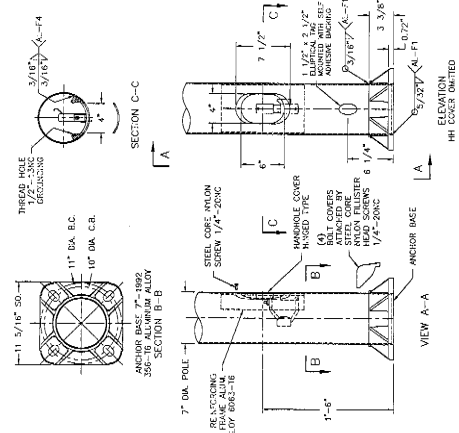
POLE TOP

TOP OF POLE DETAIL
1/8" = 1"



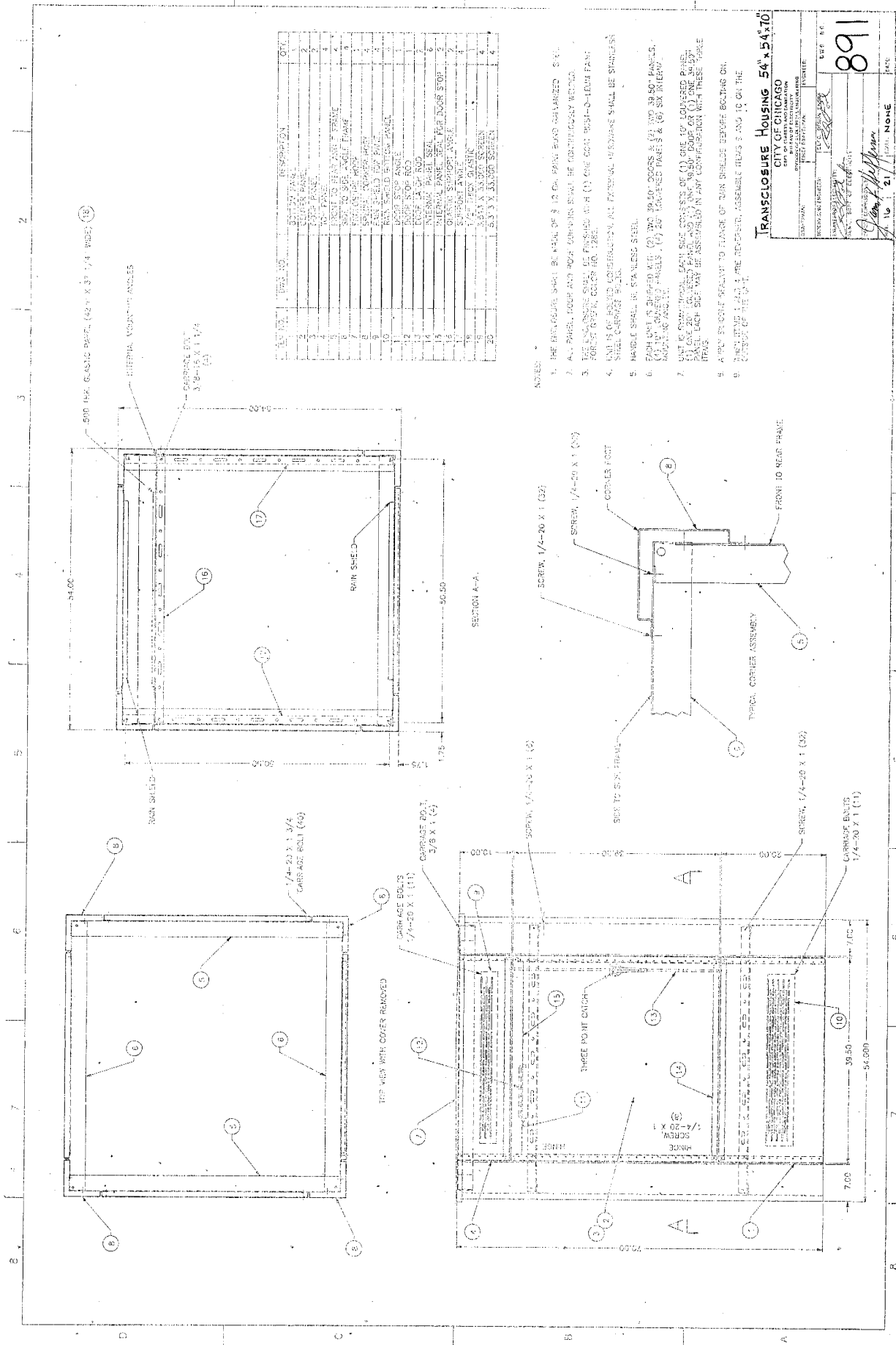
ELEVATION

HEAT TREAT AFTER WELDING



POLE BASE

ALUMINUM POLE		E.W.C. NO.	
7" X 4.5" X 20'-0"		890	
FOR RESIDENTIAL STREETS			
CITY OF CHICAGO			
DEPT. OF STREET LIGHTS & SIGNALS			
ENGINEERED ELECTRICAL CONTRACTING			
DESIGNER	DRAWN	CHECKED	DATE
DATE	SCALE		



NO.	DESC.	QTY.
1	RAIN SHIELD	2
2	RAIN SHIELD TOP FRAME	2
3	RAIN SHIELD BOTTOM FRAME	2
4	RAIN SHIELD CORNER JOINT	4
5	RAIN SHIELD CORNER JOINT	4
6	RAIN SHIELD CORNER JOINT	4
7	RAIN SHIELD CORNER JOINT	4
8	RAIN SHIELD CORNER JOINT	4
9	RAIN SHIELD CORNER JOINT	4
10	RAIN SHIELD CORNER JOINT	4
11	RAIN SHIELD CORNER JOINT	4
12	RAIN SHIELD CORNER JOINT	4
13	RAIN SHIELD CORNER JOINT	4
14	RAIN SHIELD CORNER JOINT	4
15	RAIN SHIELD CORNER JOINT	4
16	RAIN SHIELD CORNER JOINT	4
17	RAIN SHIELD CORNER JOINT	4
18	RAIN SHIELD CORNER JOINT	4
19	RAIN SHIELD CORNER JOINT	4
20	RAIN SHIELD CORNER JOINT	4

- NOTES:
1. THE ENCLOSURE SHALL BE MADE OF 1/2" GAL. PAIN BAND GALVANIZED STEEL.
 2. ALL PANEL JOINTS AND JOINTS BETWEEN PANELS SHALL BE GASKETED WITH BUTYL RUBBER GASKET.
 3. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.
 4. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.
 5. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.
 6. EACH UNIT IS SHIPPED WITH (2) TWO 39" DOORS & (2) TWO 39" DOOR PANELS, (2) TWO 39" DOOR PANELS, (2) TWO 39" DOOR PANELS & (2) TWO 39" DOOR PANELS.
 7. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.
 8. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.
 9. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.
 10. THE ENCLOSURE SHALL BE FINISHED WITH (1) ONE COAT PUSH-ON-TOILET PAINT POLYESTER GLOSS COLOR 1001.

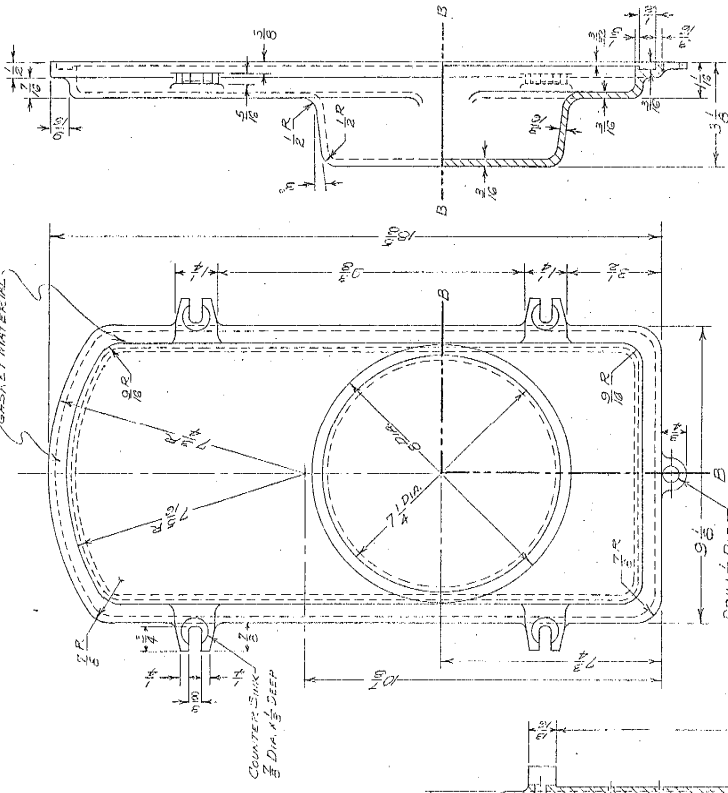
TRANSCLOSURE HOUSING 54" X 54" X 70"
CITY OF CHICAGO
 DEPARTMENT OF PUBLIC WORKS
 DIVISION OF STREET LIGHTS

DATE: 10/21/11
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]
 APPROVED BY: [Signature]

891

10 21 11

NOTE
DUE TO BE GASKETED WITH
1/2" X 1/2" SPONGE NEOPRENE
GASKET MATERIAL



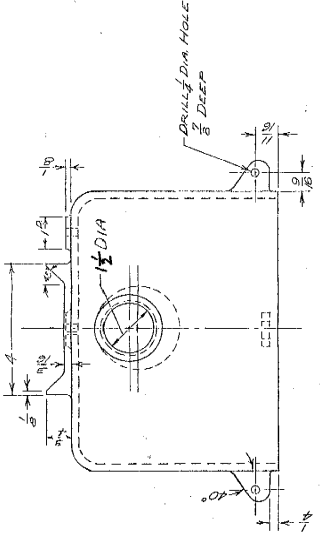
CONTROL CABINET DOOR
MATERIAL: CAST ALUMINUM

CLAMPING AND HINGING
PARTS REQUIRED

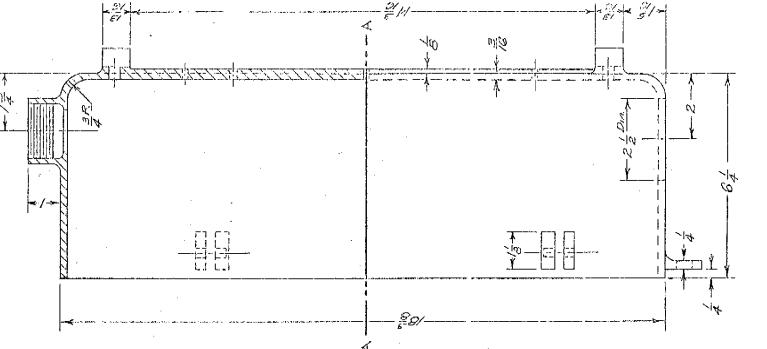
- 4- 1/4" HEAD BRONZE BOLTS WITH
- 1"-20 NC THREAD - 1" LONG
- 4- 1/4"-20 NC BRONZE WING NUTS
- 4- 1/4" DIA. X 1/8" LG. STAINLESS STEEL
- KNURLED PINS
- 2- 1/4"-20 NC PLATED BRASS CAP
- NUTS (HINGE SIDE)

INSTRUCTIONS

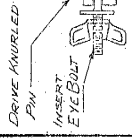
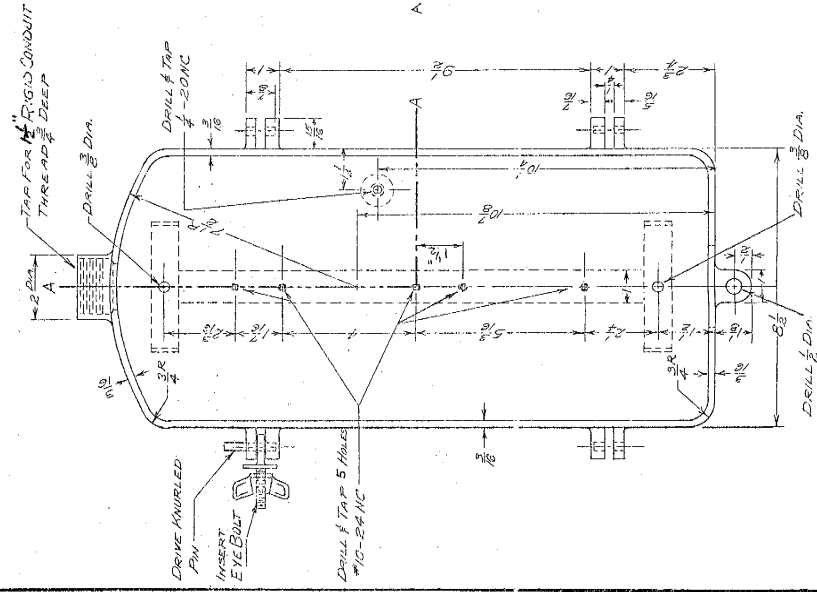
INSERT EYE-BOLT HEAD BETWEEN
SIDES OF HINGE FIRST POINTS AND
DRIVE PIN HEAD INTO CROWN END
AS SHOWN IN FRONT VIEW OF CABINET.



TAP FOR 1/4" RIGID CONDUIT
THREAD 1/8 DEEP



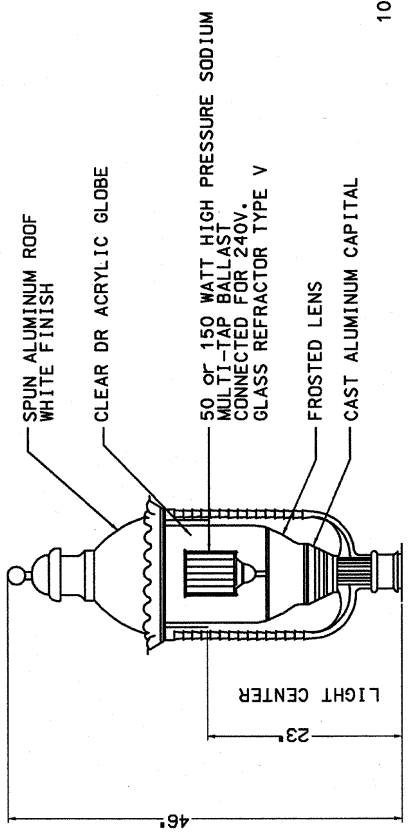
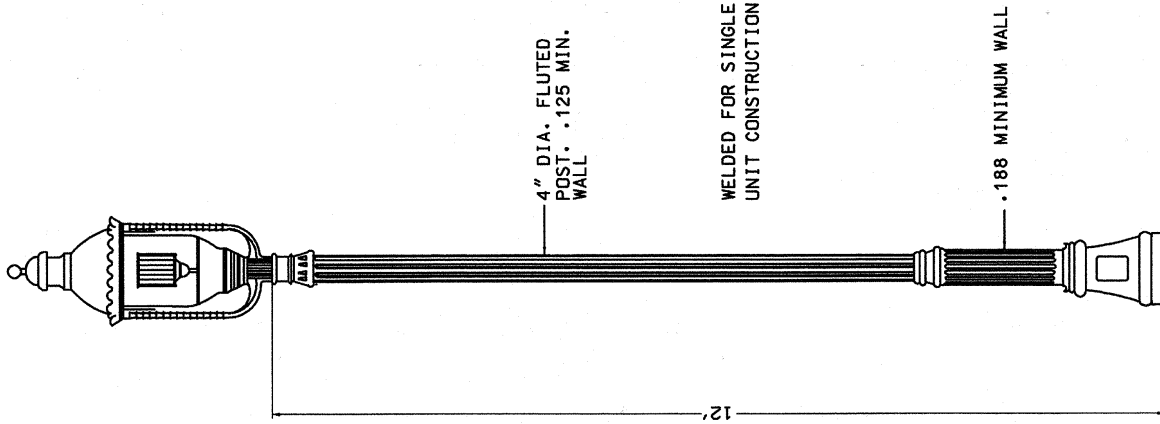
CONTROL CABINET
MATERIAL: CAST ALUMINUM



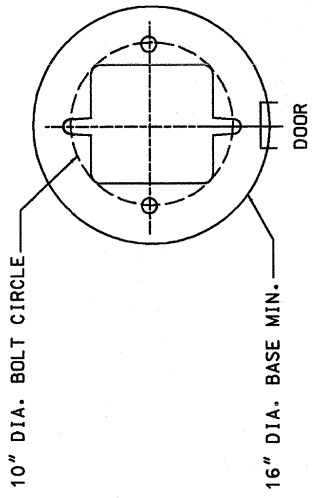
DRILL & TAP 5 HOLES
#10-24 NC

REVISED		RESIDENTIAL TYPE STREET LIGHT CONTROL CABINET / SERVICE DISCONNECT CABINET	
A1	2-22-35	DRAWN	ENGINEER
B		CHECKED	DIVISION OF ELECTRICAL ENGINEERING
C		APPROVED	CITY OF CHICAGO
D			DEPT. OF STREETS AND SANITATION
E			NO. 12 CHANGE
F			DATE
G			SCALE

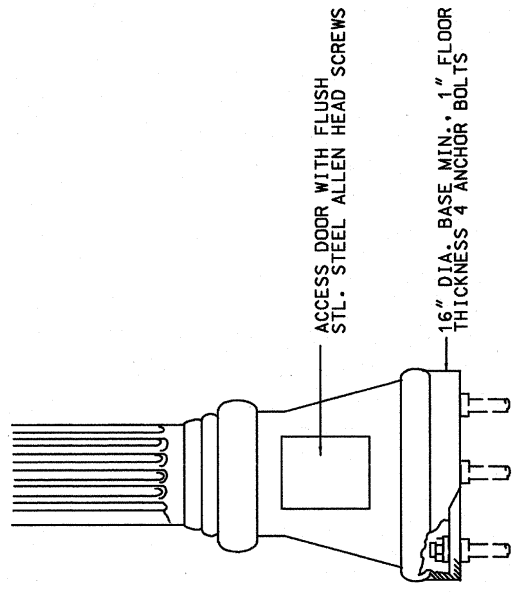
893



CAPITAL & GLOBE DETAIL



BASE PLAN DETAIL

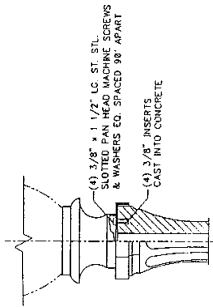


ANCHOR BOLT & BASE DETAIL

A	REVISION	DATE
ORNAMENTAL VICTORIAN GASLIGHT		
CITY OF CHICAGO DEPT. OF PUBLIC WORKS		
DESIGNED BY	PROJECT ENGINEER	CONTRACT NO.
DRAWN BY	PROJECT MANAGER	895
CHECKED BY	DATE	01-07-02

POLE SPECIFICATIONS

SECTION: FLUTED
 COLOR: SALT & PEPPER
 FINISH: ENAMEL
 POLE TOP: 9" FL/FL
 POLE LENGTH: 10' 0"
 APPROX. WT.: 830 LBS.



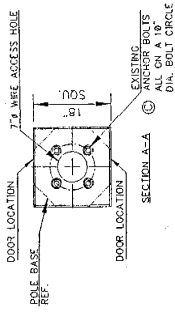
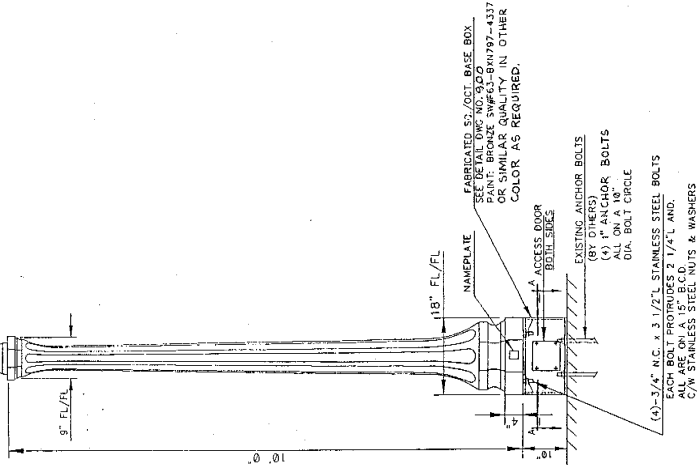
POLE TOP DETAIL



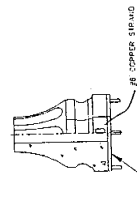
TYPICAL POLE CROSS-SECTION

COLOR & FINISH: SALT & PEPPER
 FINISH: ENAMEL
 C/W SILANE FINISH COAT
 (CAPSEAL X75)

ORNAMENTAL ACORN
 LUMINAIRE SEE DRG # 902



EXISTING BOLTS
 ALL ON A 10"
 DIA. BOLT CIRCLE

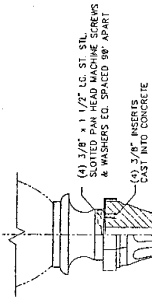


3/4" THK. STEEL HOT DIPPED GALV. BP
 & TREATED ANCHOR BOLTS
 (BY OTHERS)
 (4) 1/2" ANCHOR BOLTS
 DIA. BOLT CIRCLE
 C/W STAINLESS STEEL NUTS & WASHERS

REVISION	
A	DATE
10' ORNAMENTAL CONCRETE POLE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN:	ENGINEER:
SUPERVISING ENGINEER:	DWG. N.O.
ENGINEER-IN-CHARGE:	898
SUPV. OF CONSTRUCTION:	
DEPT. COMMISSIONER:	
SCALE: 15' 2 1/4"	DATE: 6-1-75

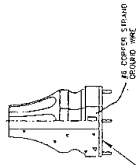
POLE SPECIFICATIONS

SECTION:
 COLOR: SALT & PEPPER
 FINISH: ETCHED
 POLE TOP: 9" FL/FL
 POLE LENGTH: 13' 9"
 APPROX. WGT.: 1,150 LBS.



(4) 3/8" x 1 1/2" LG. ST. WASHERS & NUTS SPACED 90° APART
 (4) 3/8" INSERTS
 CAST INTO CONCRETE

POLE TOP DETAIL



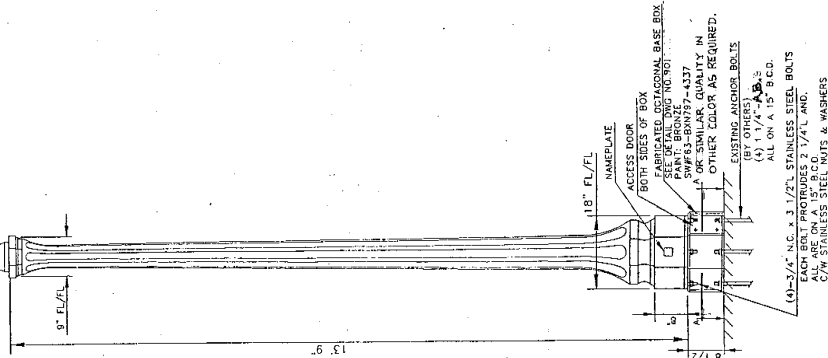
3/4" THK. STEEL HOT DIPPED GALV. B.F. & TREATED AROUND OUTER EDGE TO PREVENT RUST. PAINT OR SIMILAR QUALITY IN OTHER COLOR AS REQUIRED.



TYPICAL POLE CROSS-SECTION

COLOR & FINISH:
 COLOR: SALT & PEPPER
 FINISH: ETCHED
 C/W SILANE FINISH COAT
 (CAPSEAL X75)

ORNAMENTAL ACORN
 LUMINAIRE SEE DRG. 902



18" FL/FL NAMEPLATE
 ACCESS DOOR
 BOTH SIDES OF BOX
 ACCORDING TO ACCORAL BASE BOX
 SEE DETAIL DRG. 902
 PANEL BRONZE #4337
 OR SIMILAR QUALITY IN
 OTHER COLOR AS REQUIRED.
 EXISTING ANCHOR BOLTS
 (BY OTHERS)
 (4) 1 1/4" x 3/8"
 ALL ON A 15" B.C.D.
 (4) 3/4" N.C. x 3 1/2" STAINLESS STEEL BOLTS
 EACH END OF POLE
 2 1/4" AND
 C/W STAINLESS STEEL NUTS & WASHERS

DATE	REVISION
A	

13'-9" ORNAMENTAL CONCRETE POLE

CITY OF CHICAGO
 BUREAU OF ELECTRICITY
 DEPT. OF STREET AND SANITATION

DRAFTSMAN: [Signature]
 SUPERVISING ENGINEER: [Signature]
 ENGINEER: [Signature]

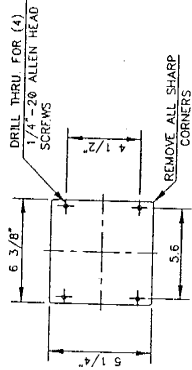
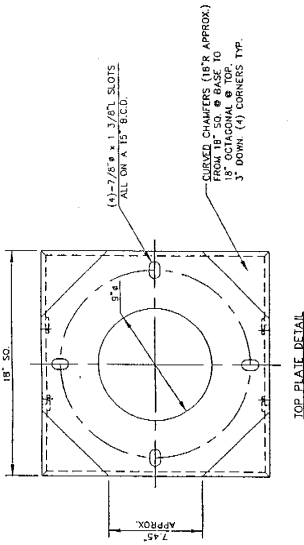
DWG. NO. **899**

ENGINEER'S ELECTRICAL:
 SPT. OF CONSTRUCTION:
 DEPUTY COMMISSIONER:
 [Signature]

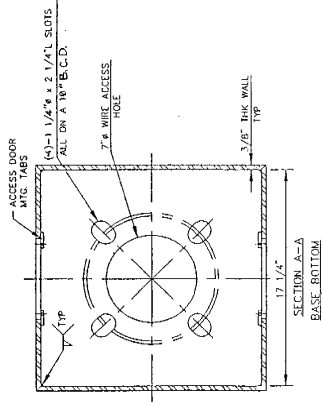
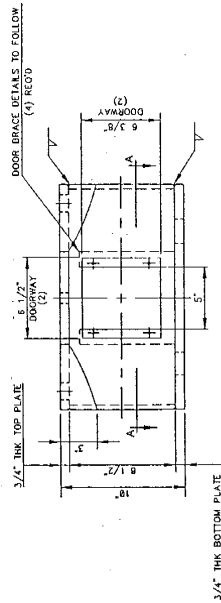
SCALE: 1/8" = 1'-0"
 DATE: 6-1-95

NOTE:

- 1/ DRILLING & TAPPING OPERATIONS ARE TO BE PERFORMED AFTER DOORWAY BRACES HAVE BEEN WELDED INTO PLACE AND THE DOOR IS SET INTO PLACE. TO ENSURE PROPER ALIGNMENT OF CSUNK & TAPPED HOLES, DOOR MUST BE MACHINED ACCURATELY TO ALLOW INTER-CHANGEABILITY BETWEEN UNITS.
- 2/ ENTIRE BOX TO BE HOT DIPPED GALV. & TREATED TO ACCEPT PAINT.
- 3/ PAINT: BRONZE S.W. #F23-BXN797-4337 OR SIMILAR QUALITY IN OTHER COLOR AS REQUIRED.
- 4/ ALL WELDS TO BE GROUND SMOOTH & FLUSH.
- 5/ ALL CORNERS TO BE CUT & WELDED (NO BENT CORNERS).

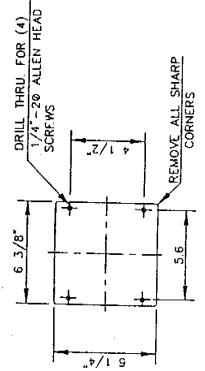
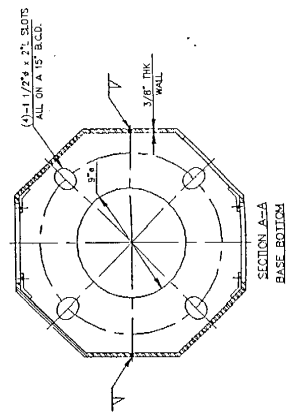
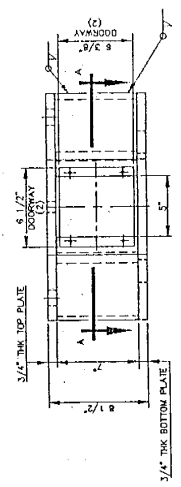
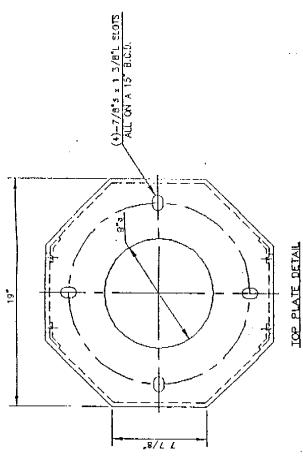
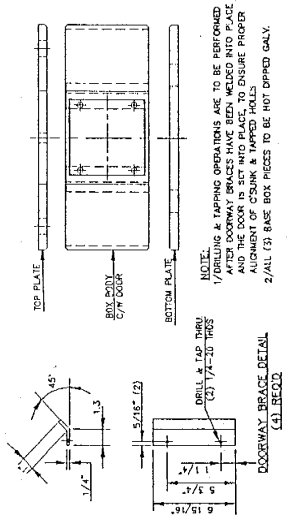


DOOR DETAIL
MATERIAL: 3/8" THK
(2) REQD

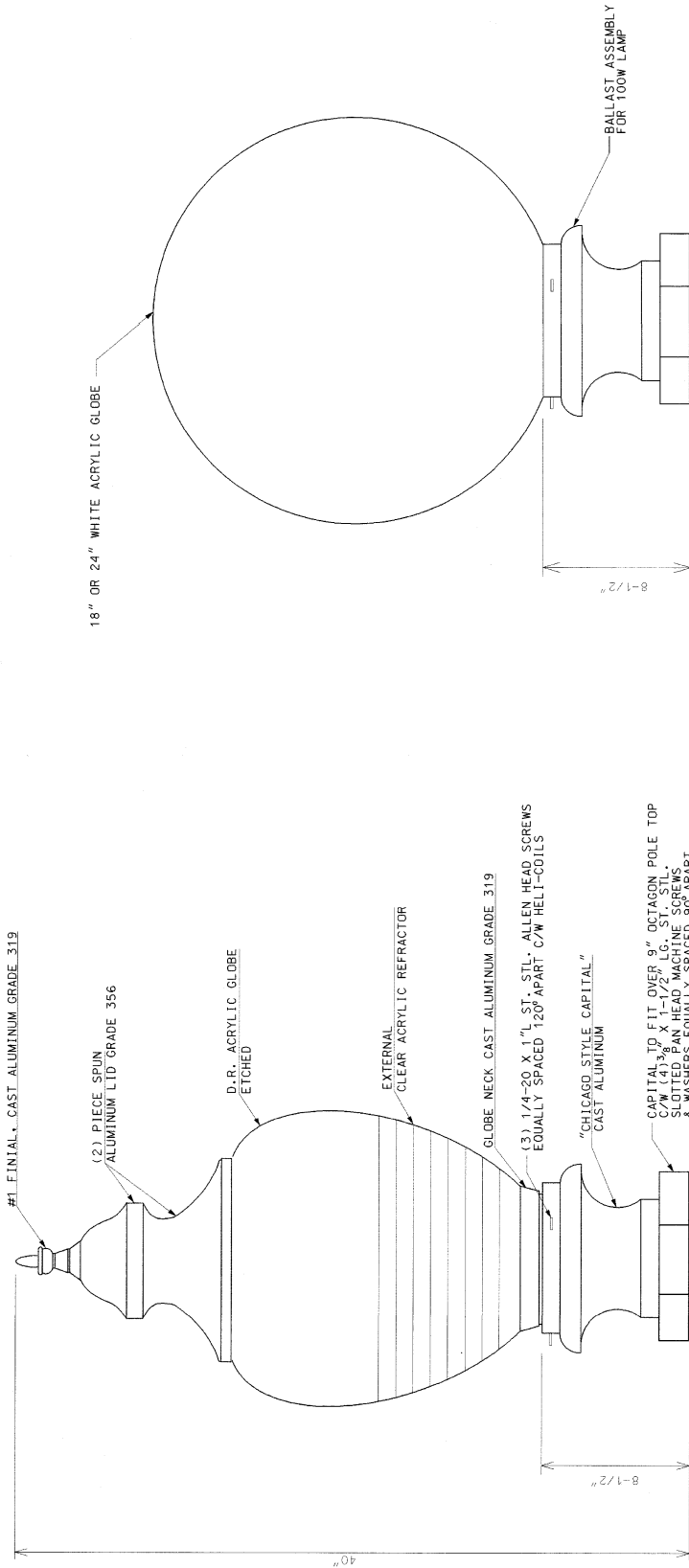


A		REVISION
DATE		
STEEL BASE FOR 10' ORNAMENTAL CONCRETE POLE		
CITY OF CHICAGO BUREAU OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING		
DRAFTSMAN:	ENGINEER:	DWG. NO.
CHIEF DRAFTSMAN:		900
SUPERVISING ENGINEER:		
ENGINEER OF ELECTRICITY:		
SUPT. OF CONSTRUCTION:		
DEPUTY COMMISSIONER:		
SIZE 16 1/2" x 21"	SCALE: C/S	DATE: 6-1-95

- NOTE:
- 1/DRILLING & TAPPING OPERATIONS ARE TO BE PERFORMED AFTER DOORWAY BRACES HAVE BEEN WELDED INTO PLACE AND THE DOOR IS SET INTO PLACE. TO ENSURE PROPER ALIGNMENT OF C'SUNK & TAPPED HOLES, DOORS MUST BE INTERCHANGEABLE BETWEEN BASE UNITS.
 - 2/ENTIRE BOX TO BE HOT DIPPED GALV. & TREATED TO ACCEPT BRONZE PAINT.
 - 3/PAINT BRONZE ISW #F63-BXN 797-4337 OR SIMILAR QUALITY IN OTHER COLOR AS REQUIRED.
 - 4/ALL WELDS TO BE GROUND SMOOTH & FLUSH.
 - 5/ALL CORNERS TO BE CUT & WELDED (NO BENT CORNERS)



A	DATE	REVISION
STEEL BASE FOR 13'-9" ORNAMENTAL CONCRETE POLE		
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY		
CHAFFMAN	CHIEF DRAFTSMAN	ENGINEER
SUPERVISING ENGINEER:		DWG. NO.
ENGINEER OF ELECTRICITY:		901
SUPPORT OF CONSTRUCTION:		
DEPT. COMMISSIONER:		
SCALE	DATE	
16"	6-1-95	



18" OR 24" WHITE ACRYLIC GLOBE

8-1/2"

8-1/2"

40"

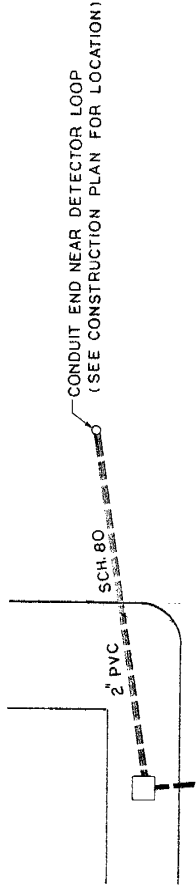
BALLAST ASSEMBLY FOR 100W LAMP

ALTERNATE CONFIGURATION

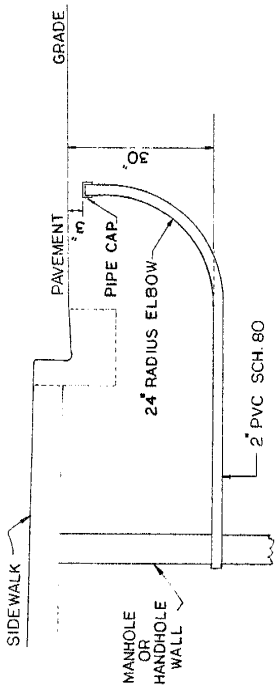
LUMINAIRE SPECIFICATIONS

- GLOBE MATERIAL: AS SHOWN ABOVE
- FINIALS: AS DIRECTED BY ENGINEER
- WATTAGE: 150W OR 100W
- LIGHT SOURCE: HIGH PRESSURE SODIUM
- LINE VOLTAGE: MULTI-TAP 120, 208, 240V
- POLE ADAPTOR: CHICAGO CAPITAL
- BALLAST TYPE: CWA C/W QUICK DISCONNECT
- PAINT: POWDER COAT TO COLOR SPECIFIED

DATE	REVISION
ORNAMENTAL LUMINAIRE FOR CONCRETE POLES	
<small>CITY OF CHICAGO DEPT. OF STREET LIGHTS & ILLUMINATION BUREAU OF ELECTRICITY DIVISION OF LIGHTING & ILLUMINATION ENGINEERS</small>	
<small>DRAFTSMAN: B. GARNSEY ELECTRICAL ENGINEER</small>	
<small>ENGINEER: J. CARTER ELECTRICITY</small>	
<small>GENERAL SUPERVISOR ELECTRICITY</small>	
<small>DEPUTY COMMISSIONER ELECTRICITY</small>	
<small>DRAWING NO. 902</small>	
SIZE: 17" x 22"	SCALE: NONE
DATE: 2/05/03	



TYPICAL LAYOUT OF CONDUIT LEAD UP TO NEAR VEHICLE DETECTOR LOOPS

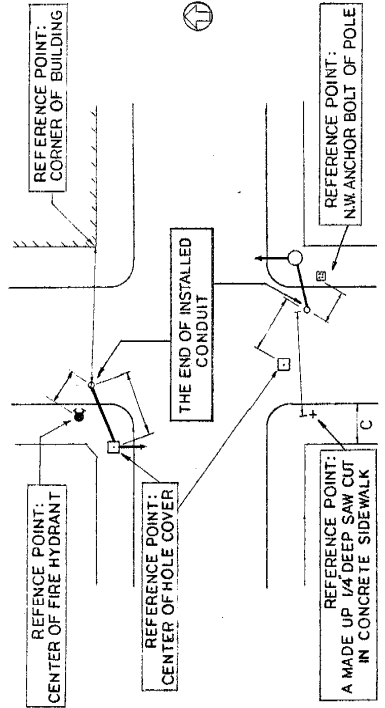


TYPICAL SECTION ALONG CONDUIT LEAD UP TO NEAR VEHICLE DETECTOR LOOPS

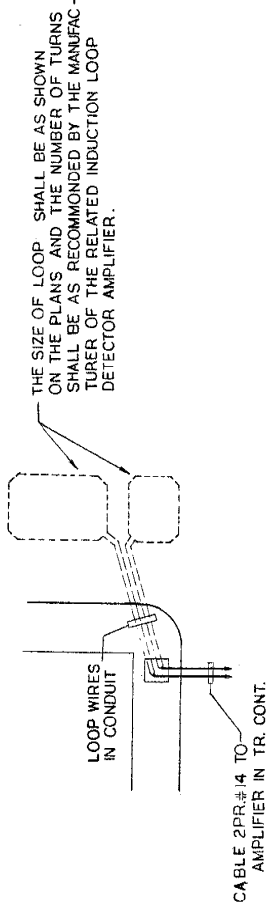
THE CONDUIT INSTALLATION NOTES

- INSTALL 2" PVC (SCH 80) CONDUIT 30" BELOW GRADE FROM MH/HH TO NEAR THE LOCATION OF END OF THE CONDUIT LEAD AS SHOWN ON PLAN.
- INSTALL (24" RADIUS) ELBOW AT END OF THE CONDUIT AS SHOWN; KEEP END OF THE ELBOW ABOUT 3" BELOW GRADE AND INSTALL PIPE CAP ON IT.
- FOREMAN TO TAKE EXACT MEASUREMENTS FROM CENTER OF THE PIPE CAP TO THREE REFERENCE POINTS (LIKE-CORNER OF BUILDING, CENTER OF FIRE HYDRANT, CENTER OF MANHOLE COVER, ETC.) AS ILLUSTRATED BELOW OR CALL ENGINEER.

ILLUSTRATION OF TAKING MEASUREMENTS LOCATING THE CONDUIT END



- THE END OF CONDUIT WILL BE 3" BELOW PAVEMENT SURFACE. THEREFORE TO ACCURATELY LOCATE THE HIDDEN END OF CONDUIT...
- PRIOR COVERING UP THE CAP OF CONDUIT END, SELECT THREE REFERENCE POINTS IN DIFFERENT DIRECTIONS AROUND THE CONDUIT END.
 - MEASURE EXACT DISTANCES BETWEEN CENTER OF THE CONDUIT END AND THE REFERENCE POINTS.
 - SUBMIT A SKETCH SHOWING THE MEASUREMENTS TO OFFICE FOR RECORD.



LOOP WIRE INSTALLATION NOTES

- THE SAW CUT (1/4" WIDE) SHALL BE CONTINUOUS FROM EDGE OF THE DETECTOR LOOP TO AND THROUGH ONE SIDE OF THE PVC ELBOW.
- AFTER THE LOOP WIRE AND RETAINERS ARE INSTALLED THE SAW CUT THROUGH THE SIDE OF THE PIPE ELBOW BE PLUGGED WITH A PLIABLE PUTTY TO PREVENT THE ENTRANCE OF THE LIQUID EPOXY LOOP-SEALER.
- THE LOOP WIRE TO BE SPLICED TO SHIELDED LEAD CABLE IN H.H. OR M.H. IN ACCORDANCE WITH PROCEDURE EXPLAINED IN SPECIAL PROVISION FOR DETECTOR LOOP'S CONSTRUCTION SPECIFICATIONS.

A	DATE	REVISION

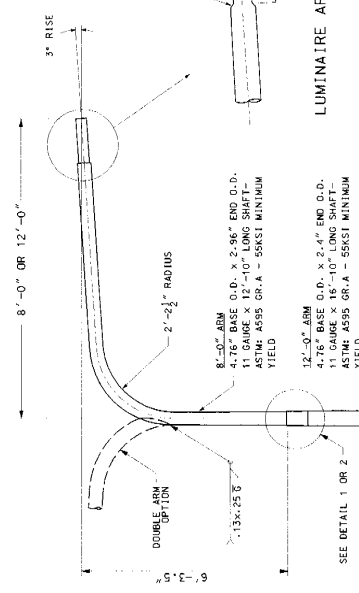
INSTALLATION OF 2" PVC CONDUIT UP TO THE VEHICLE DETECTOR LOOP

CITY OF CHICAGO
 DEPT. OF STREETS AND SANITATION
 BUREAU OF ELECTRICAL ENGINEERING

DRAFTSMAN: MOHAMMED AHMED
 CHIEF DRAFTSMAN: MOHAMMED AHMED
 SUPERVISING ENGINEER: MOHAMMED AHMED
 D.W.G. NO.: 905

ENGINEER OF ELECTRICITY: MOHAMMED AHMED
 SUPT. OF CONSTRUCTION: [Signature]
 RECORD COMMISSIONER: [Signature]

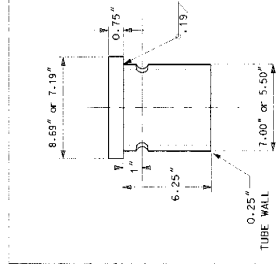
SCALE: NONE
 DATE: 2 29 96



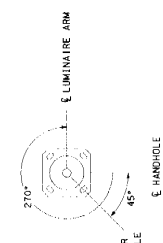
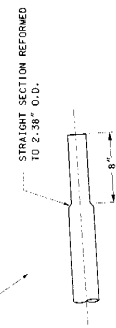
POLE AND ARM DATA

POLE	SYMS	BASE DIA.	TOP DIA.	LENGTH	BOLT CIRCLE	THICKNESS
1	□	13.0"	5.17"	34'-6"	15.0"	1.5"
2	⊗	11.0"	6.17"	34'-6"	17.25"	1.75"
3	⊙	12.5"	7.67"	34'-6"	16.5"	1.75"

DAVIT EXTENSION SLEEVE



LUMINAIRE ARM END TENON

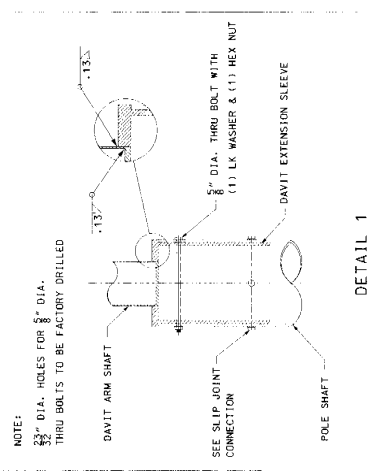


RADIAL INDEX

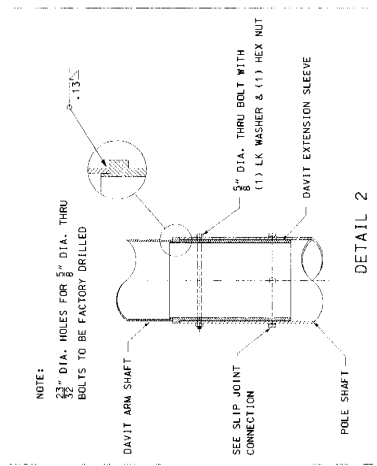
ALL ANGLES MEASURED CLOCKWISE FROM HAND-HOLE AS VIEWED FROM SMALL END OF POLE

ASTM GRADE C STEEL - 60KSI MINIMUM YIELD. CITY SPECIFICATION 1447.

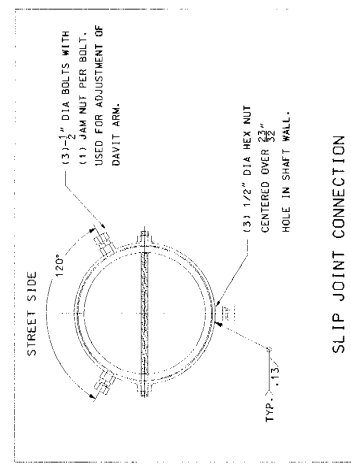
(4) ANCHOR BOLTS WITH ALL PLACES OR PROVIDED BY OTHERS.



DETAIL 1

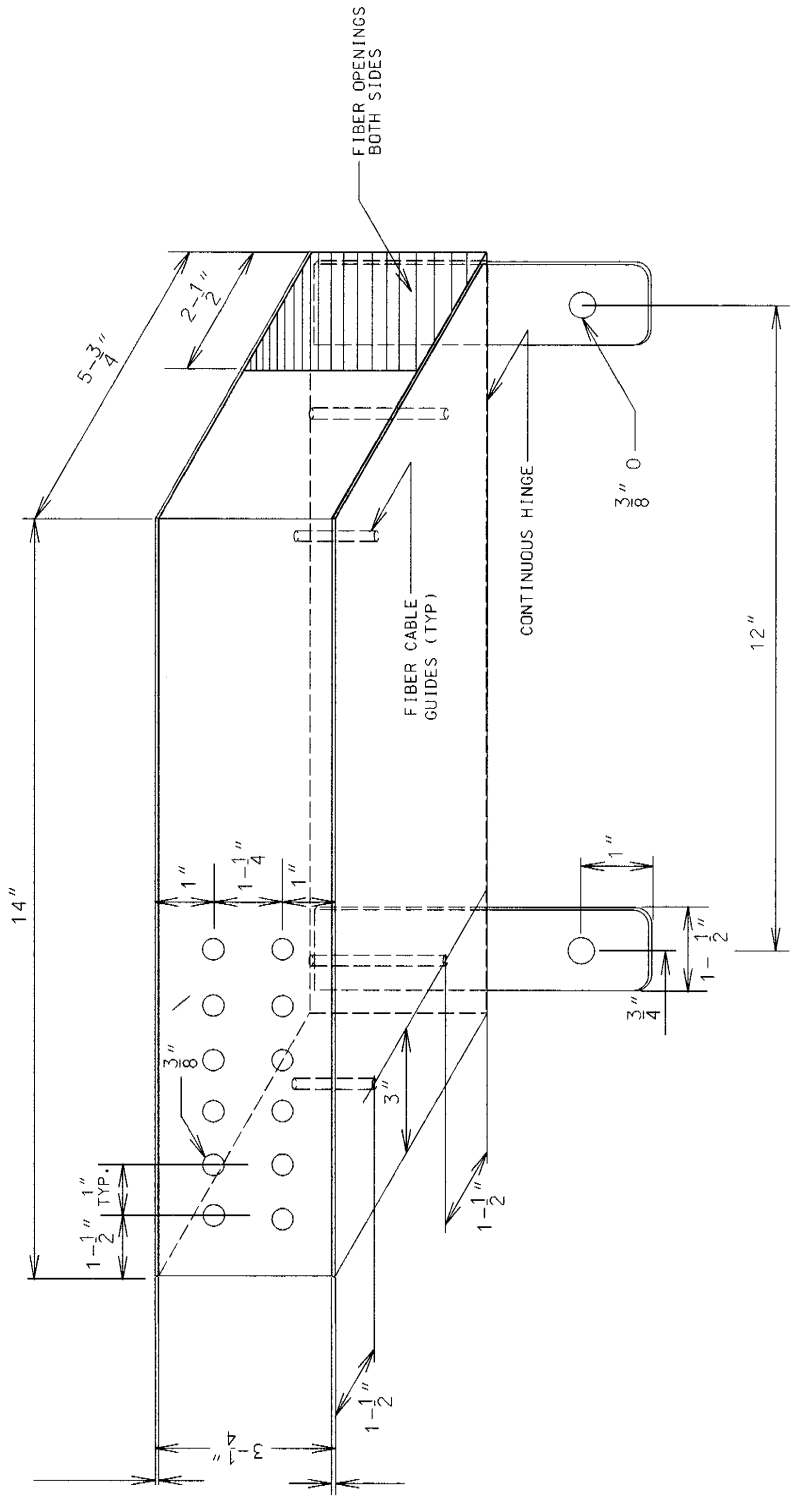


DETAIL 2



SLIP JOINT CONNECTION

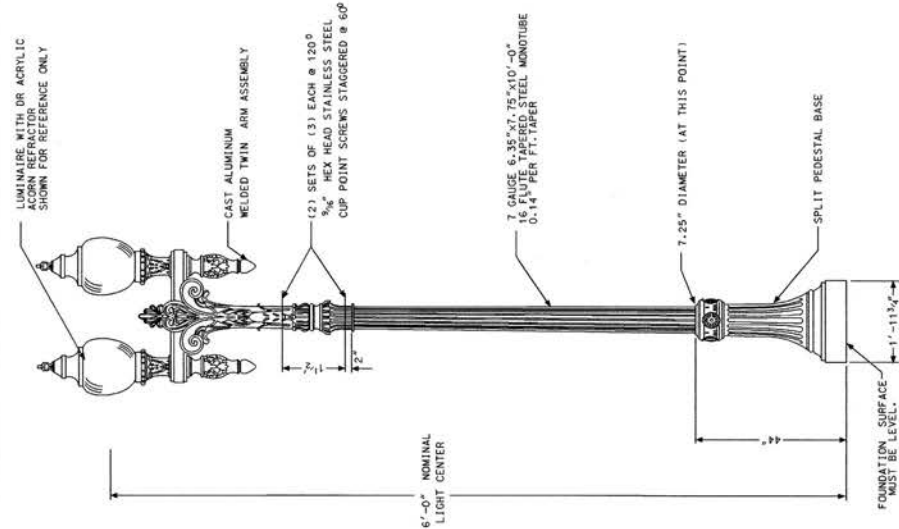
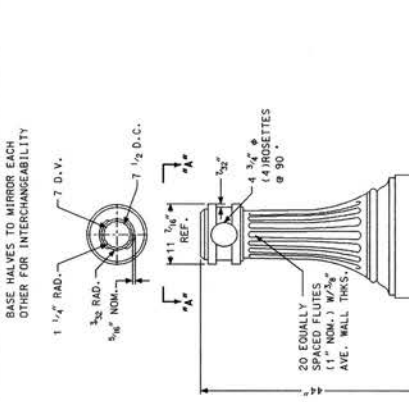
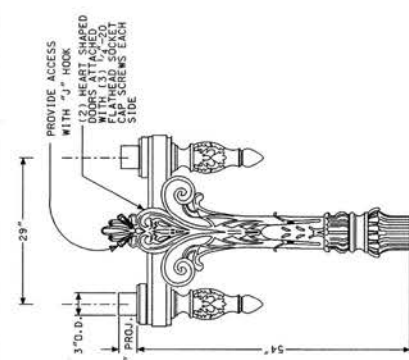
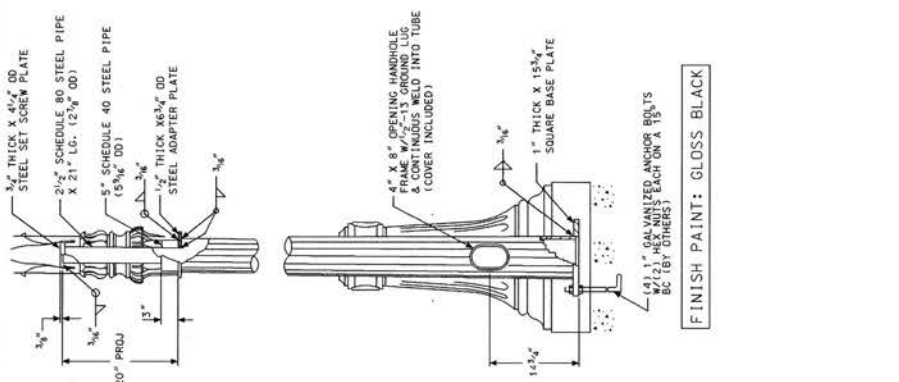
DATE	REVISION
STEEL DAVIT LIGHT POLE ARMS	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAWN BY B. GARNSEY	CHECKED BY R. CARTER
DESIGNED BY R. CARTER	IN CHARGE R. CARTER
DRAWING NO. 907	
SCALE: NONE	
DATE: 1/31/03	



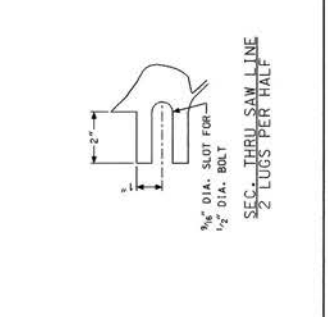
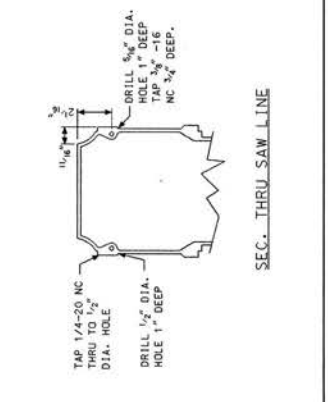
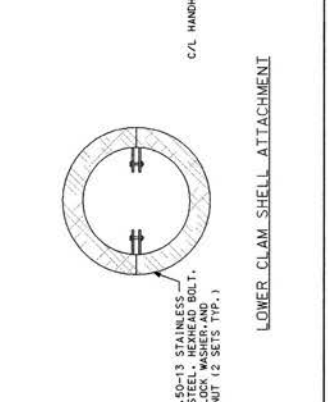
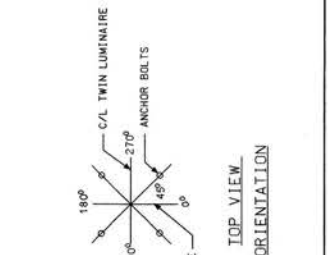
FIBER OPTIC PATCH PANEL
 FOR CITY OF CHICAGO
 TRAFFIC SIGNAL CONTROLLER

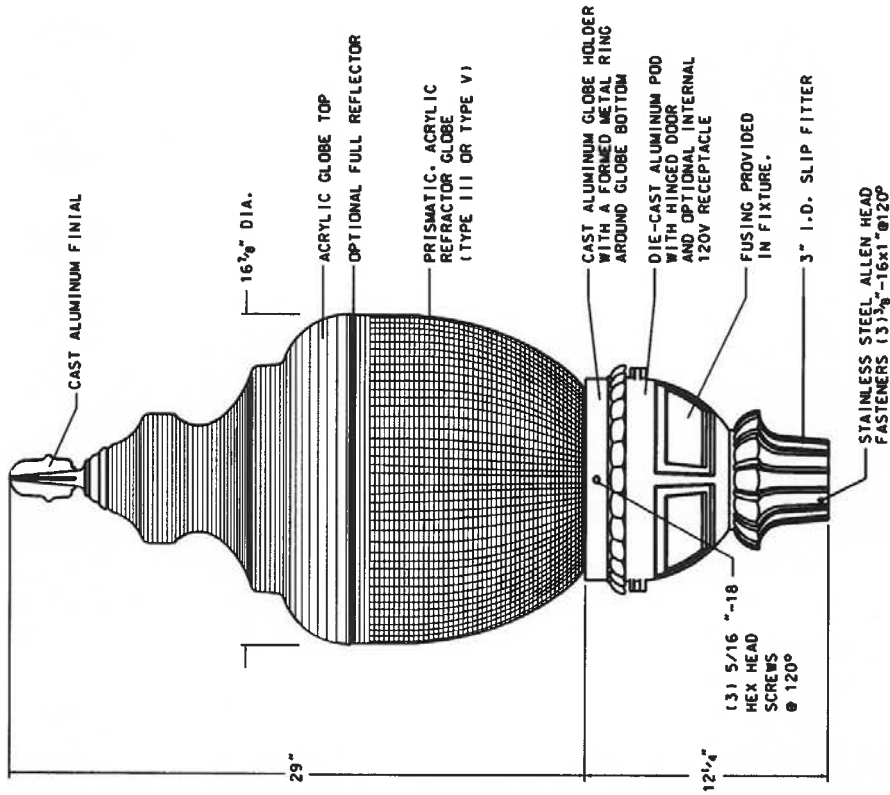
THIS PANEL WAS SUPPLIED FOR C.B.D. INTERCONNECT
 AND IS TO BE THE STANDARD FOR ALL CITY INSTALLATIONS

FIBER OPTIC PATCH PANEL	
CITY OF CHICAGO <small>DEPT. OF STREET'S AND SANITATION DIVISION OF ELECTRICAL ENGINEERING</small>	
DRAFTSMAN: ROBERT IVY	ENGINEER: WALTER TROMPKA
CHIEF DRAFTSMAN: ROBERT CARTER	ENGINEER: WALTER TROMPKA
SUPERVISING ENGINEER: ELEC. DESIGNER	DWG. NO. 909
ENGINEER OF ELECTRICITY: <i>[Signature]</i>	DATE: 11-01-02
DEPT. Supt. OF ELECTRICITY: <i>[Signature]</i>	SCALE:
DEPUTY COMMISSIONER: <i>[Signature]</i>	

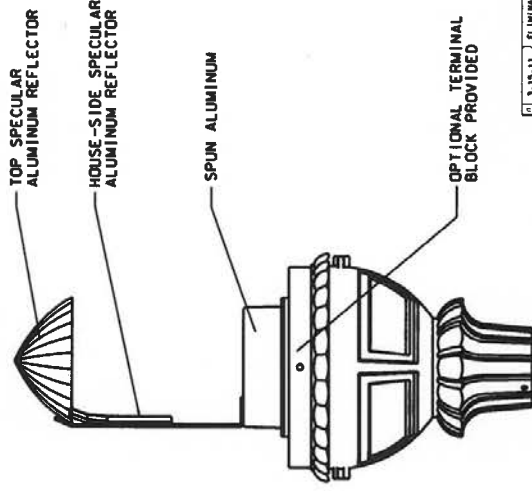


4	REVISION	DATE
ORNAMENTAL LOOP LIGHT POLE		
CITY OF CHICAGO DEPARTMENT OF INFRASTRUCTURE		
DESIGNED BY	PROJECT DESCRIPTION	DATE
DRAWN BY	DATE	
CHECKED BY		
911		
Diana S. Kibbey		
CITY OF CHICAGO		
911		



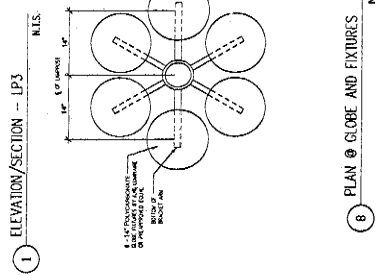
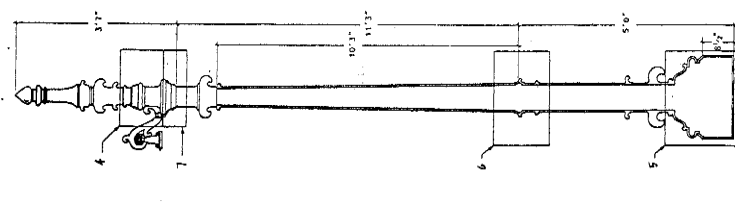


FINISH: CORVEL BLACK POWDER COATING
 FIXTURE DIMENSIONS
 HEIGHT: 41 1/4"
 WIDTH: 16 7/8"

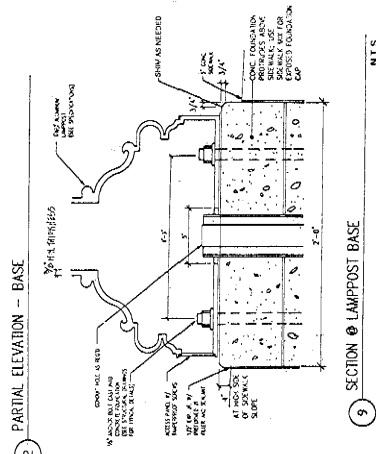
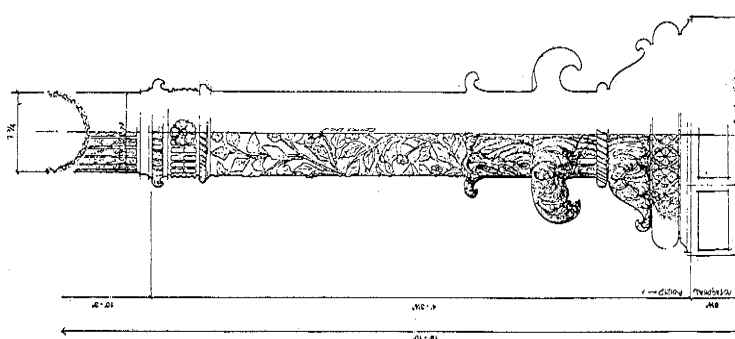


BALLAST ASSEMBLY

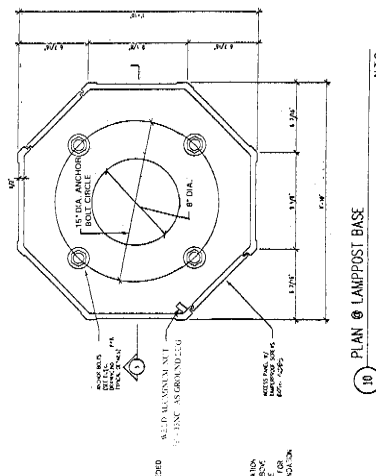
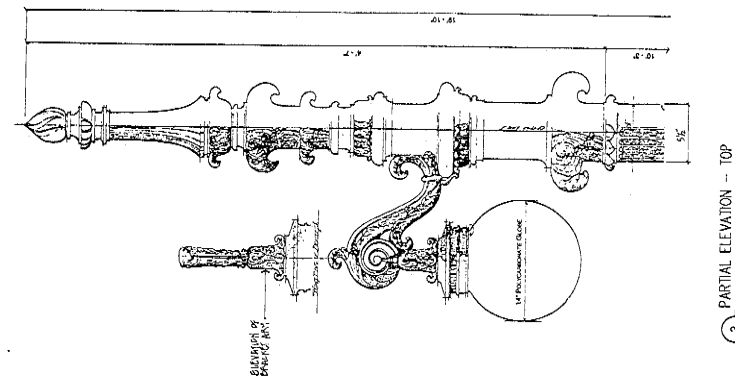
DATE	3-15-11	ELIMINATE NPS	REVISOR	DRAWING
ACORN LUMINAIRE FOR LOOP LIGHTING POLE				
CITY OF CHICAGO OFFICE OF THE COMMISSIONER PUBLIC WORKS DEPARTMENT 110 N. LAUREL STREET, 11TH FLOOR CHICAGO, ILLINOIS 60602-4000 TEL: (773) 312-3100 FAX: (773) 312-3101 WWW.CITYOFCHICAGO.IL.GOV				
PROJECT NO.	10-00000000	DATE	10/11/10	912
DESIGNED BY	W. G. CRUTCH	CHECKED BY	[Signature]	
DRAWN BY	[Signature]	SCALE	AS SHOWN	



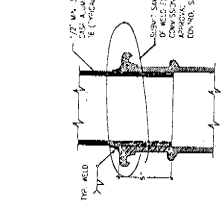
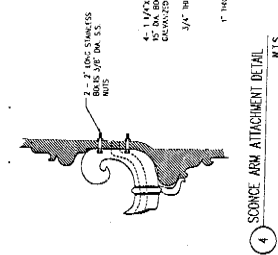
1 ELEVATION/SECTION -- LP3
N.T.S.



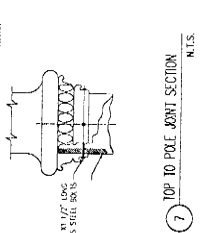
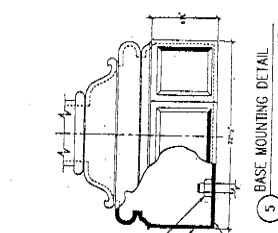
2 PARTIAL ELEVATION -- BASE
N.T.S.



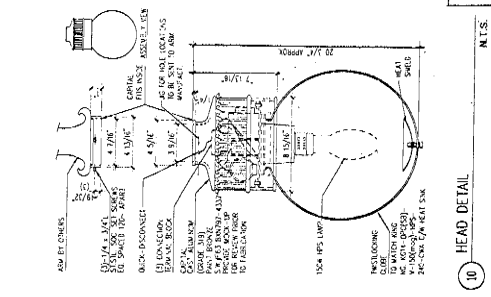
3 PARTIAL ELEVATION -- TOP
N.T.S.



4 SOURCE ARM ATTACHMENT DETAIL
N.T.S.



5 BASE MOUNTING DETAIL
N.T.S.



6 BASE TO POLE JOINT SECTION
N.T.S.

7 TOP TO POLE JOINT SECTION
N.T.S.

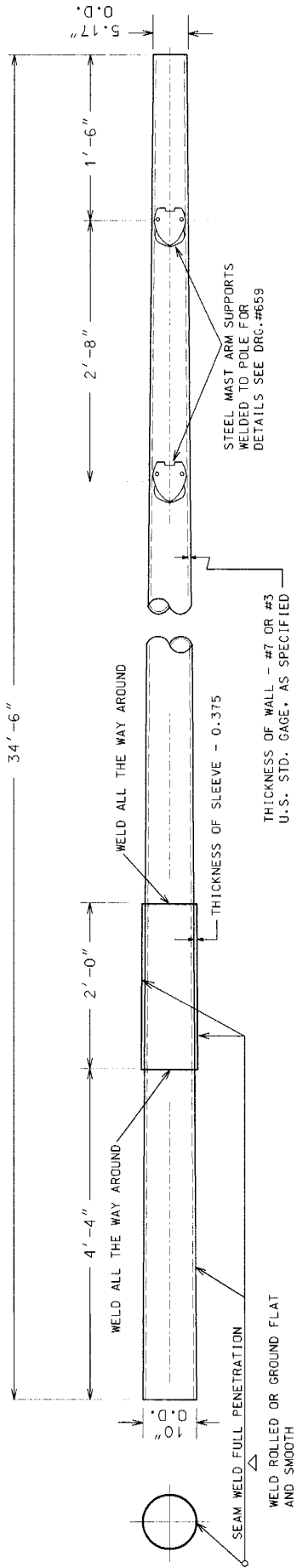
8 PLAN @ GLOBE AND FIXTURES
N.T.S.

9 SECTION @ LAMPOST BASE
N.T.S.

10 PLAN @ LAMPOST BASE
N.T.S.

10 HEAD DETAIL
N.T.S.

ELECTROLIER LIGHT POLE AND LUMINAIRE	
CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS	DRAW. NO. 914
DATE: 12-1-22	BY: [Signature]
CHECKED: [Signature]	APPROVED: [Signature]



MATERIAL

BOTH THE TUBE AND SLEEVE TO BE STEEL PER SPECIFICATION, TAPER 0.14" PER FOOT PAINT INSIDE AND OUTSIDE PER SPECIFICATION

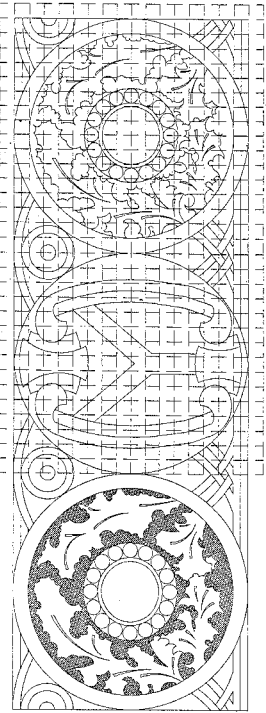
34'-6" EMBEDDED TAPERED TUBULAR
#7 OR #3 GAUGE STEEL POLE
WITH 2 BOLT MAST ARM ATTACHMENTS

REVISED	CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
A	DESIGNED BY	ENGINEER
B	R. IVY	R. CARTER
C		R. POOL
D		
E		
F		
G		
H		
I		

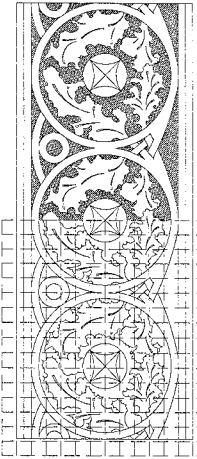
DATE: 05-14-98

916

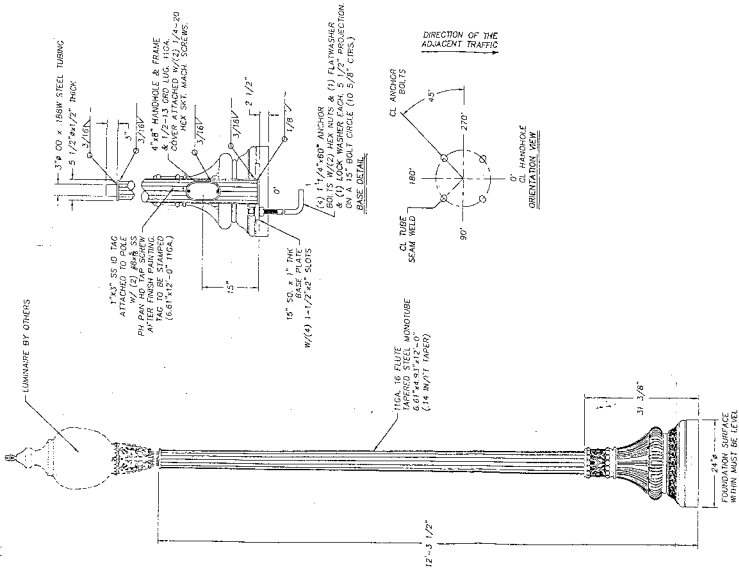
BRUCE S. THOMPSON



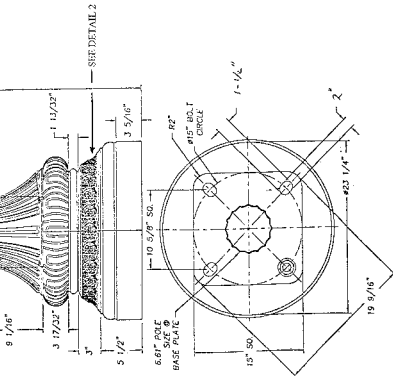
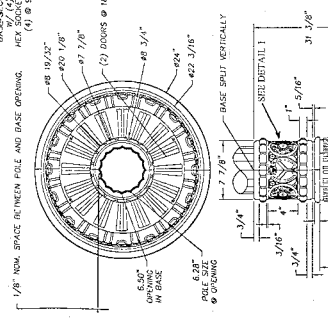
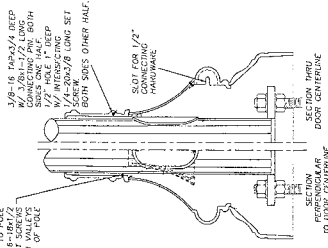
1 ENLARGED PATTERN TOP ORNAMENTATION
SCALE: FULL SIZE



2 ENLARGED PATTERN BOTTOM ORNAMENTATION
SCALE: FULL SIZE



POLE AND BASE
Scale: 3/4" = 1'



SHUTTLE BASE DETAIL
Scale: 1/4" = 1'

CHICAGO 2000 PEDESTRIAN POLE
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION
DESIGNED BY: [Signature] DRAWN BY: [Signature] CHECKED BY: [Signature]
DATE: [Date] SCALE: AS NOTED

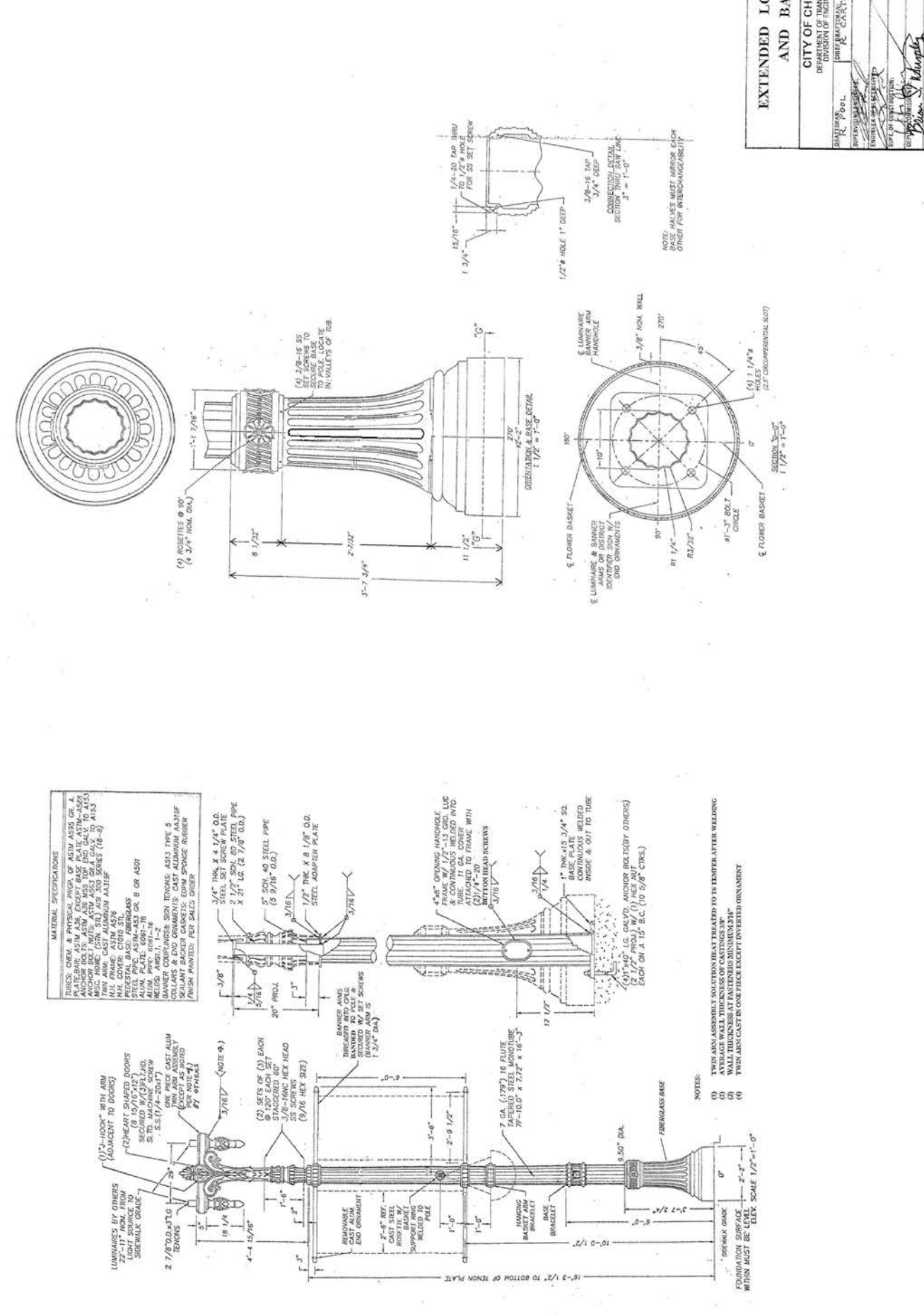
THIS DRAWING IS THE PROPERTY OF THE CITY OF CHICAGO. IT IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREON. IT IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF THE CITY OF CHICAGO. THE CITY OF CHICAGO ASSUMES NO LIABILITY FOR ANY DAMAGE OR INJURY TO PERSONS OR PROPERTY ARISING FROM THE USE OF THIS DRAWING.

DWG. NO. 928

DATE 1-28-2001

MATERIAL SPECIFICATIONS

TUBES: CHECK & PHYSICAL PROPS. OF ASTM A552 OR A 552
ANCHOR BOLTS: ASTM A307 OR A307B
MISC. HARDWARE: ASTM A307 OR A307B
WELDING: E70T18 OR E70T18-1
PAINT: ENVIRO-FLUOROPOLYMER
FINISH: POLISHED
ANCHOR BOLTS: ASTM A307 OR A307B
MISC. HARDWARE: ASTM A307 OR A307B
WELDING: E70T18 OR E70T18-1
PAINT: ENVIRO-FLUOROPOLYMER
FINISH: POLISHED



LUMINAIRE BY OTHERS
 LIGHT SOURCE TO BE
 SIDEWALK CRABE

(1) 17\"/>

(2) HEART SHAPED DOORS
 SECURED W/ (3) 1/4\"/>

(3) 2\"/>

(4) 2\"/>

(5) 2\"/>

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(100) 2\"/>

- NOTES:**
- (1) TWIN ARM ASSEMBLY SOLUTIONS SHALL BE TREATED TO IN TEMPERATURE WELDING
 - (2) WALL THICKNESS AT FASTENERS MINIMUM 3/16"
 - (3) TWIN ARM CAST IN ONE PIECE EXCEPT INVERTED ORNAMENT

FOUNDATION SURFACE TO BE
 WHEN MUST BE
 ELEV. SCALE 1/2"=1'-0"

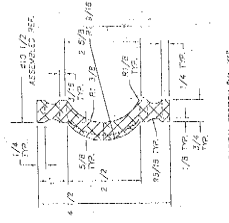
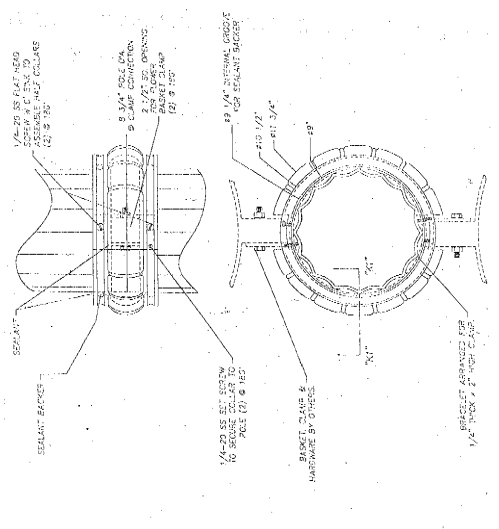
EXTENDED LOOP POLE AND BASE

CITY OF CHICAGO
 DEPARTMENT OF TRANSPORTATION
 DIVISION OF ENGINEERING

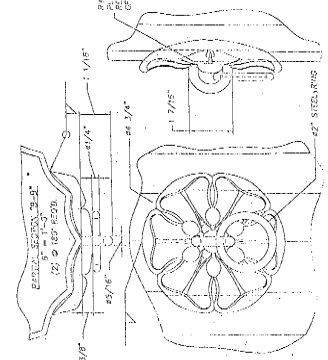
DESIGNER: [Signature]
 CHECKED: [Signature]
 APPROVED: [Signature]

DATE: 02/26/01

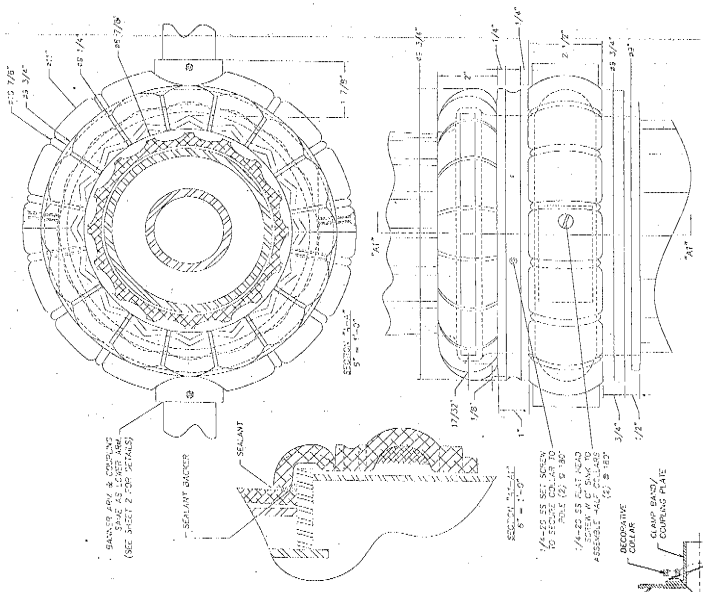
BWG. NO. 929



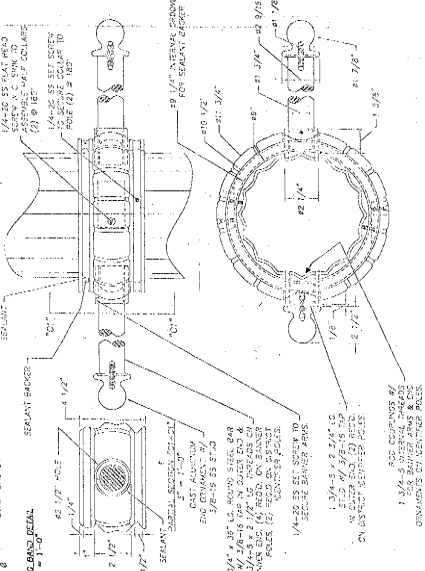
HANGING BASKET ARM BRACKET



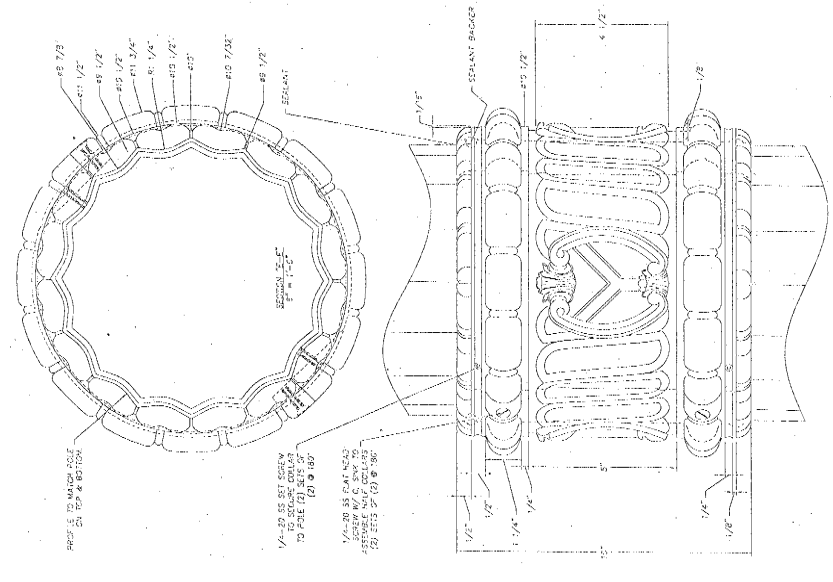
HANGING BASKET ROSETTE



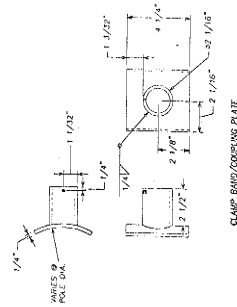
UPPER BANNER BRACKET



LOWER BANNER BRACKET



BASE BRACKET



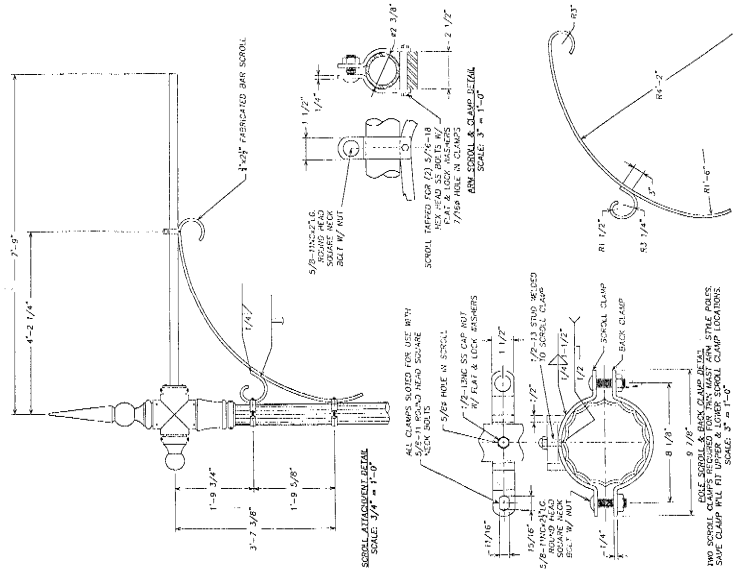
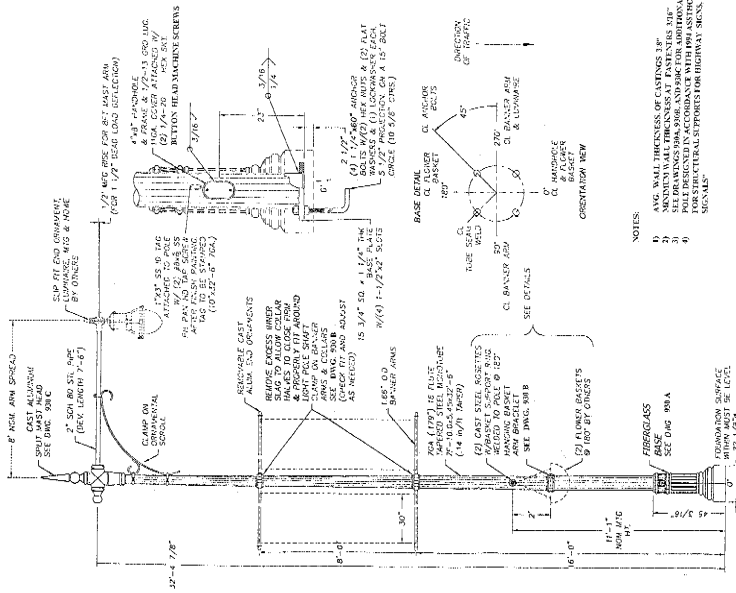
CLAMP RING (SEE DRAWING)

EXTENDED LOOP POLE BRACELETS

CITY OF CHICAGO
 DEPARTMENT OF PUBLIC WORKS
 DIVISION OF STREET LIGHTS
 121 N. LAKE ST., CHICAGO, ILL. 60602
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]
 DATE: 10/1/54

DWG. NO. **929**
 SHEET NO. **A**

AS NOTED

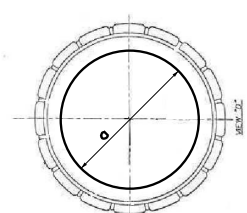


ALL CLAMPS SIZED FOR USE WITH 1/2\"/>

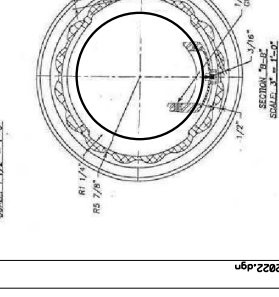
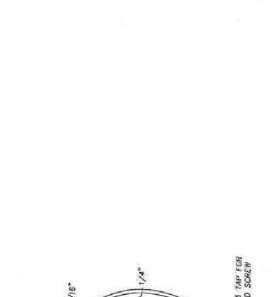
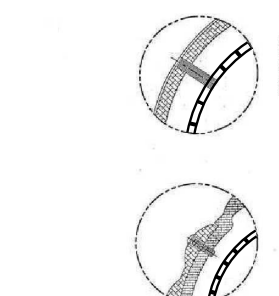
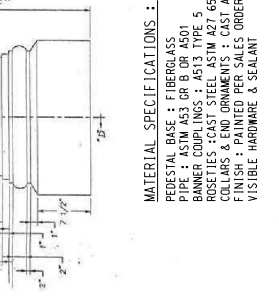
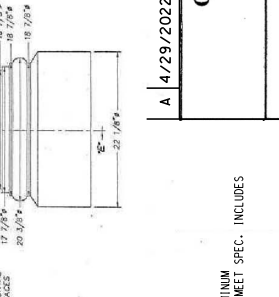
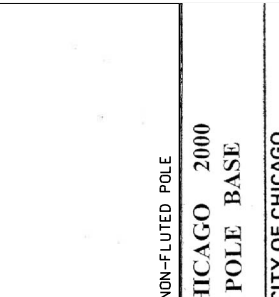
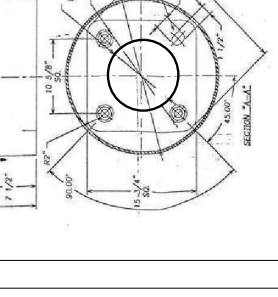
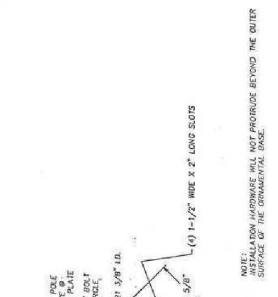
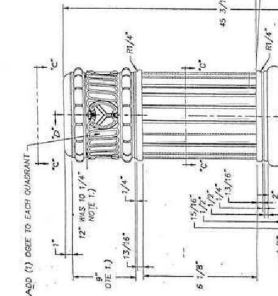
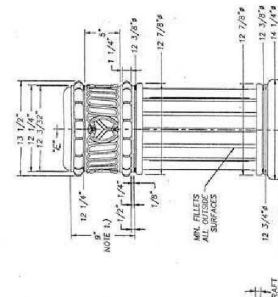
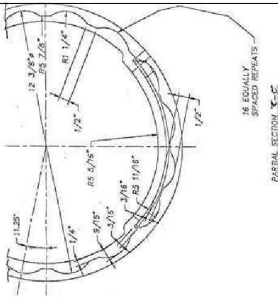
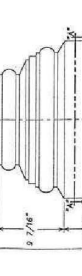
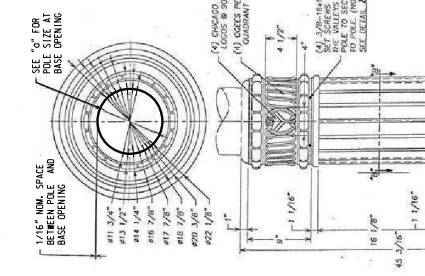
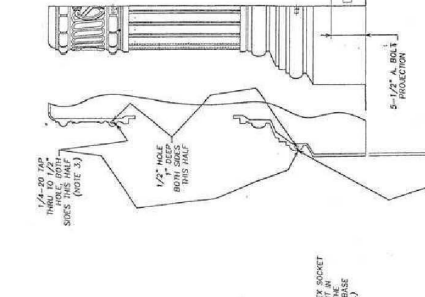
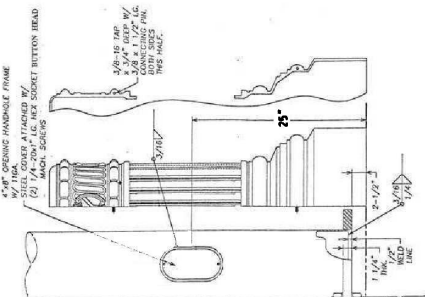
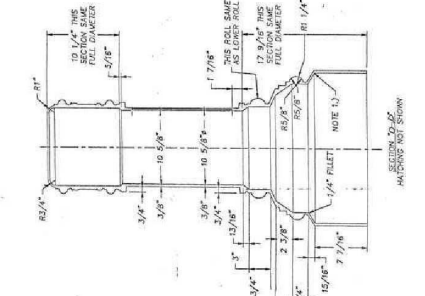
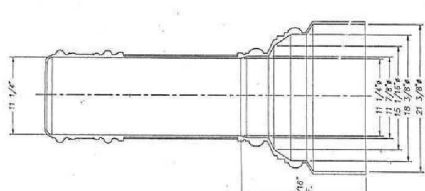
- NOTES:
- 1) AVERAGE WALL THICKNESS OF CASTINGS IS 3/8"
 - 2) MINIMUM WALL THICKNESS AT PATENTS IS 1/4"
 - 3) ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED
 - 4) ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED
 - 5) ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED

SCALE: 1/4" = 1'-0"
 SCALE: 1/4" = 1'-0"

CHICAGO 2000 POLE AND ARM	
CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS	
DRAWING NO. 2000-100	SHEET NO. 930
DATE: 10/1/19	SCALE: AS SHOWN



0 1 - 3.41\"/>

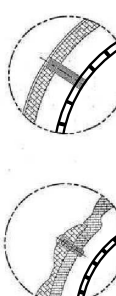


**CHICAGO 2000
POLE BASE**

A 4/29/2022 NON-FLUTED POLE

CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: K. POOL	ENGINEER: K. POOL
SUPERVISING ENGINEER: K. CARTER	
ENGINEER OF ELECTRICITY: K. POOL	
SCALE: AS NOTED	
DWG. NO. 930	DATE: 2-01-01
DESIGNED BY: K. POOL	
CHECKED BY: K. POOL	
APPROVED BY: K. POOL	

MATERIAL SPECIFICATIONS:
 PEDESTAL BASE: FIBERGLASS
 PIPE: ASTM A53 OR B OR A501
 BANNER COUPLINGS: A513 TYPE 5
 ROSETTES: CAST STEEL ASTM A27 65/35
 COLLARS & END ORNAMENTS: CAST ALUMINUM
 HARDWARE: AS PER ORDER & MEET SPEC. INCLUDES
 VISIBLE HARDWARE & SEALANT

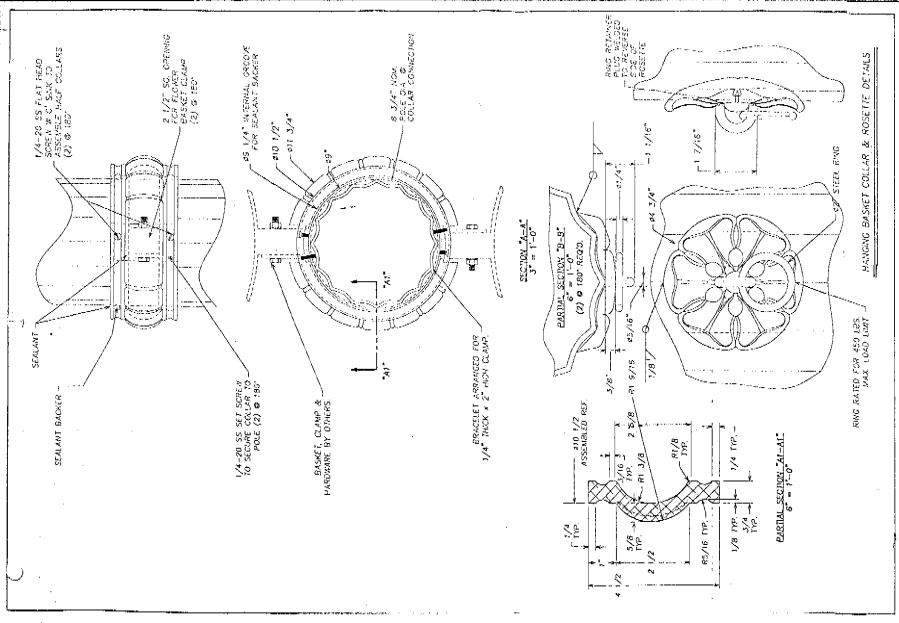


NOTE: INSTALLATION HARDWARE WILL NOT PROTRUDE BEYOND THE OUTER SURFACE OF THE ORNAMENTAL BASE.

NOTE: 1/4\"/>

NOTE: 1/4\"/>

NOTE: 1/4\"/>

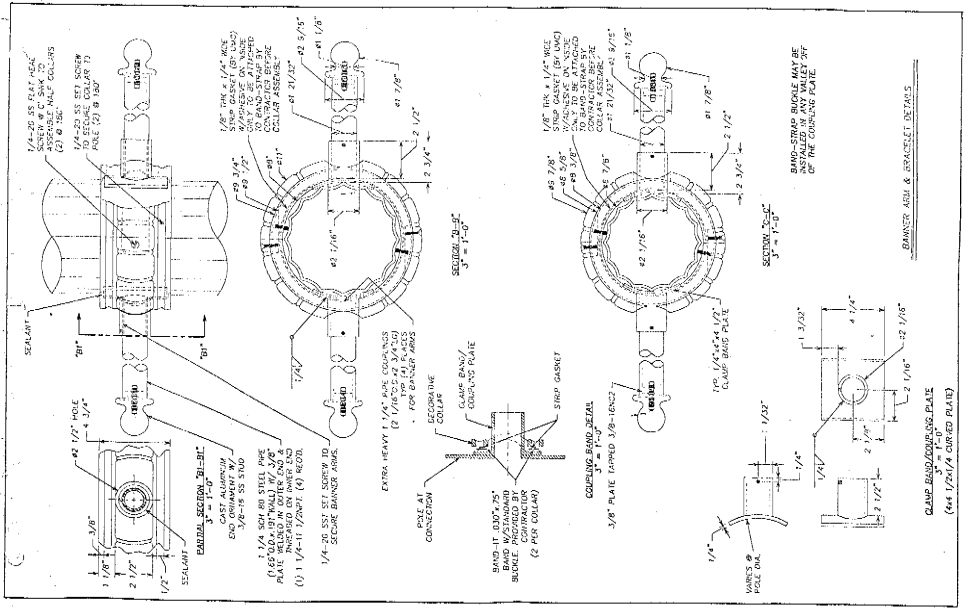


**CHICAGO 2000
BRACELETS**

CITY OF CHICAGO OFFICE OF GENERAL MANAGER	
CONTRACT NO. 004147	ISSUED BY POOL
DESIGNED BY POOL	DATE 01/23/11
PREPARED BY POOL	PROJECT NO. 004147
APPROVED BY POOL	DWG. NO. 930
DATE OF REVISION 01/23/11	BY B

DATE 2-01-11

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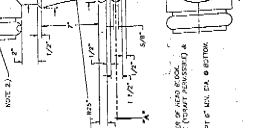
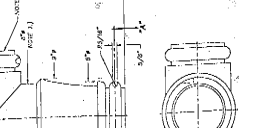
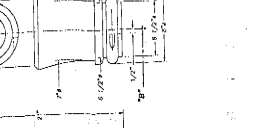
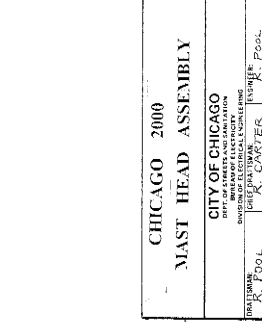
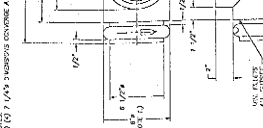
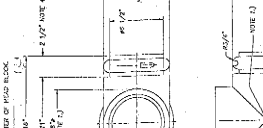
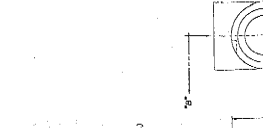
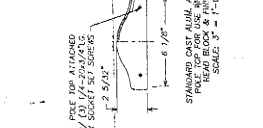
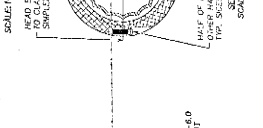
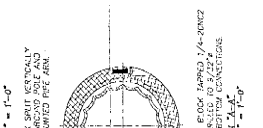
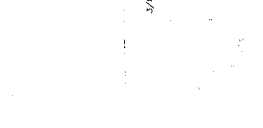
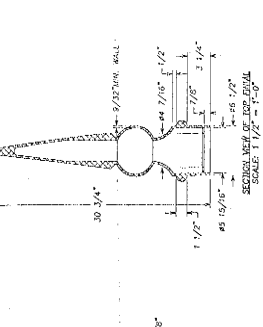
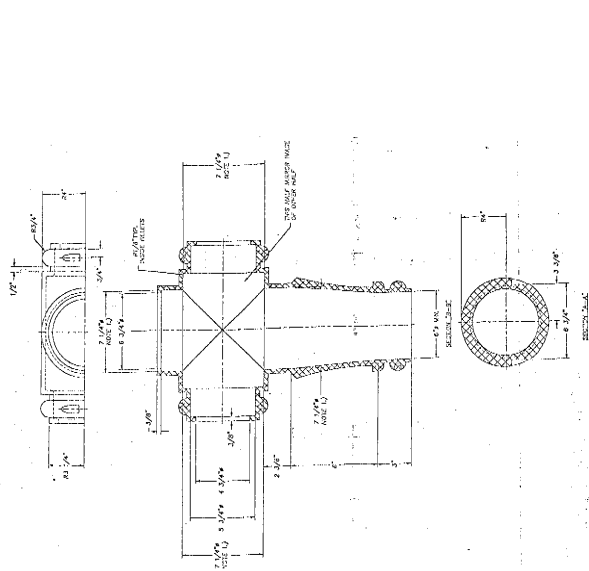
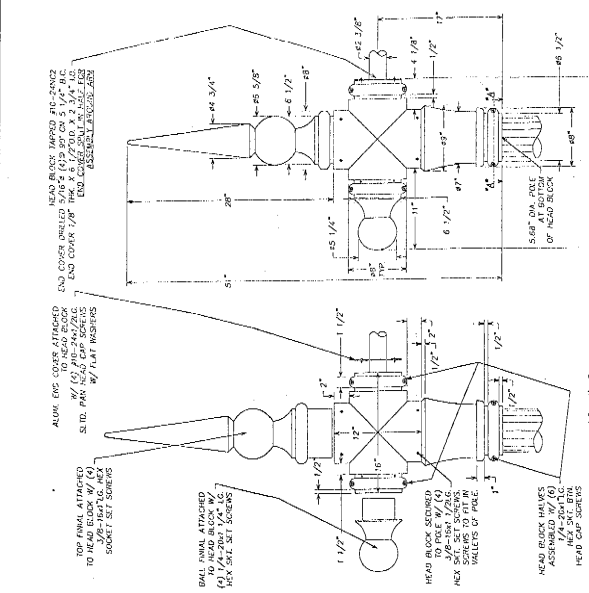
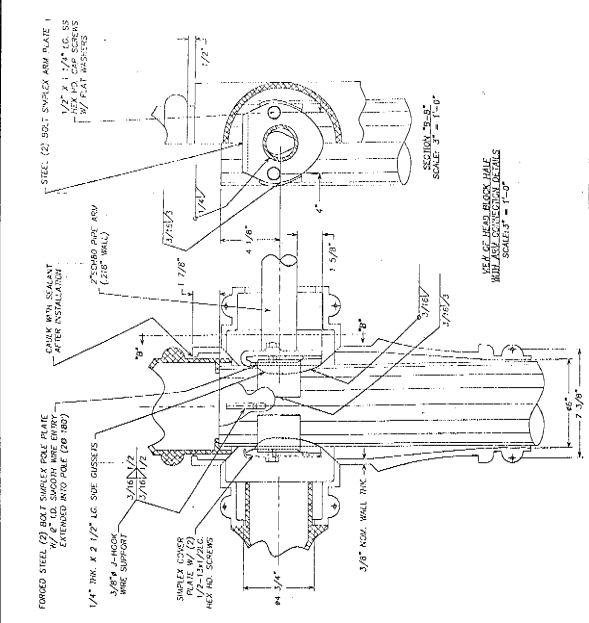


**CHICAGO 2000
BRACELETS**

CITY OF CHICAGO OFFICE OF GENERAL MANAGER	
CONTRACT NO. 004147	ISSUED BY POOL
DESIGNED BY POOL	DATE 01/23/11
PREPARED BY POOL	PROJECT NO. 004147
APPROVED BY POOL	DWG. NO. 930
DATE OF REVISION 01/23/11	BY B

DATE 2-01-11

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CHICAGO 2000
MAST HEAD ASSEMBLY

CITY OF CHICAGO
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

DRAWN BY: [Name]
CHECKED BY: [Name]
DATE: 2-21-01

SCALE: 3\"/>

SCALE: 3\"/>

SCALE: 3\"/>

SCALE: 3\"/>

SCALE: 3\"/>

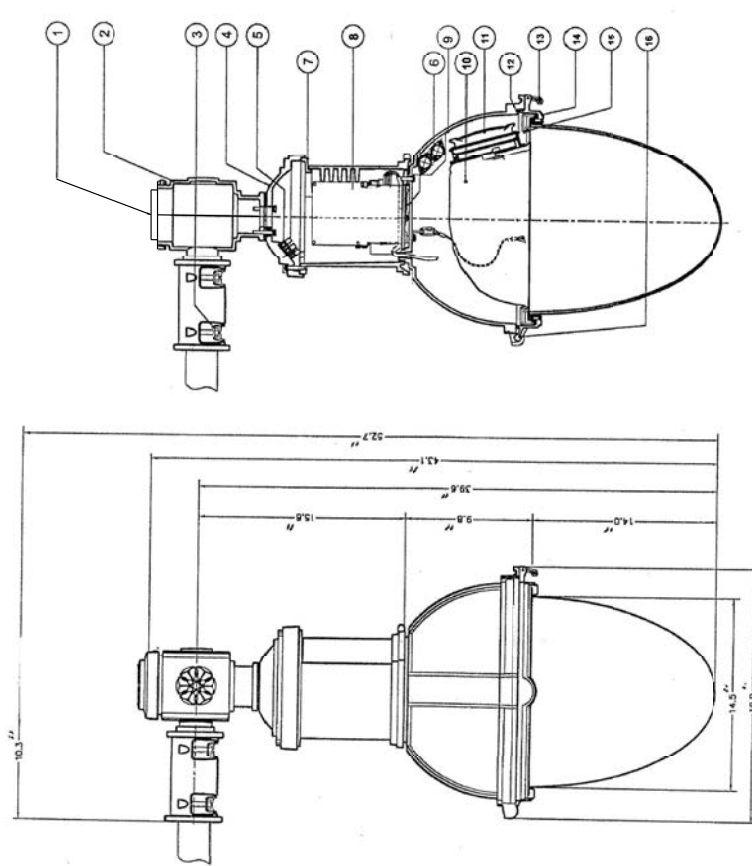
SCALE: 3\"/>

SCALE: 3\"/>

SCALE: 3\"/>

SCALE: 3\"/>

NOTES:
1) FINALS AND END PLATE
2) DIMENSIONS AND PARTS LIST
3) DIMENSIONS AND PARTS LIST
4) DIMENSIONS AND PARTS LIST



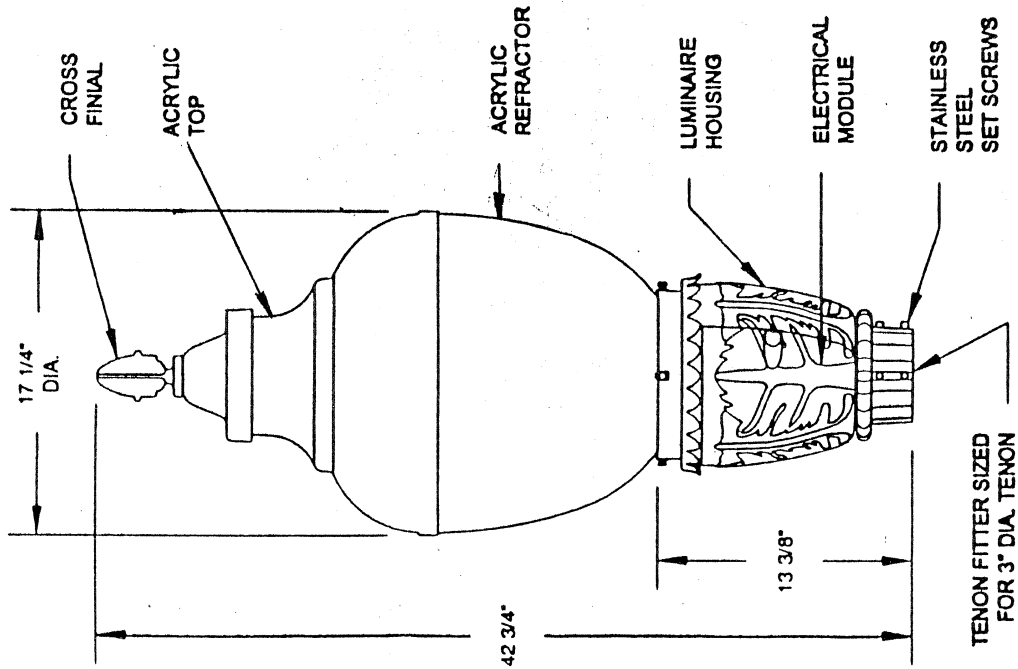
1. 7 Pin Receptacle
2. Slip-Fitter : Permanent cast aluminum, 356 alloy, allowing level adjustment.
3. Clamp (2X) : Galvanized steel c/w (4x)3/8-16 s.s.dryloc treated bolts.
4. Upper Housing Cap : Permanent cast aluminum, 356 alloy, secured to slip-fitter by 6 X 5/16-18 bolts.
5. Terminal Block.
6. Fuse and Fuse Holder : (2X) Bayonet-type knob for 1-1/2 fuse.
7. Upper Housing : Permanent cast aluminum, 356 alloy.
8. Ballast Compartment.
9. Lower Housing : Permanent cast aluminum, 356 alloy, secured to upper housing by 3 1/4-20 Bolts.
10. Reflector : Chemically brightened anodized hydroformed aluminum, permanently assembled to lens (Sealsafe) using liquid silicone. Tool-free removable from the lens frame.
11. Shutter : Polyphenylene sulfide plastic (PPS) c/w silicone gasket and lamp-holder. Tool-free lamp access.
12. Gasket : EPDM gasket.
13. Tension Latch : 0.125" dia. 304 s.s. wire allowing tool-free access to optical system.
14. Lens Frame : Permanent cast aluminum, 356 alloy, giving access to optical system and secured by stainless steel cable.
15. Optical System Retainer : (4x) 0.125" dia. 304 s.s. wire allowing tool-free access to optical system.
16. Hinge : Lens frame and lower housing have an integral hinge.

Color : Overall color is textured black, paint is applied at the interior and exterior of all concerned parts except the slip-fitter which is only partially interior painted.

B 18-15-18	ADD 7 PIN RECEPTACLE	G.PADIYAR
A 3-15-11	ELIMINATE HPS REFERENCES	G.PADIYAR
REVISION		
TEARDROP LUMINAIRE FOR CHICAGO 2000 POLE		
CITY OF CHICAGO DEPT. OF PUBLIC WORKS DIVISION OF ELECTRICITY CONSTRUCTION DIVISION		
DATE	DESIGNED BY	ENGINEER
	U.S.C. 2000	
SCALE	DATE	DWG. NO.
	9-5-02	931

1. LUMINAIRE SECTION

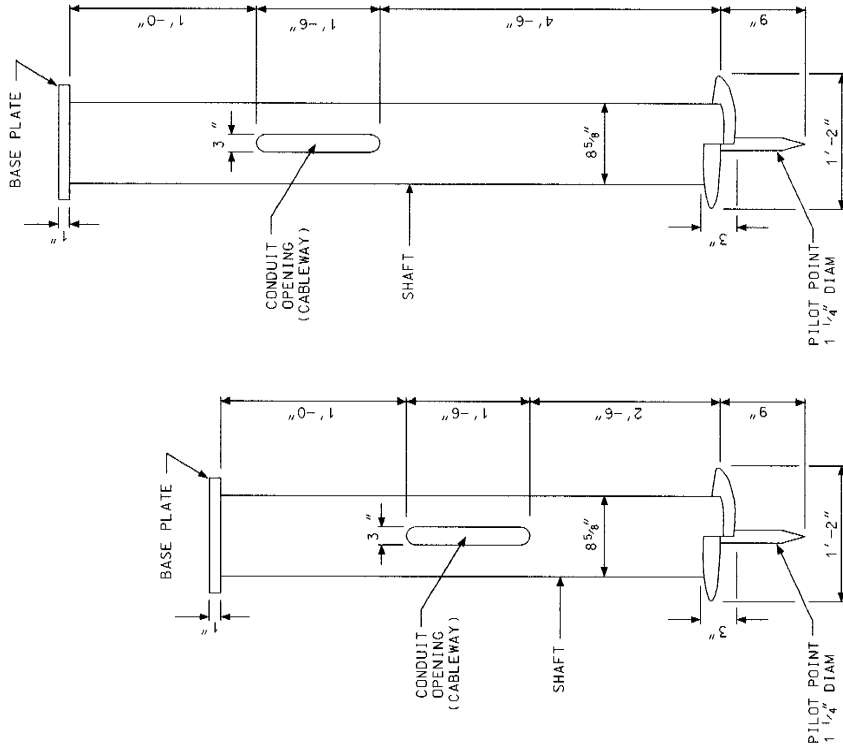
1. LUMINAIRE ELEVATION



A	DATE	REVISION
		ACORN LUMINAIRE
		CHICAGO 2000
		PEDESTRIAN POLE
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
DRAFTSMAN:	ELEC. DRAFTSMAN:	ENGINEER:
SUPERVISING ENGINEER:	ELEC. SUPERVISING ENGINEER:	
ENGINEER OF ELECTRICITY:		
CHECKED BY:		
DEPUTY COMMISSIONER:		
SIZE:	SCALE:	DATE: 9-5-02

DWG. NO. 932

[Handwritten Signature]

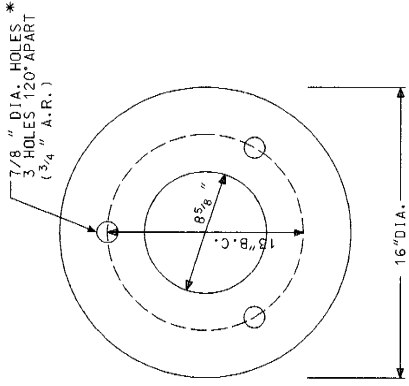


5' FOUNDATION

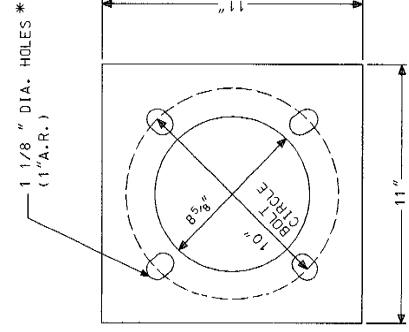
7' FOUNDATION

NOTES:

1. SHAFT MUST HAVE 1/4" WALL AND HAVE 8 5/8" OUTSIDE DIAMETER.
2. SHAFT MATERIAL MUST BE ASTM A53B STEEL PIPE OR LATEST REVISION.
3. HELIX MUST BE FORMED BY MATCHING METAL DIE.
4. HELIX MATERIAL MUST BE ASTM A709 GR 36 OR LATEST REVISION.
5. HELIX MUST HAVE 3 INCH PITCH.
6. PILOT POINT MATERIAL WILL BE ASTM A36 STEEL OR LATEST REVISION.
7. BASE PLATE MATERIAL WILL BE ASTM A36 STEEL.
8. ENTIRE STEEL FOUNDATION TO BE HOT DIP GALVANIZED PER ASTM A123 OR LATEST REVISION.
9. BASE PLATE MUST BE PERMANENTLY STAMPED WITH MANUFACTURER'S NAME, MANUFACTURING DATE, AND PRODUCT IDENTIFICATION.
10. BASE PLATE MUST BE PERMANENTLY MARKED ON TOP INDICATING CONDUIT OPENING ORIENTATION.

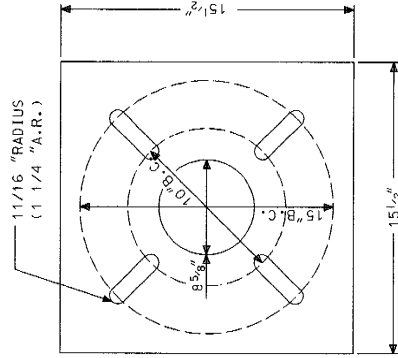


BASE PLATE
5 FOOT FOUNDATION
13" BOLT CIRCLE



BASE PLATE
5 FOOT FOUNDATION
10" BOLT CIRCLE

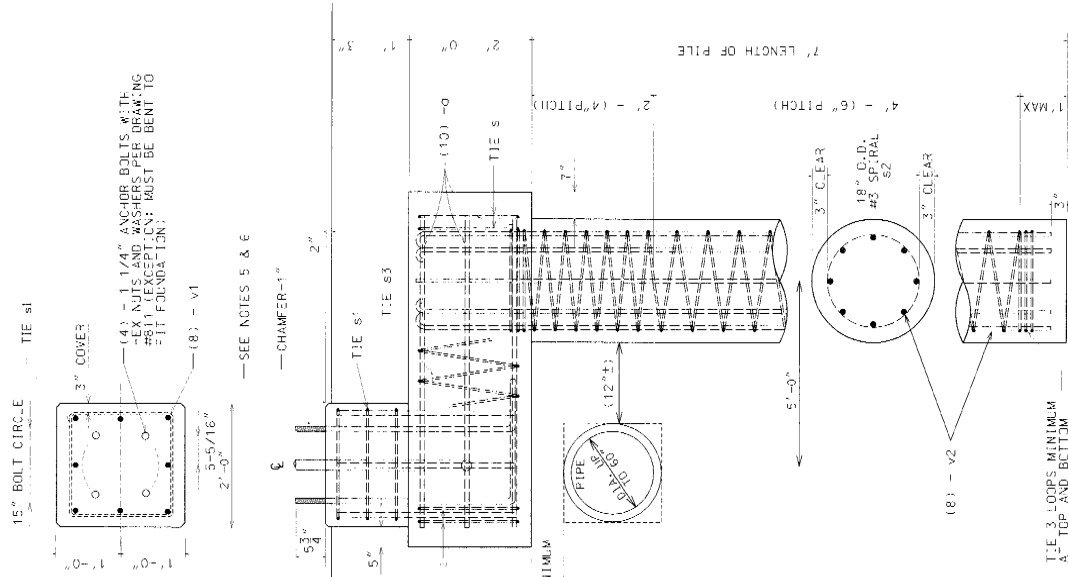
* HOLES IN BASE PLATE
MAY BE RADIALLY SLOTTED



BASE PLATE
7 FOOT FOUNDATION
10"-15" BOLT CIRCLE

NO.	REVISION	DATE
HELIX LIGHT POLE FOUNDATIONS		
<small> CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS DIVISION OF STREETS AND SANITATION ENGINEER IN CHARGE PROJECT NO. 34524 SHEET NO. 21-2 </small>		
 Brian S. Murphy		936

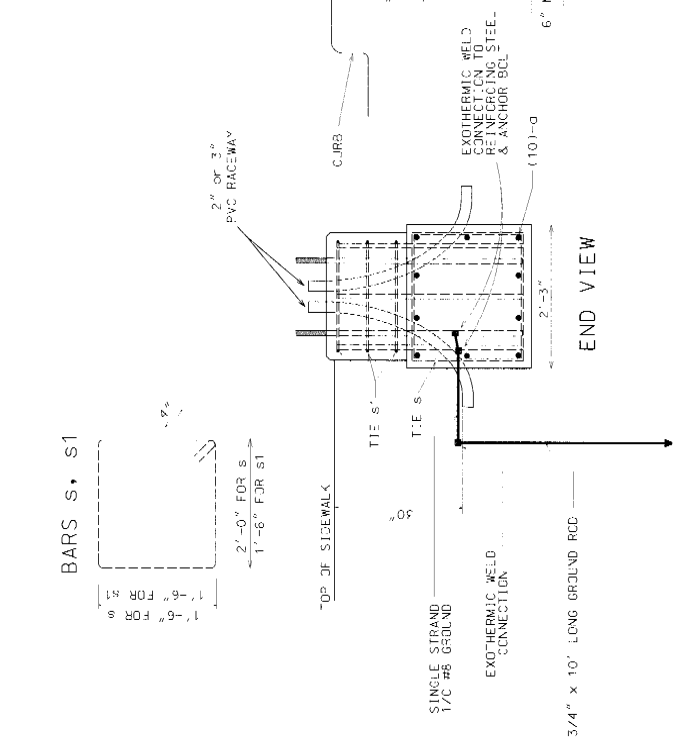
TOP VIEW



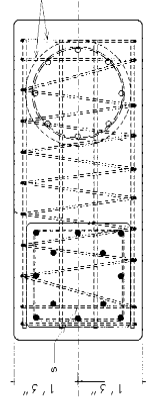
ELEVATION

1 MAX
4' - (6" PITCH)
5' - 0"
3" CLEAR
18" O.D. #3 SPIRAL S2
3" CLEAR
24" DIA.
TIE 3 LOOPS MINIMUM AT TOP AND BOTTOM

END VIEW



PLAN-CAP BEAM



NOTES

- EXCAVATION OF THE SOLE FOUNDATION MUST BE MADE WITH AN AUGER, 30" IN DIAMETER.
- THE ANCHOR WILL BE A TACK WELDED TYPE, SGT OR HOOK TYPE BOLT. COLD BENDING OF THE HOOK BOLT WILL NOT BE ALLOWED.
- THE ANCHOR BOLTS AND CONDUITS MUST BE PLACED IN THE CONCRETE BEFORE THE CONCRETE IS PLACED IN THE FORM.
- THE ENTIRE LENGTH OF THE ANCHOR BOLTS AS WELL AS THE NUTS AND WASHERS MUST BE HOT DIP GALVANIZED IN ACCORDANCE WITH THE REQUIREMENTS OF AS M DESIGNATION A 53.
- ANCHOR BOLTS AND CONDUITS MUST PROJECT 5-3/4" ABOVE THE CONCRETE SURFACE. THE CONCRETE MUST BE COMPACTED BEFORE THE LIGHT SCHEDULE IS ERECTED.
- POLES MUST BE INSTALLED PER DRAWING 837.
- THE CONDUIT BENCH MUST BE BACKFILLED AND FIRMLY COMPACTED BEFORE THE LIGHT SCHEDULE IS ERECTED.
- CONCRETE MUST MEET TEST REQUIREMENTS FOR PORTLAND CEMENT CLASS ST CONCRETE.
- ALL REINFORCEMENT SHALL HAVE A MINIMUM 3" COVER OF CONCRETE.

RE-BAR SCHEDULE

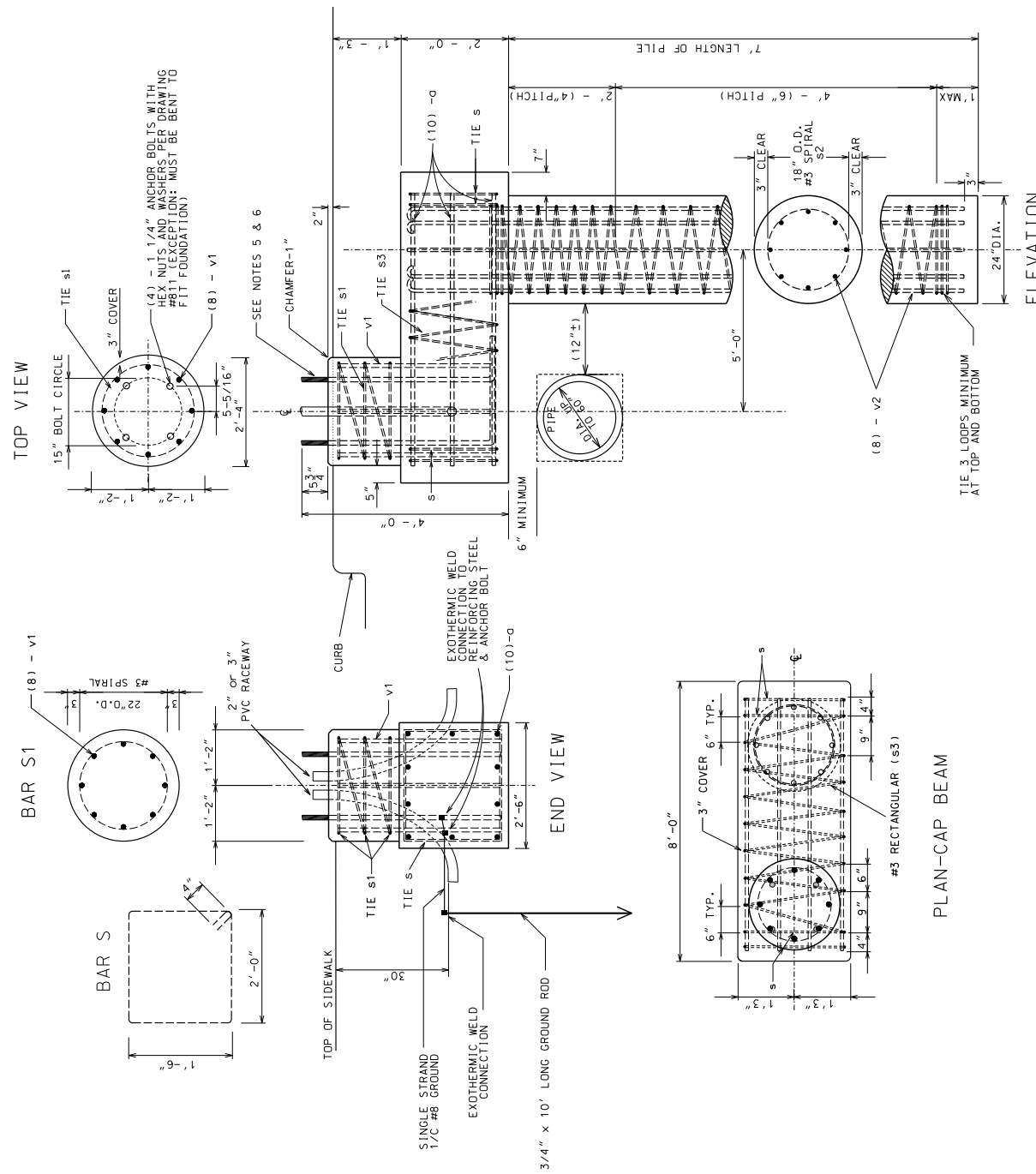
MARK	NO.	SIZE	SHAPE	LENGTH
C	10	6		7'-0"
S	2	4		7'-9"
S1	3	3		6'-8"
S2	1	3		99'-3"
S3	1	3		99'-8"
V1	8	6		2'-11"
V2	8	6		5'-0"

OFFSET FOUNDATION FOR LIGHT POLE

CITY OF CHICAGO
DEPT. OF STREETS AND SANITATION
BUREAU OF ELECTRICAL ENGINEERING
DIVISION OF ELECTRICAL ENGINEERING
DRAWN BY: B. GARNSEY
SUPERVISING ENGINEER: B. GARNSEY
ENGINEER: GARNSEY, LEAMOND
PROF. OF ELECTRICAL ENGINEERING
CITY OF CHICAGO
OFFICE: 110 N. LA SALLE ST.
CHICAGO, ILL. 60601
DATE: 1/25/03
PAGE: N.T.S.
937

NOTES

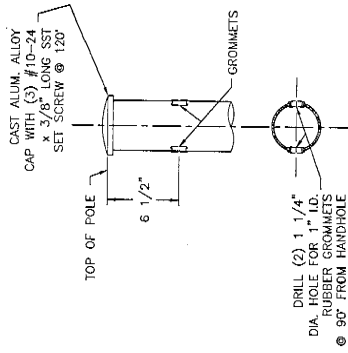
1. EXCAVATION OF THE POLE FOUNDATION MUST BE MADE WITH AN AUGER, 50" IN DIAMETER
2. THE ANCHOR WILL BE A TACK WELDED TYPE BOLT OR HOOK TYPE BOLT. COIL BENDING OF THE HOOK BOLT WILL NOT BE ALLOWED.
3. THE ANCHOR BOLTS AND CONDUITS MUST BE PROPERLY SECURED IN PLACE BEFORE THE CONCRETE IS PLACED IN THE FORM.
4. THE ENTIRE LENGTH OF THE ANCHOR BOLTS AS MARKED MUST BE WELDED TO THE ANCHOR BOLT AND SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH THE REQUIREMENTS OF ASTM DESIGNATION A153.
5. ANCHOR BOLTS AND CONDUITS MUST PROJECT 5-3/4" ABOVE TOP OF THE FOUNDATION. THE CONTRACTOR MUST CONFIRM ANCHOR BOLT AND CONDUIT EXTENSIONS WITH ENGINEER.
6. POLES MUST BE INSTALLED PER DRAWING 837
7. THE CONDUIT TRENCH MUST BE BACKFILLED AND FIRMLY COMPACTED BEFORE THE LIGHT POLE IS ERECTED
8. CONCRETE MUST MEET TOTT REQUIREMENTS FOR PORTLAND AND CEMENT CLASS S1 CONCRETE
9. ALL REINFORCEMENT SHALL HAVE A MINIMUM 3" COVER OF CONCRETE



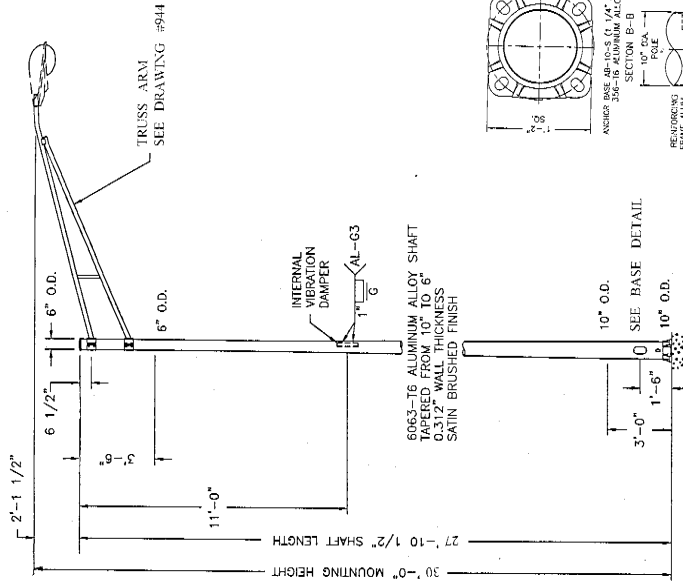
RE-BAR SCHEDULE

MARK	NO.	SIZE	SHAPE	LENGTH
O	10	6		7'-0"
S	4	4		7'-8"
S1	1	3		14'-0"
S2	1	3		93'-0"
S3	1	3		112'-0"
V1	8	6		2'-11"
V2	8	6		9'-0"

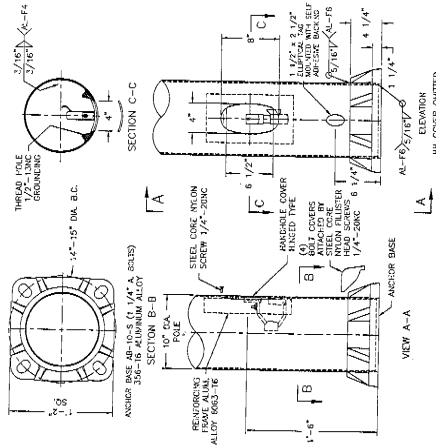
DATE	REVISION
A 12-27-12	ROUND CAP
OFFSET FOUNDATION FOR LIGHT POLE	
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION DIVISION OF ENGINEERING-ELECTRICAL SECTION	
DRAFTSMAN: B. GARNSEY ENGINEER: GARNSEY, LETAMENDI	DWG. NO. 937 A
SUPERVISING ENGINEER: ELEC. DESIGN ENGR.	
ENGINEER OF ELECTRICALITY:	
GEN'L Supt. OF ELECTRICALITY:	
DEPUTY COMMISSIONER:	
SCALE: 3/6" = 1'-0"	DATE: 1/28/03



POLE TOP



SEE BASE DETAIL



POLE BASE

ALUMINUM POLE
10" x 6" x 27'-10.5"
FOR ARTERIAL STREETS

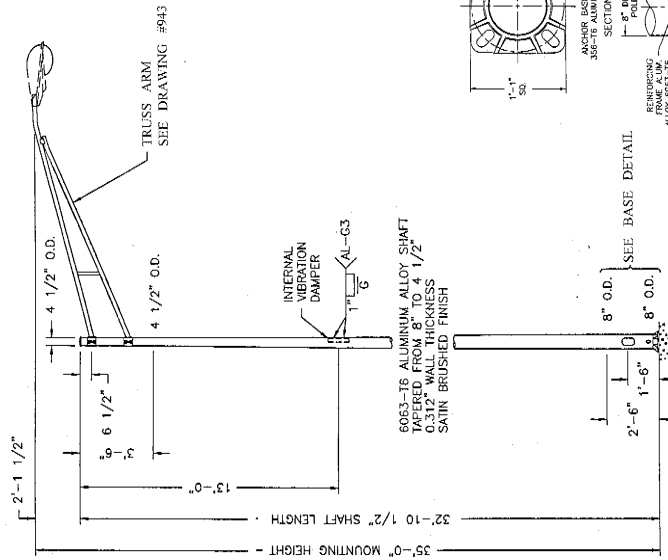
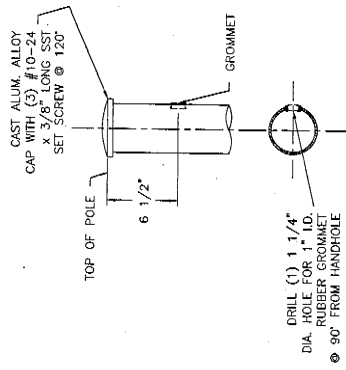
CITY OF CHICAGO
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ELECTRICAL ENGINEERING

ENGINEER: [Signature]

DATE: 1-27-52

938

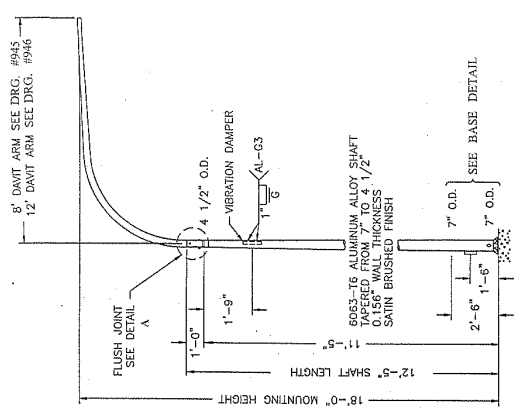
Sheet 1-27-52



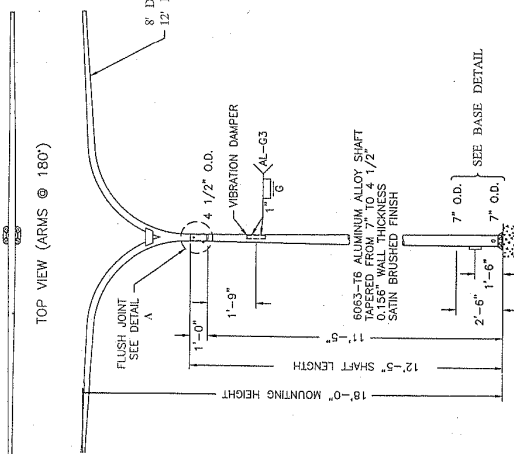
POLE TOP

POLE BASE

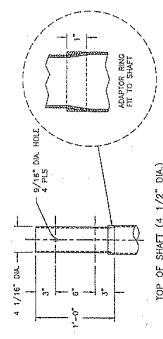
ALUMINUM POLE 8" x 4.5" x 32'-10.5"		DWG. NO.	939
CITY OF CHICAGO OFF. OF PUBLIC WORKS & INFRASTRUCTURE DIVISION OF ELECTRICAL INFRASTRUCTURE		DATE	11/29/22
DESIGNED BY	ENGINEER	CHECKED BY	DATE
APPROVED BY	DATE	DATE	DATE



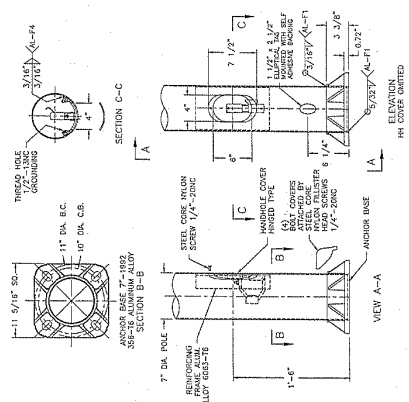
POLE WITH SINGLE DAVIT ARM



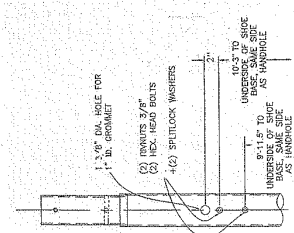
POLE WITH TWIN DAVIT ARMS



DETAIL A

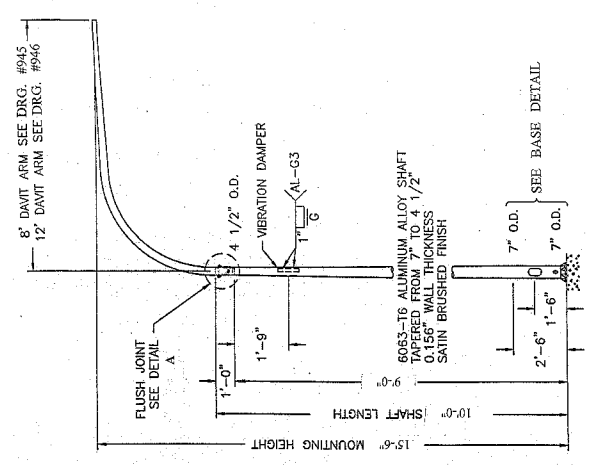


POLE BASE

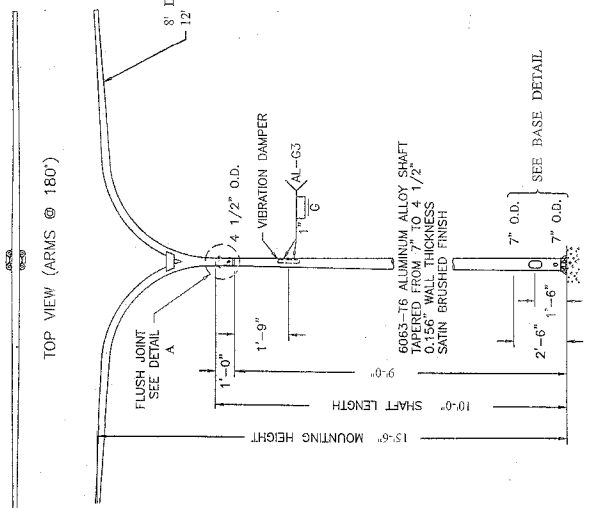


OPTIONAL SIDE MOUNT FOR LUMINAIRE

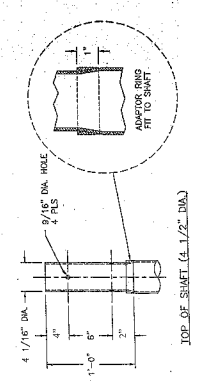
REVISED	06-13-2012
ALUMINUM DAVIT POLE	
7" x 4.5" x 12'-5"	
FOR RESIDENTIAL STREETS	
CITY OF CHICAGO	
DEPARTMENT OF TRANSPORTATION	
OFFICE OF THE CHIEF ENGINEER	
DESIGNED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE
D.W.G. NO.	
940	
DATE: 7-23-02	



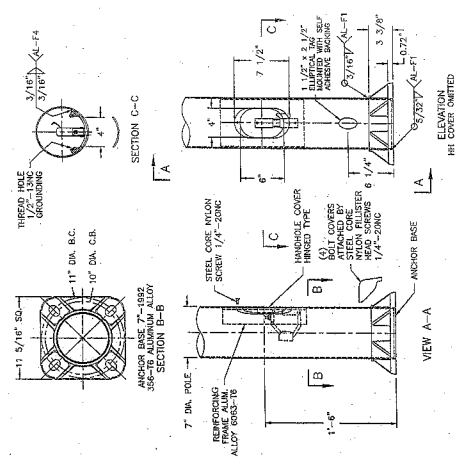
POLE WITH SINGLE DAVIT ARM



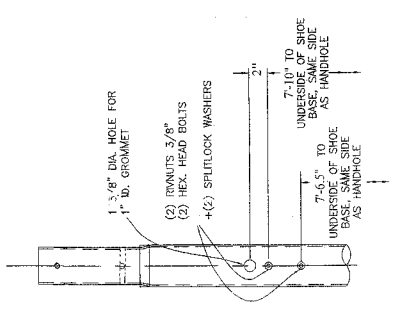
POLE WITH TWIN DAVIT ARMS



DETAIL A

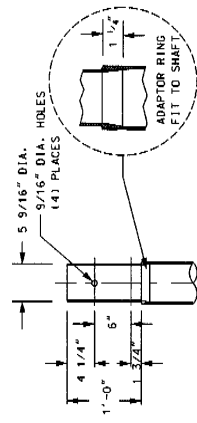


POLE BASE



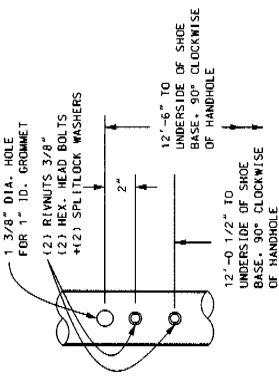
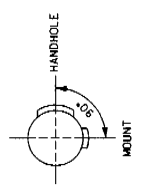
OPTION: SIDE MOUNT FOR LUMINAIRE

SHORT ALUMINUM DAVIT POLE		D.W.G. NO. 940
7" x 4.5" x 10'-0"		
FOR RESIDENTIAL STREETS		
CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS DIVISION OF STREET LIGHTING		
DATE: _____	SCALE: _____	DATE: _____
DESIGNED BY: _____	CHECKED BY: _____	DATE: _____
DRAWN BY: _____	APPROVED BY: _____	DATE: _____
PROJECT NO.: _____	PROJECT NAME: _____	DATE: _____

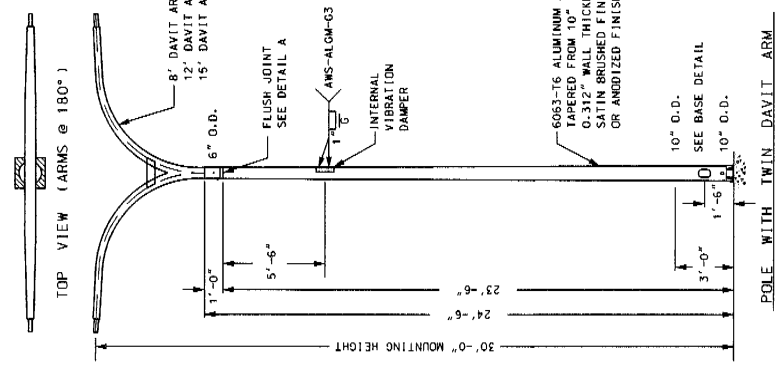


DETAIL A

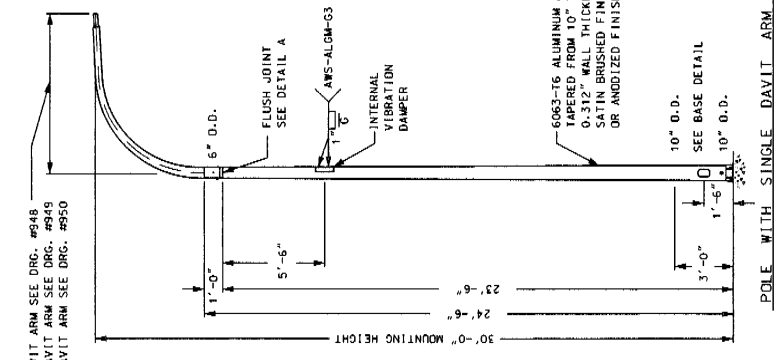
GENERAL NOTES:
 - UNITS SHALL BE MANUFACTURED IN ACCORDANCE WITH THE 1994 ASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS.
 - DESIGN WIND VELOCITY SHALL BE 80 MILES PER HOUR WITH 1.3 GUST FACTOR.
 - LIGHT POLE SHALL BE DESIGNED TO SUPPORT (1) 40 POUNDS LUMINAIRE WITH AN EFFECTIVE PROJECTED AREA OF 1.2 SQUARE FEET MOUNTED ON A 30'-0" SINGLE DAVIT ARM.



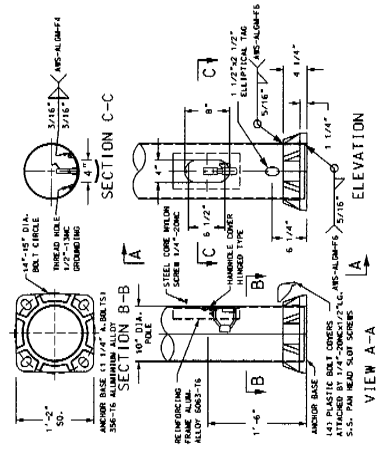
OPTION: SIDE MOUNT FOR LUMINAIRE



POLE WITH TWIN DAVIT ARM



POLE WITH SINGLE DAVIT ARM



VIEW A-A

A	DATE	REVISION

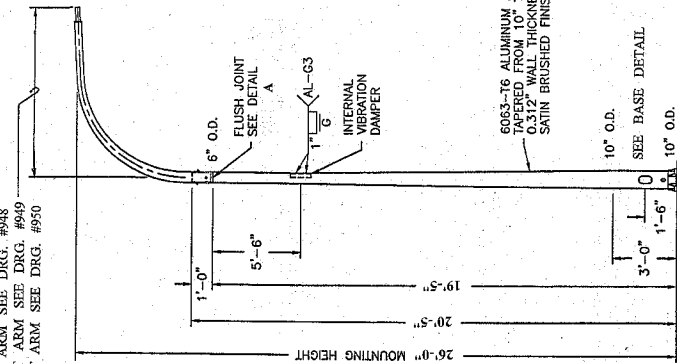
ALUMINUM DAVIT POLE
 10" x 6" x 30'
 FOR ARTERIAL STREETS

CITY OF CHICAGO
 DEPARTMENT OF TRANSPORTATION
 DIVISION OF ENGINEERING

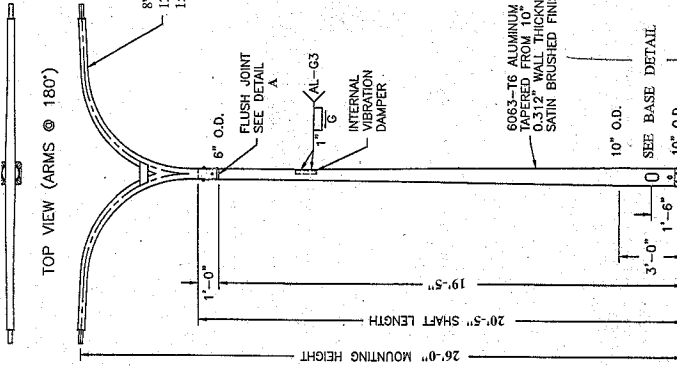
DRWG. NO. 941
 ENGINEER: G. W. PADYAR
 SUPERVISING ENGINEER: R. POOL
 ENGINEER OF ELECTRICITY: [Signature]
 DEPUTY COMMISSIONER: [Signature]

SCALE: NONE DATE: 04/15/73

8' DAVIT ARM SEE DRG. #948
 12' DAVIT ARM SEE DRG. #949
 15' DAVIT ARM SEE DRG. #950

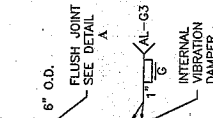


POLE WITH SINGLE DAVIT ARM

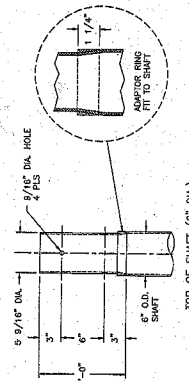


POLE WITH TWIN DAVIT ARMS

8' DAVIT ARM SEE DRG. #948
 12' DAVIT ARM SEE DRG. #949
 15' DAVIT ARM SEE DRG. #950



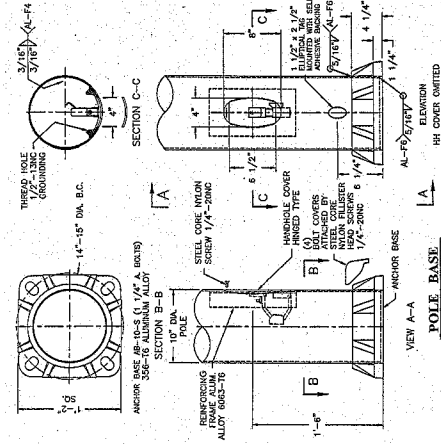
DETAIL A



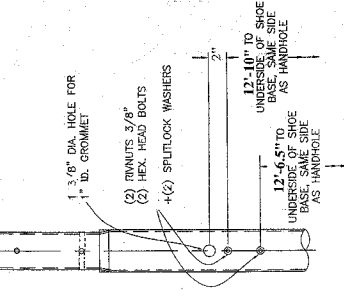
DETAIL A

6063-T6 ALUMINUM ALLOY SHAFT
 TAPERED FROM 10" TO 6"
 0.312" WALL THICKNESS
 SATIN BRUSHED FINISH

6063-T6 ALUMINUM ALLOY SHAFT
 TAPERED FROM 10" TO 6"
 0.312" WALL THICKNESS
 SATIN BRUSHED FINISH

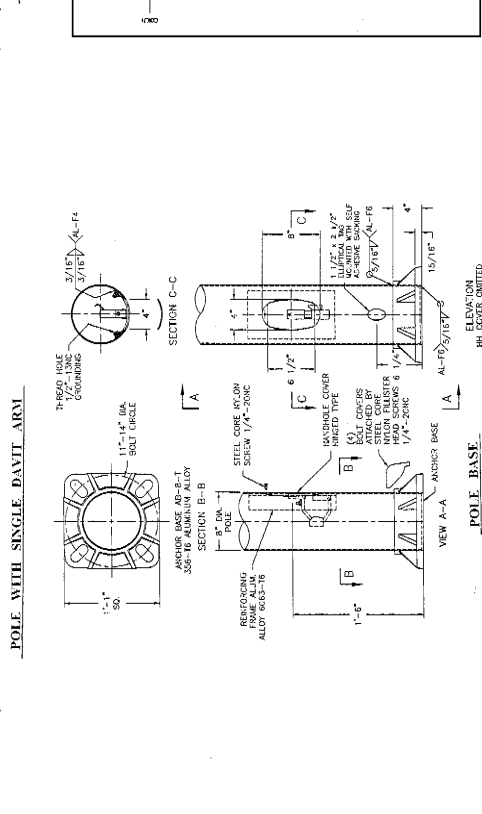
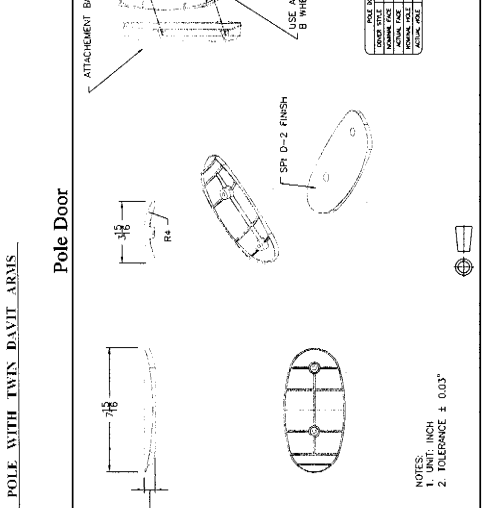
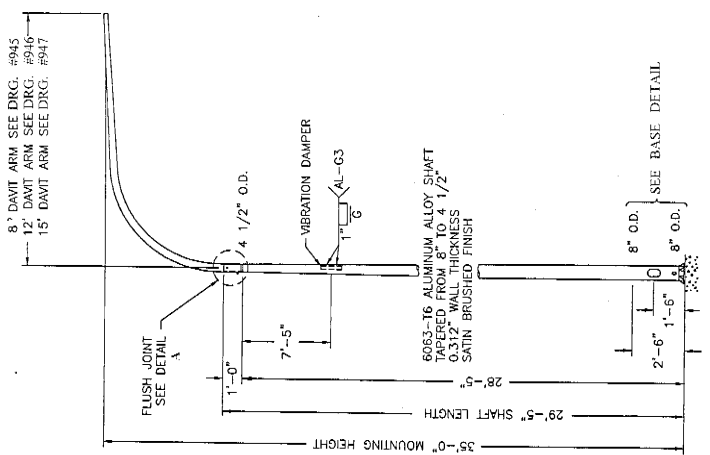
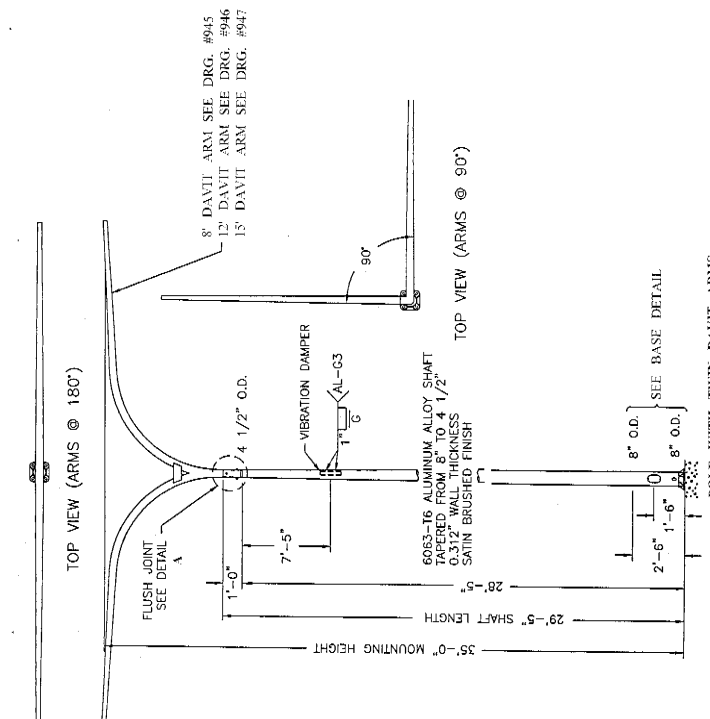


SECTION C-C



OPTION: SIDE MOUNT FOR LUMINAIRE

SHORT ALUMINUM DAVIT POLE		DWG. NO.	941
10" x 6" x 20'-5"		DATE	A
FOR ARTERIAL STREETS		CITY OF CHICAGO	
DIVISION OF STREET AND SANITATION		ENGINEER	<i>[Signature]</i>
OFFICE OF ELECTRICAL ENGINEERING		DRAWN BY	<i>[Signature]</i>
CITY OF CHICAGO		CHECKED BY	<i>[Signature]</i>
DIVISION OF STREET AND SANITATION		DATE	



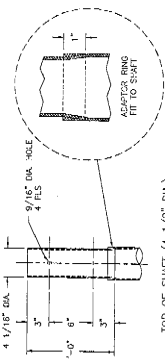
ALUMINUM DAVIT POLE
8" x 4 1/2" x 29'-5"
FOR CHICAGO SKYWAY

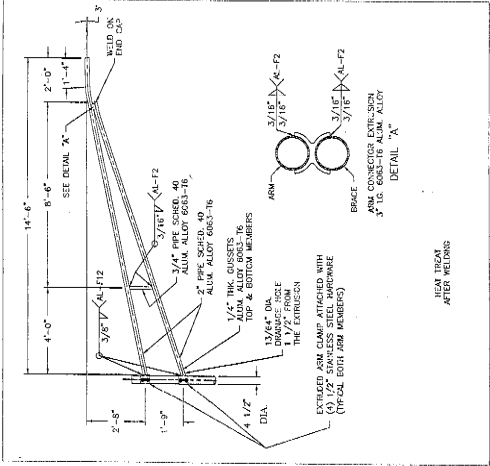
CITY OF CHICAGO
REWORKED AND REVISIONS
DATE: 10/22/81
SCALE: *1/8" = 1'-0"*

DESIGNED BY: *[Signature]*
CHECKED BY: *[Signature]*
DATE: 10/22/81
SCALE: *1/8" = 1'-0"*

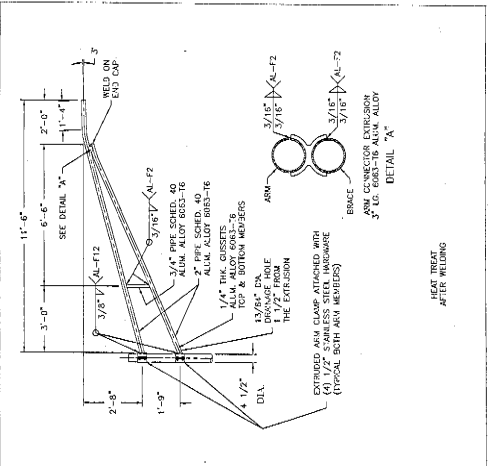
PROJECT NO. **942**

SHEET NO. 2 OF 2

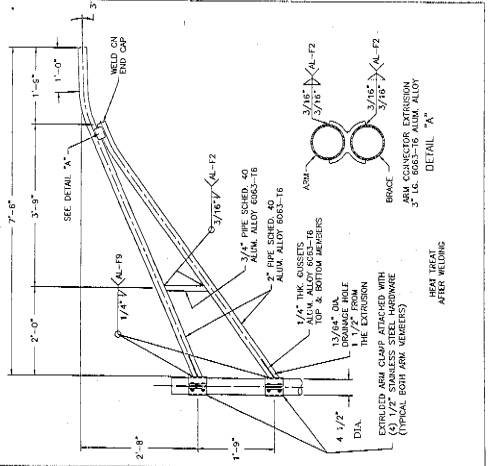




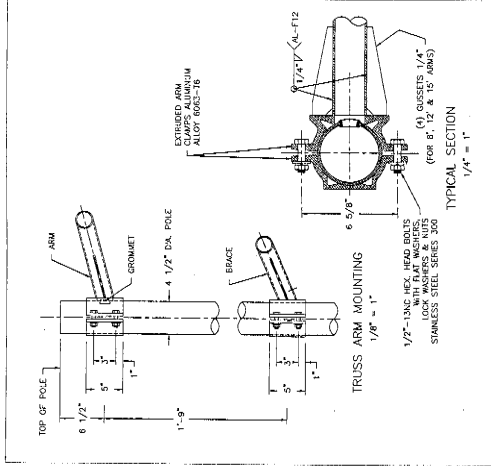
15 FOOT ARM



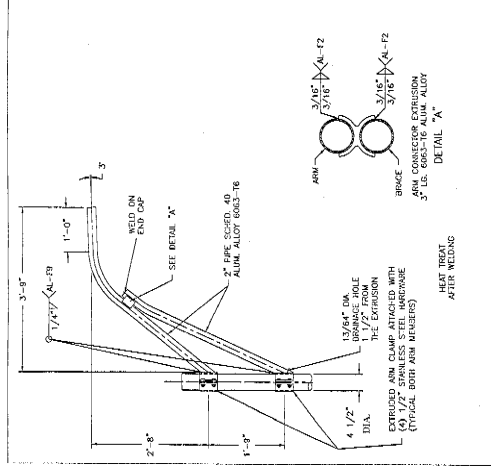
12 FOOT ARM



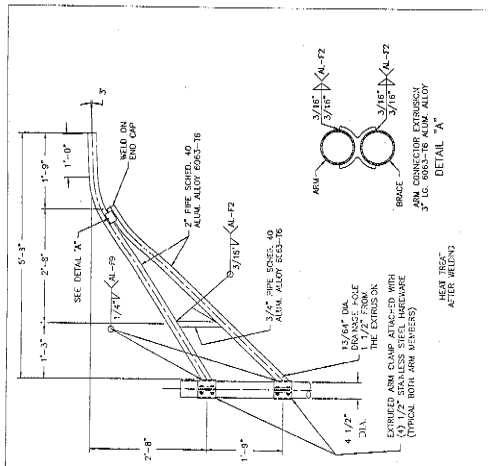
8 FOOT ARM



BRACKETS FOR 4.5" POLE TOP



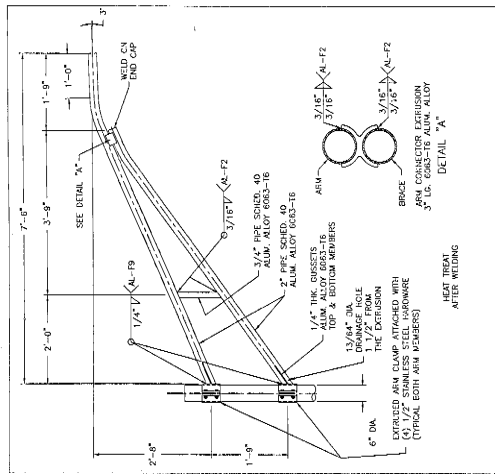
4 FOOT ARM



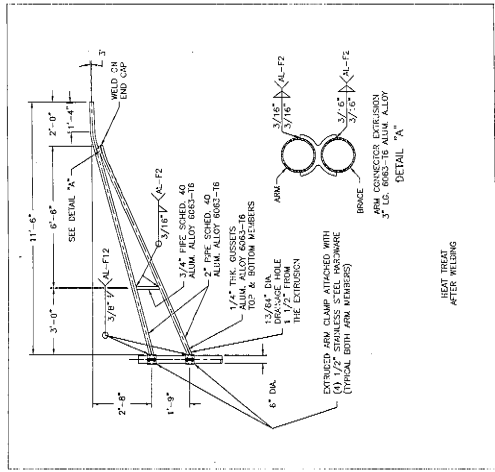
6 FOOT ARM

ALUMINUM TRUSS ARMS
FOR 4.5" POLE TOPS

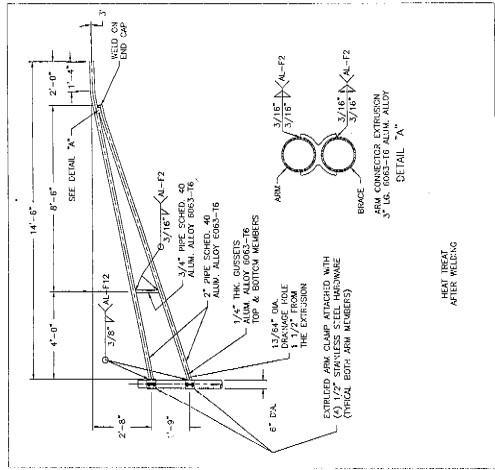
DESIGNED BY	PROJECT ENGINEER	DATE
CHECKED BY	PROJECT CRAFTSMAN	SCALE
APPROVED BY	SUPERVISING ENGINEER	DATE
CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS DIVISION OF ELECTRICAL ENGINEERING	ENGINEER	DWG. NO. 943
PROJECT NO.	CONTRACT NO.	DATE: 1-27-92



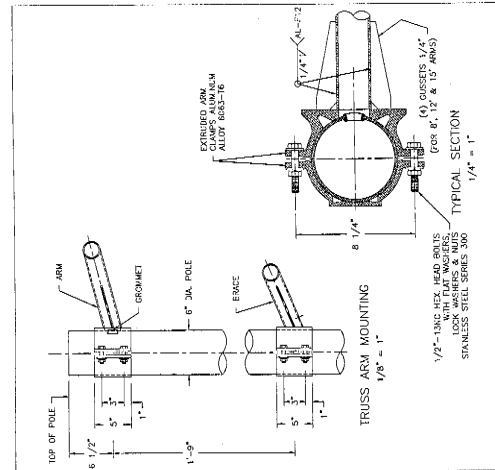
8 FOOT ARM



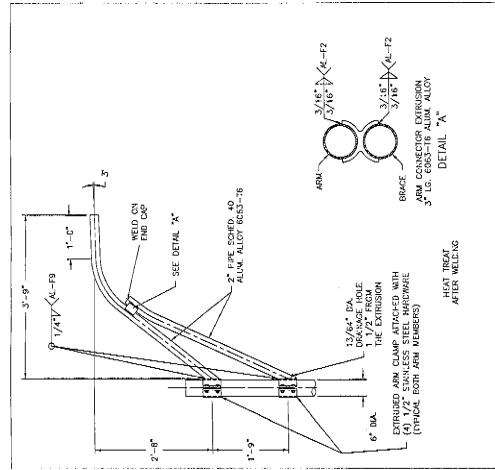
12 FOOT ARM



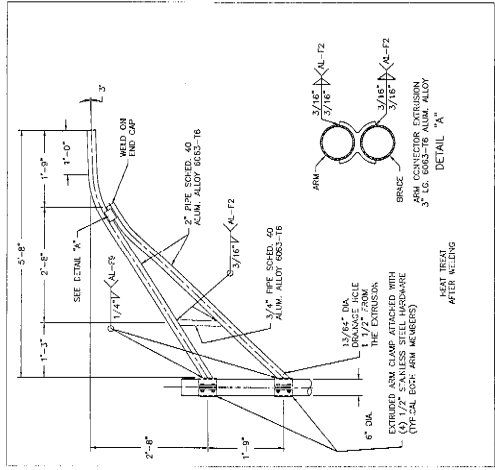
15 FOOT ARM



BRACKETS FOR 6" POLE TOP

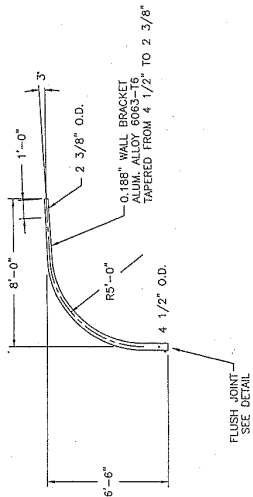


4 FOOT ARM

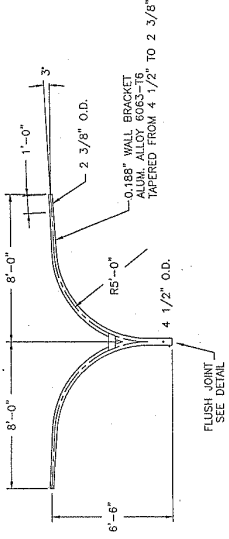


6 FOOT ARM

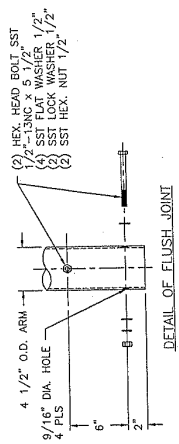
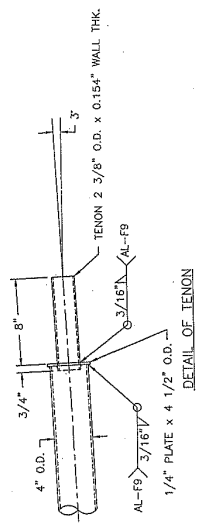
ALUMINUM TRUSS ARMS		DWG. NO.	944
FOR 6" POLE TOPS		DATE	1-23-22
CITY OF CHICAGO			
DEPARTMENT			
SUPERVISING ENGINEER			
DESIGNER			
CHECKED BY			
APPROVED BY			



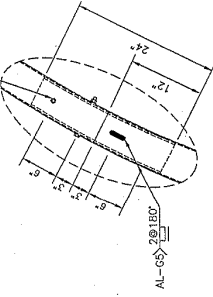
SINGLE DAVITT ARM



TWIN DAVITT ARM AT 180°

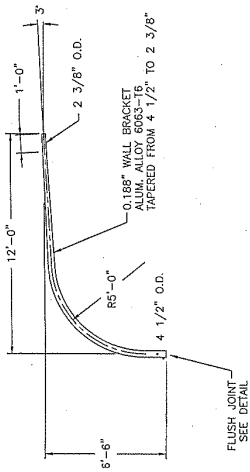


- (2) HEX. HEAD BOLT SST
- (4) 1/2"-13NC x 5 1/2" SST FLAT WASHER 1/2"
- (2) SST LOCK WASHER 1/2"
- (2) SST HEX. NUT 1/2"

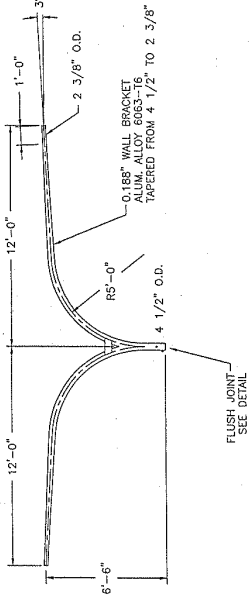


TWIN ARM (180°) WELD DETAIL

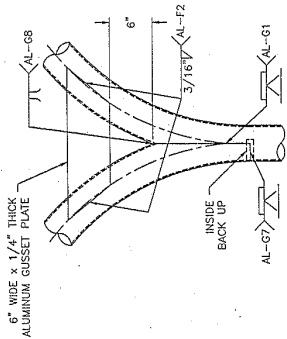
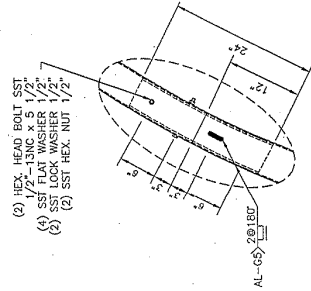
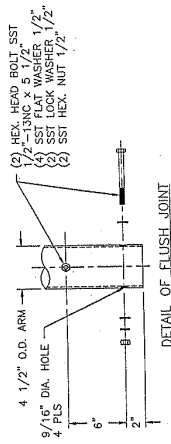
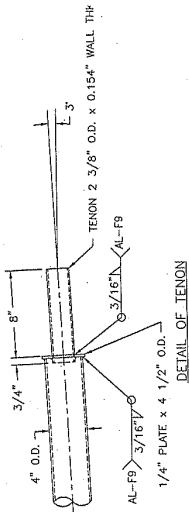
REVISED	06-12-2012
ALUMINUM DAVITT ARM 4.5" x 8'-0"	
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION DIVISION OF ELECTRICAL OPERATIONS	
DESIGNER	PROJECT
SUPERVISING ENGINEER	PROJECT
DATE	NO. NO.
	945
	DATE: 1-23-02



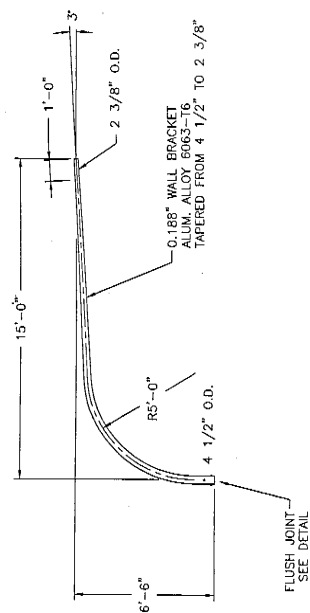
SINGLE DAVIT ARM



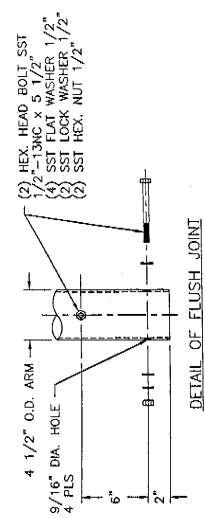
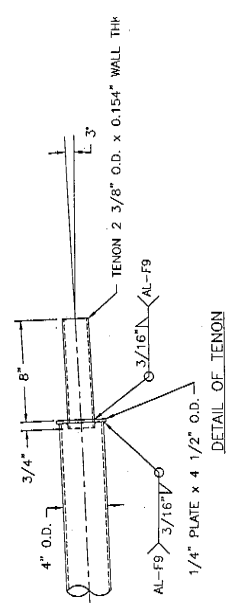
TWIN DAVIT ARM AT 180°



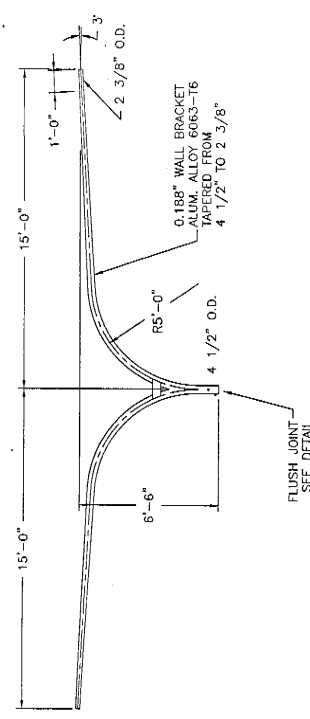
REVISED	04-15-2012
ALUMINUM DAVIT ARM	
4.5" x 12'-0"	
CITY OF CHICAGO DEPARTMENT OF PUBLIC WORKS DIVISION OF ELECTRICAL OPERATIONS	
DESIGNED BY	ENGINEER
CHECKED BY	ENGINEER
APPROVED BY	ENGINEER
DATE	04/15/12
DWG. NO.	946
SCALE	0418 / 23.02



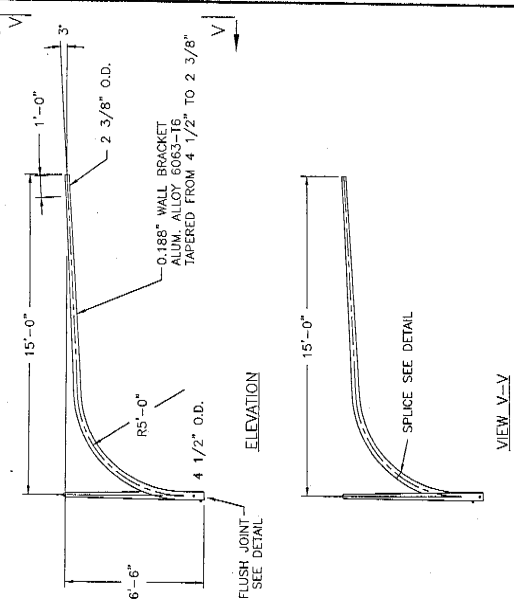
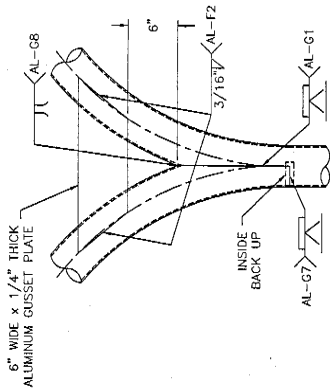
SINGLE DAVIT ARM



- (2) HEX. HEAD BOLT SST
- 1/2"-13NC x 5 1/2"
- (4) SST FLAT WASHER 1/2"
- (2) SST LOCK WASHER 1/2"
- (2) SST HEX. NUT 1/2"

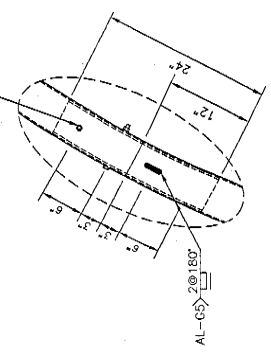


TWIN DAVIT ARM AT 180°

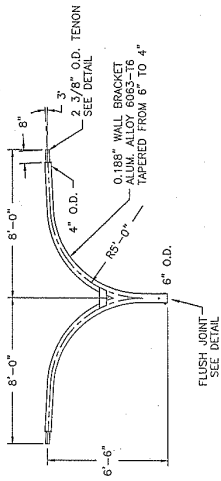


TWIN DAVIT ARM AT 90°

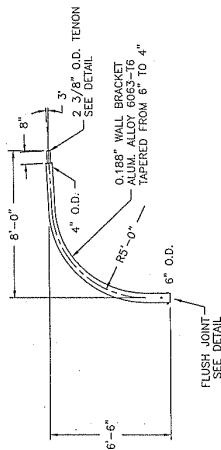
- (2) HEX. HEAD BOLT SST
- 1/2"-13NC x 5 1/2"
- (4) SST LOCK WASHER 1/2"
- (2) SST HEX. NUT 1/2"



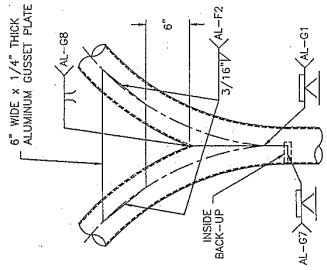
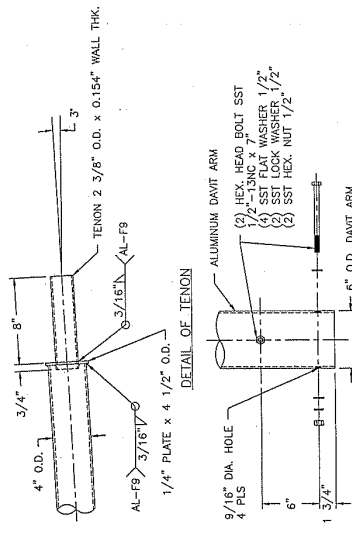
ALUMINUM DAVIT ARM		DWG. NO.	947	DATE: 7-23-92
CITY OF CHICAGO DEPT. OF PUBLIC WORKS DIVISION OF PUBLIC UTILITIES		DESIGNED BY	CHICAGO ELECTRICAL CONTRACTORS	
SUPERVISOR		ENGINEER	DESIGNER	
CHIEF CONTRACTOR		DEPT. OF PUBLIC UTILITIES	CHICAGO ELECTRICAL CONTRACTORS	
SUPERVISOR		ENGINEER	DESIGNER	
CHIEF CONTRACTOR		DEPT. OF PUBLIC UTILITIES	CHICAGO ELECTRICAL CONTRACTORS	
SUPERVISOR		ENGINEER	DESIGNER	
CHIEF CONTRACTOR		DEPT. OF PUBLIC UTILITIES	CHICAGO ELECTRICAL CONTRACTORS	



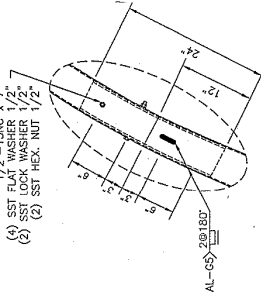
SINGLE DAVIT ARM AT 180°



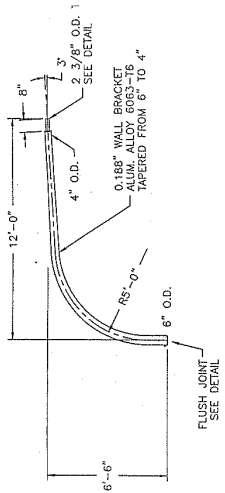
TWIN DAVIT ARM AT 180°



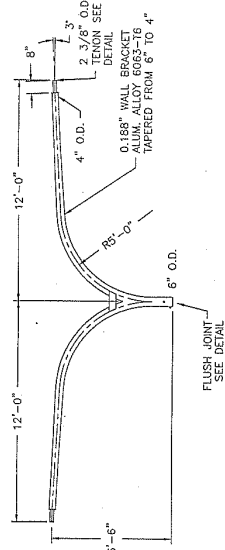
- (2) HEX. HEAD BOLT SST.
- (4) SST FLAT WASHER 1/2"
- (2) SST HEX. NUT 1/2"



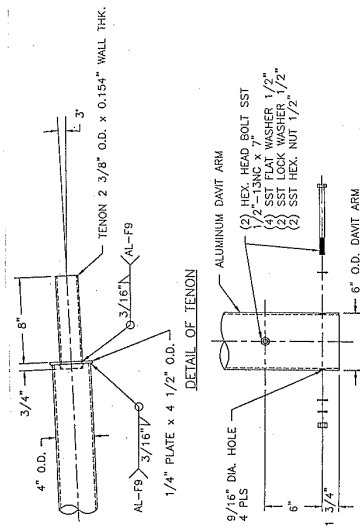
REVISED	06-12-2012
ALUMINUM DAVIT ARM 6" x 8'-0"	
CITY OF CHICAGO DIVISION OF ELECTRICAL OPERATIONS	
DESIGNED BY	ENGINEER
CHECKED BY	ENGINEER
APPROVED BY	ENGINEER
DATE	06/12/2012
DWG. NO. 9478	



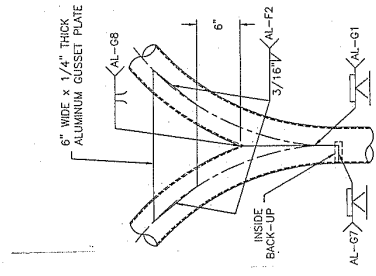
SINGLE DAVIT ARM



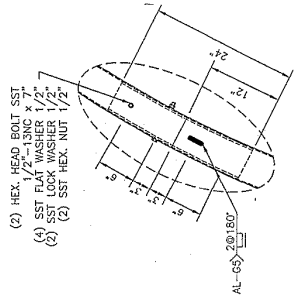
TWIN DAVIT ARM AT 180°



DETAIL OF TENON

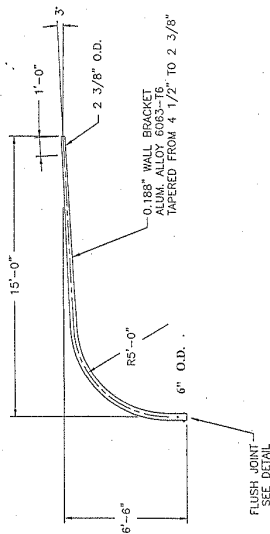


TWIN ARM (180°) WELD DETAIL

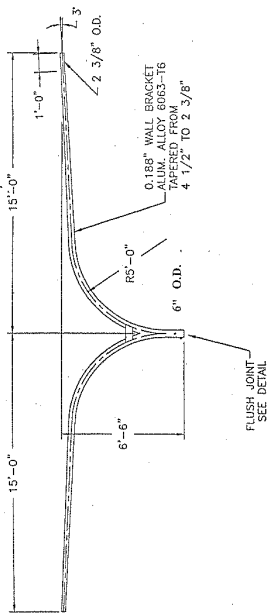


SPLICE DETAIL

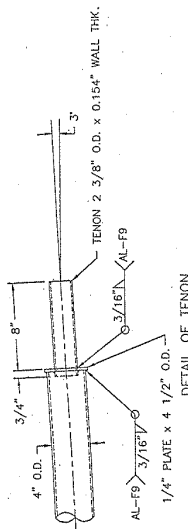
REVISED	06-16-2012	ALUMINUM DAVIT ARM	6" x 12'-0"
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION DIVISION OF INFRASTRUCTURE DIVISION OF BRIDGE AND TUNNELS			
DESIGNED BY	CHECKED BY	DATE	ENG. NO.
APPROVED BY	DESIGNED BY	DATE	949
DATE	SCALE	SHEET NO. 27 OF 32	



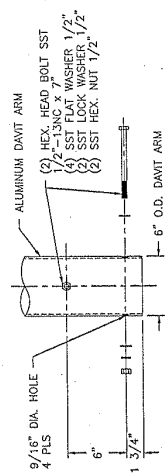
SINGLE DAVIT ARM



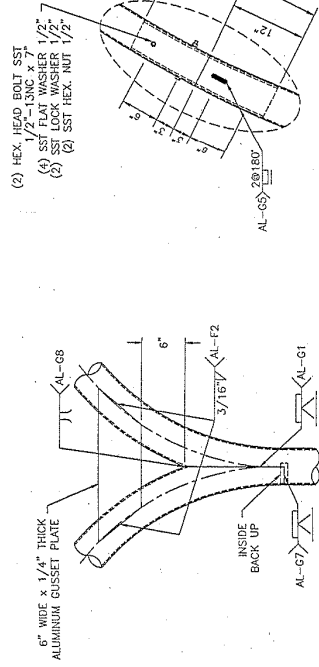
TWIN DAVIT ARM AT 180°



DETAIL OF TENON

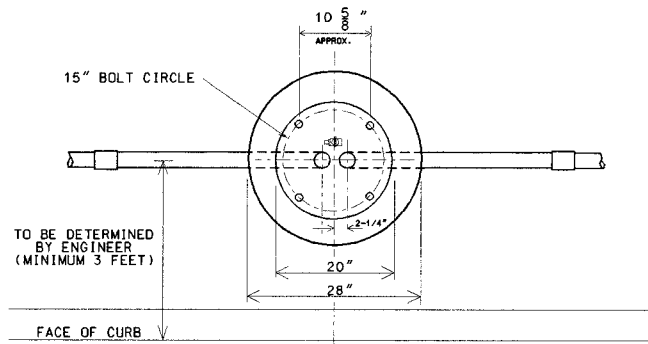


DETAIL OF FLUSH JOINT

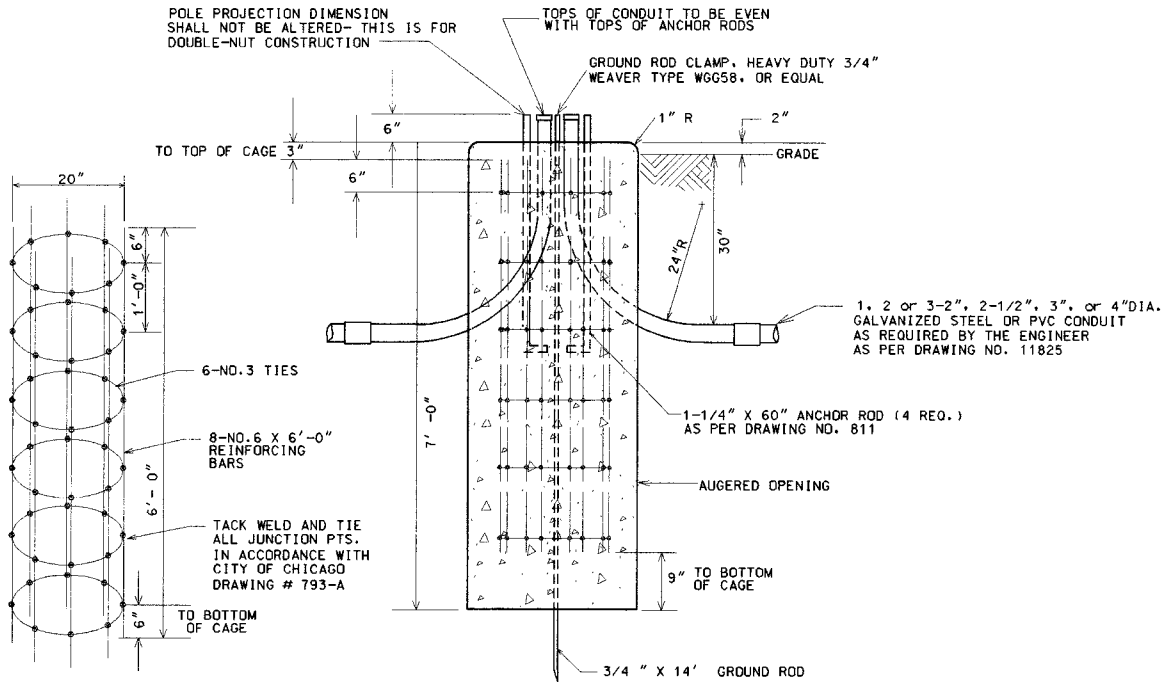


SPLICE DETAIL

REVISED	6-12-2012
ALUMINUM DAVIT ARM	
6" x 15'-0"	
CITY OF CHICAGO DIVISION OF ELECTRICAL OPERATIONS	
DRAWN BY	DATE
CHECKED BY	DATE
SUPERVISING ENGINEER	DATE
DESIGNED BY	DATE
CONTRACT NO.	950
PROJECT NO.	7-27-02



TOP VIEW



ELEVATION

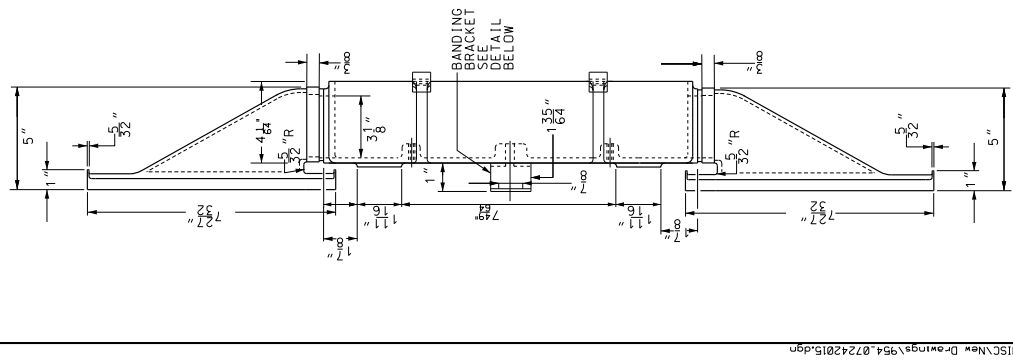
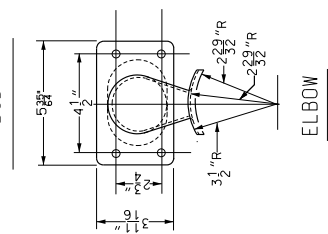
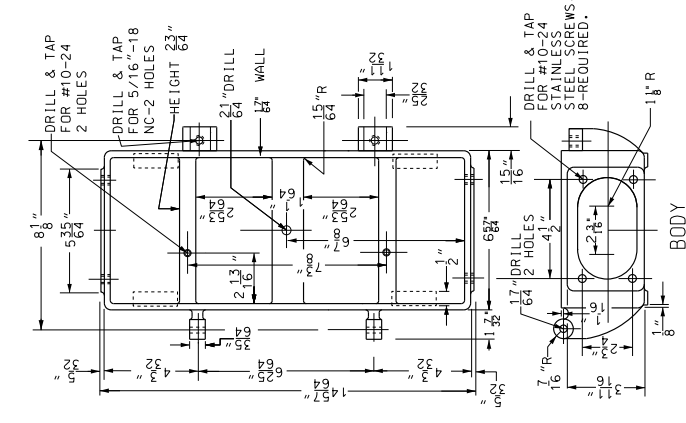
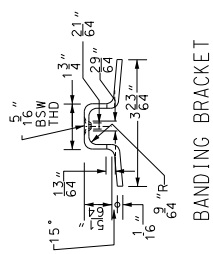
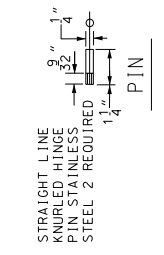
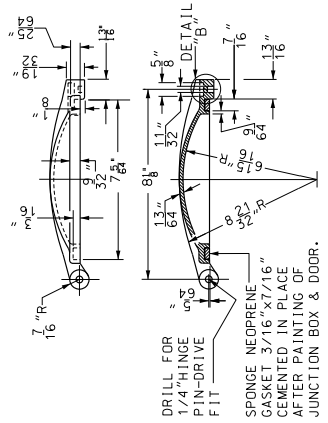
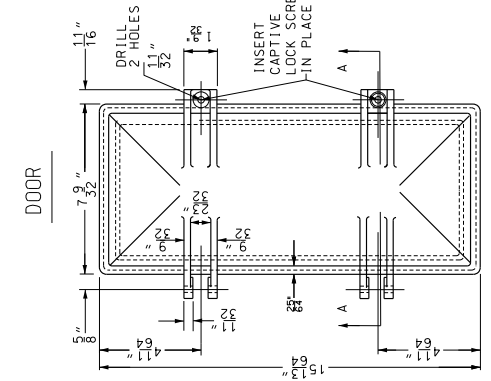
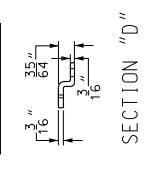
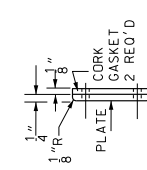
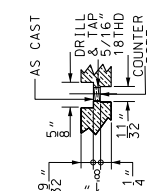
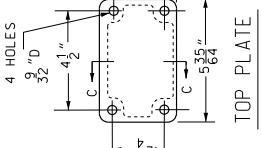
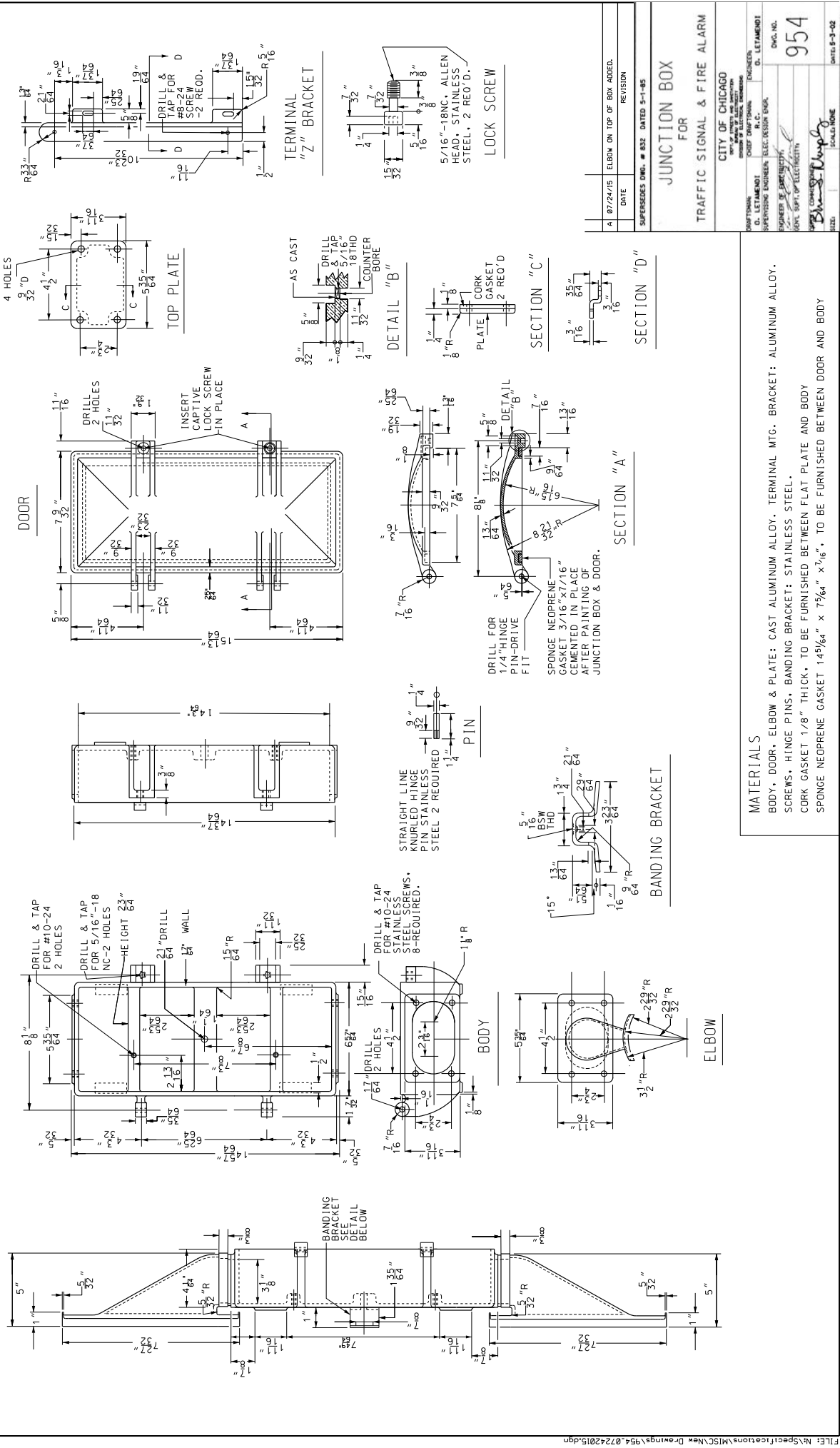
ISOMETRIC VIEW
OF STEEL CAGE

NOTE:
HOLE FOR FOUNDATION
MUST BE AUGERED IN
UNDISTURBED SOIL

NOTES:
1. CONCRETE MUST MEET IDOT
REQUIREMENTS FOR PORTLAND
CEMENT CLASS SI CONCRETE.
2. REINFORCING BARS MUST MEET
ASTM A-615 GRADE 60.

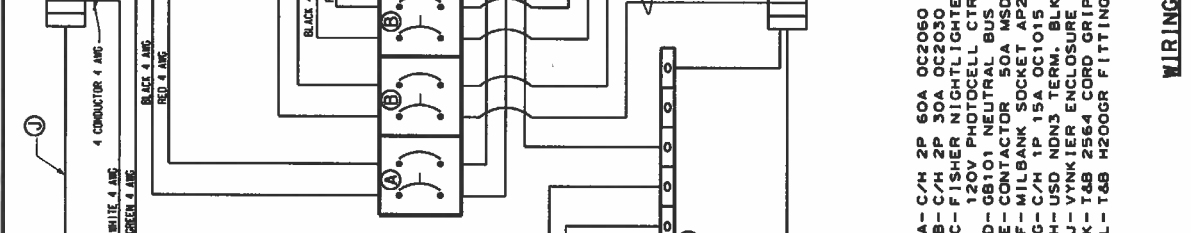
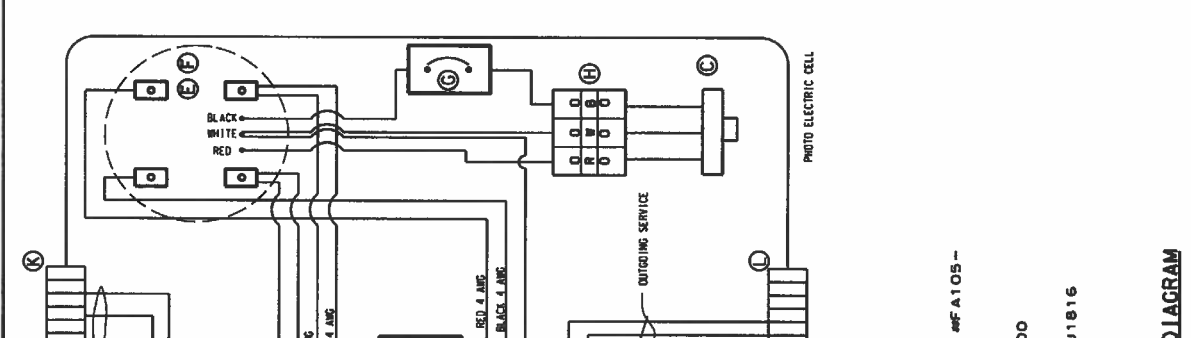
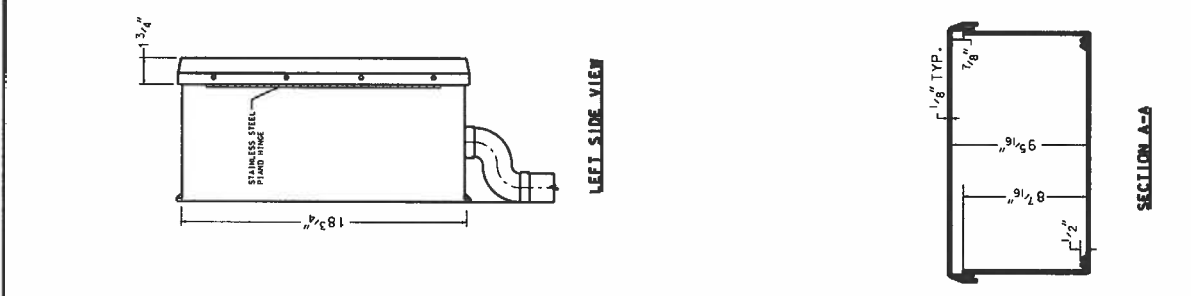
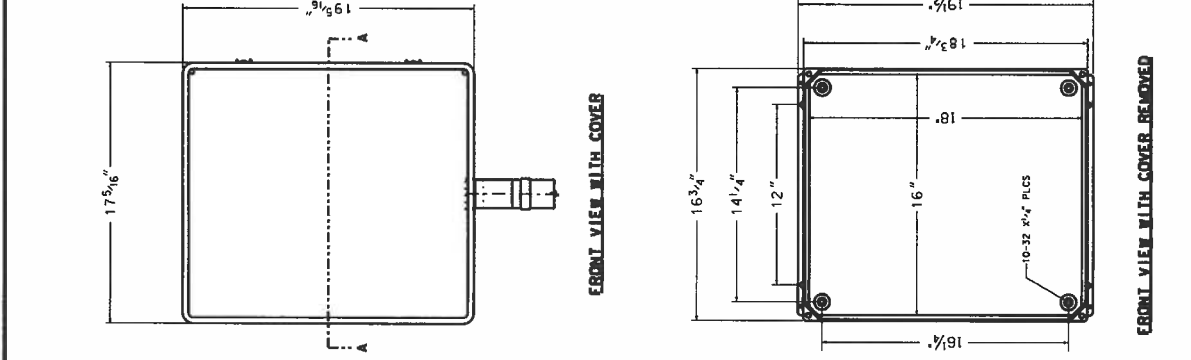
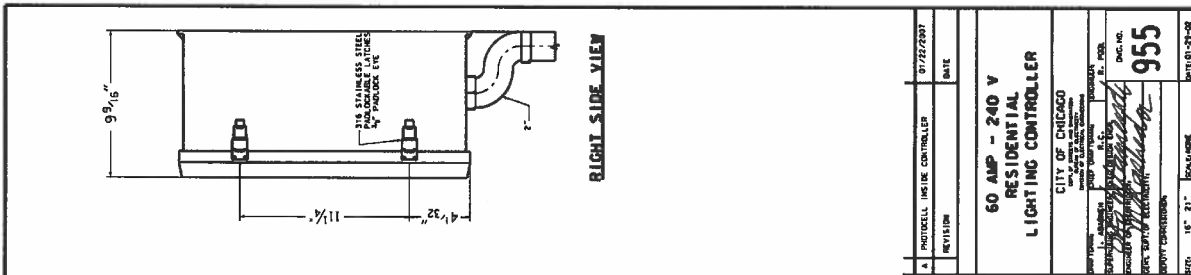
CODE	COMMODITY	SIZE	QUANTITY
05-3267-2940	REDI-MIX CONCRETE	CU. YD.	1.11
09-4001-	ELBOW, LARGE RADIUS	2", 2-1/2", 3", 4"	AS REQUIRED
37-8180-0200	ANCHOR ROD	1-1/4" X 60"	4
05-5054-6910	RE-BAR CAGE	20" X 6'-0"	1
09-7796	GROUND ROD	3/4" X 14'-0"	1
09-2636-	GROUND ROD CLAMP	3/4"	1
	GROUND BUSHING	2", 2-1/2", 3", 4"	AS REQUIRED

DATE	REVISION
FOUNDATION FOR CHICAGO 2000 GATEWAY POLE & CHICAGO 2000 PEDESTRIAN POLE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY	CHIEF DRAFTSMAN: ENGINEER: R. CARTER
ELECTRICAL DESIGN ENGINEER	B. GARNSEY
ENGINEER OF ELECTRICITY	DRAWING NO.
GENERAL SUPERINTENDENT	953
DEPUTY ASSISTANT	
SIZE: 11" x 17"	SCALE: NONE DATE: 8/21/02



MATERIALS
 BODY, DOOR, ELBOW & PLATE: CAST ALUMINUM ALLOY. TERMINAL MTG. BRACKET: ALUMINUM ALLOY.
 SCREWS, HINGE PINS, BANDING BRACKET: STAINLESS STEEL.
 CORK GASKET 1/8" THICK, TO BE FURNISHED BETWEEN FLAT PLATE AND BODY
 SPONGE NEOPRENE GASKET 14 5/16" x 7 5/16" x 3/16", TO BE FURNISHED BETWEEN DOOR AND BODY

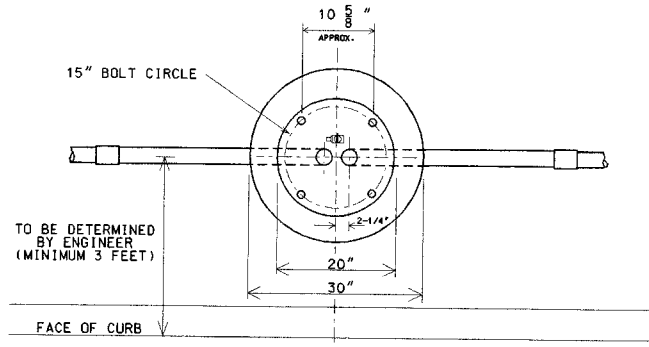
DATE: 7/24/2015	FILE: M:\Specifications\MISC\New Drawings\954_02242015.dgn
DATE	REVISION
A 07/24/15	ELBOW ON TOP OF BOX ADDED.
SUPERSEDES DRI. # 832 DATED 5-1-85	
JUNCTION BOX	
FOR	
TRAFFIC SIGNAL & FIRE ALARM	
CITY OF CHICAGO	
DESIGNED BY: D. LETAMENDI	ENGINEER: D. LETAMENDI
CHECKED BY: D. LETAMENDI	DRG. NO. 954
APPROVED BY: D. LETAMENDI	SCALE: NONE
DATE: 7/24/2015	FILE: M:\Specifications\MISC\New Drawings\954_02242015.dgn



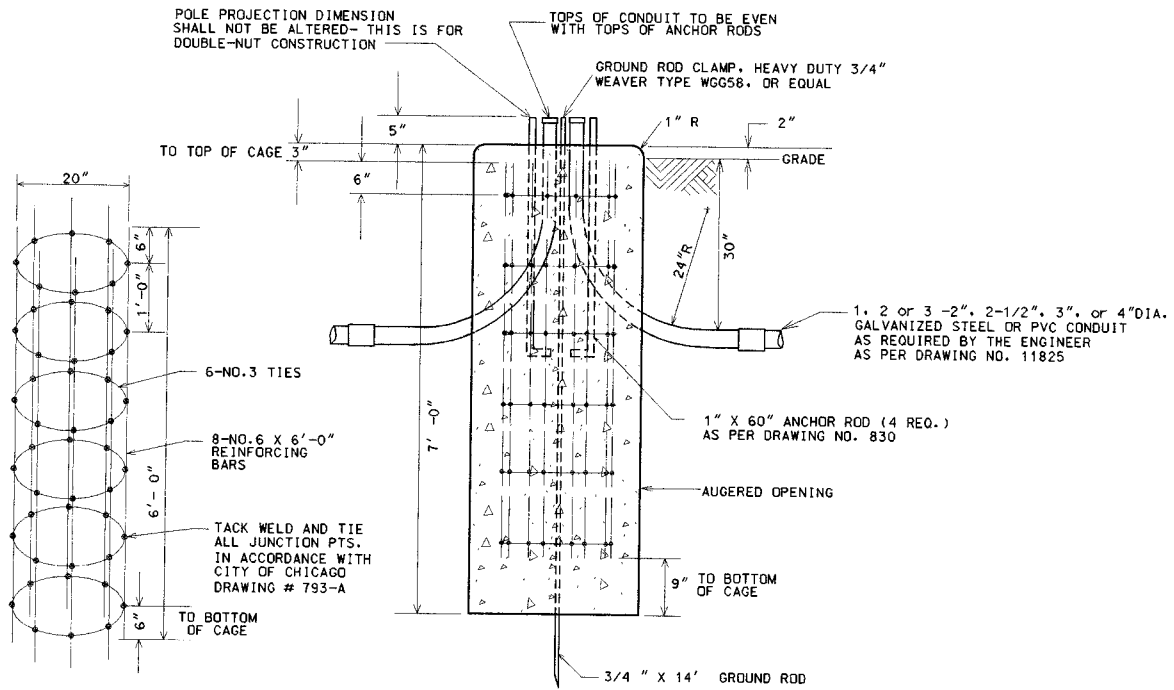
4	PHOTOCELL LIGHT CONTROLLER	9/22/2007
REV	DATE	
60 AMP - 240 V RESIDENTIAL LIGHTING CONTROLLER		
CITY OF CHICAGO		
100 N. LAKE STREET, SUITE 1000 CHICAGO, ILLINOIS 60602		
DESIGNED BY	DATE	SCALE
DRAWN BY		
CHECKED BY		
APPROVED BY		
QUANTITY		
PCS.	18" x 21"	SCALE
		DATE 01-23-08



- A - C/H 2P 60A OC2060
- B - C/H 2P 30A OC2030
- C - FISHER NIGHTLIGHTER #F A105 - 120V PHOTOCELL CTRL
- D - GB101 NEUTRAL BUS
- E - CONTACTOR 50A MSD
- F - MILBANK SOCKET AP2300
- G - C/H 1P 15A OC1015
- H - USD NDN3 TERM. BLK
- I - VYNKIER ENCLOSURE VJ1816
- K - T&B 2564 CORD GRIP
- L - T&B H200GR FITTING



TOP VIEW



ISOMETRIC VIEW
OF STEEL CAGE

ELEVATION

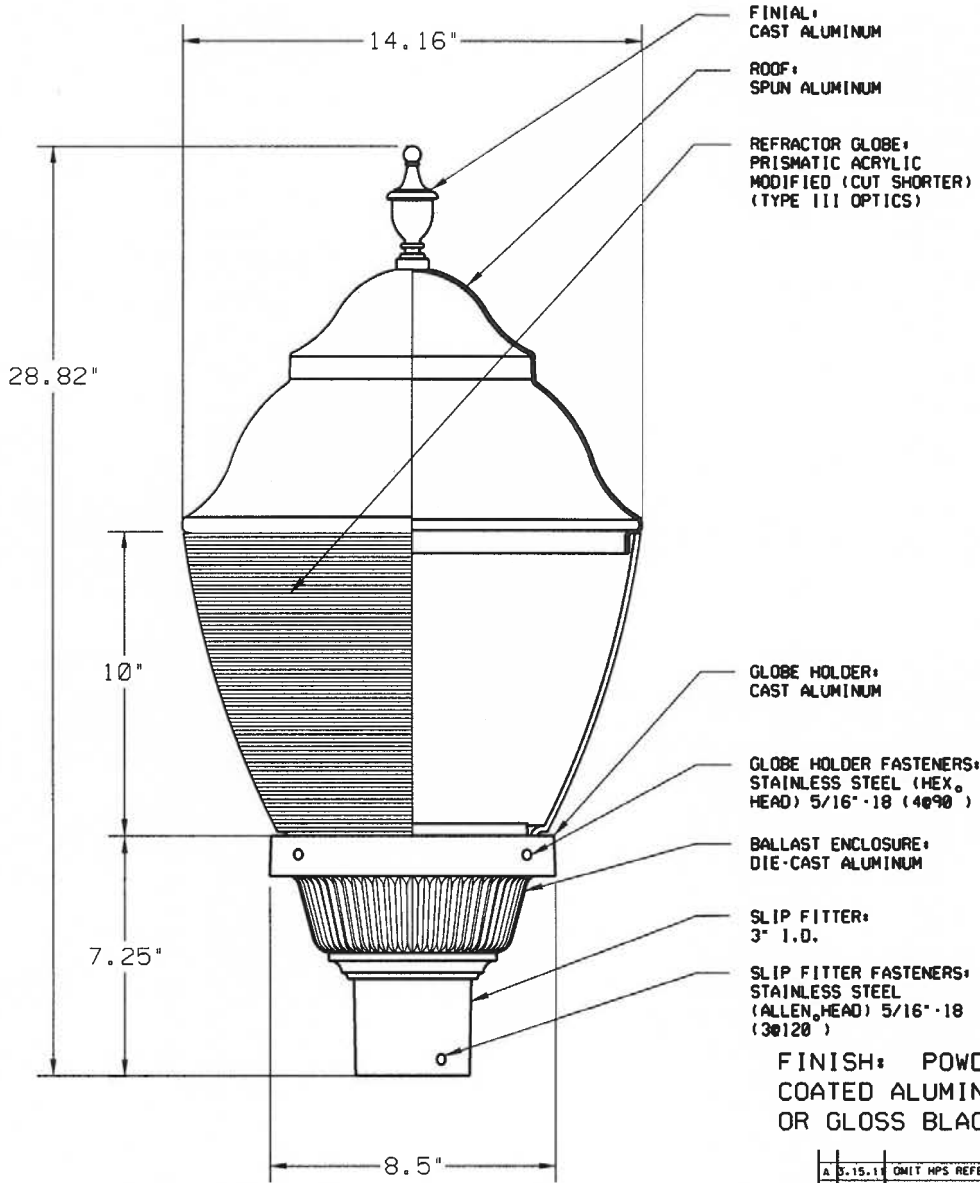
NOTES:
 1. CONCRETE MUST MEET IDOT REQUIREMENTS FOR PORTLAND CEMENT CLASS SI CONCRETE.
 2. REINFORCING BARS MUST MEET ASTM A-615 GRADE 60.

NOTE:
 HOLE FOR FOUNDATION MUST BE AUGERED IN UNDISTURBED SOIL

CODE	COMMODITY	SIZE	QUANTITY
05-3267-2940	REDI-MIX CONCRETE	CU. YD.	1.27
09-4001-	ELBOW, LARGE RADIUS	2", 2-1/2", 3", 4"	AS REQUIRED
37-8180-0200	ANCHOR ROD	1" X 60"	4
05-5054-6910	RE-BAR CAGE	20" X 6'-0"	1
09-7796	GROUND ROD	3/4" X 14'-0"	1
09-2636-	GROUND ROD CLAMP	3/4"	1
	GROUND BUSHING	2", 2-1/2", 3", 4"	AS REQUIRED

DATE	REVISION
FOUNDATION FOR LOOP POLE & EXTENDED LOOP POLE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY	CHIEF DRAFTSMAN: B. CARTER
ENGINEER: B. GARNSEY	ENGINEER: B. GARNSEY
DRAWING NO. 956	
GENERAL SUPERINTENDENT: <i>[Signature]</i>	DEPUTY COMMISSIONER: <i>[Signature]</i>
SIZE: 11" x 17"	SCALE: NONE
DATE: 8/21/02	

LUMINAIRE SPECIFICATIONS



FINIAL:
CAST ALUMINUM

ROOF:
SPUN ALUMINUM

REFRACTOR GLOBE:
PRISMATIC ACRYLIC
MODIFIED (CUT SHORTER)
(TYPE III OPTICS)

GLOBE HOLDER:
CAST ALUMINUM

GLOBE HOLDER FASTENERS:
STAINLESS STEEL (HEX.
HEAD) 5/16" · 18 (4090)

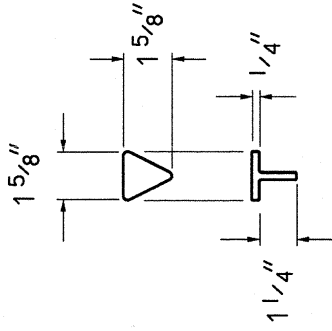
BALLAST ENCLOSURE:
DIE-CAST ALUMINUM

SLIP FITTER:
3" I.D.

SLIP FITTER FASTENERS:
STAINLESS STEEL
(ALLEN HEAD) 5/16" · 18
(30120)

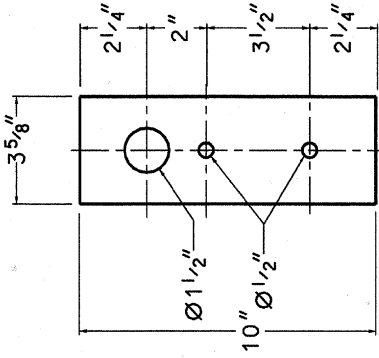
FINISH: POWDER
COATED ALUMINUM
OR GLOSS BLACK

A	8.15.11	OMIT MPS REFERENCES	G. PADHYAR
	DATE	REVISION	
LUMINAIRE RESIDENTIAL MID-MOUNT			
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING			
DRAFTSMAN:	CHIEF DRAFTSMAN:	ENGINEER:	
B. GARNSEY	R. CARTER	B. GARNSEY	
ELECTRICAL DESIGN ENGINEER			DRAWING NO.
ENGINEER OF ELECTRICITY			958
DESIGN SUPERINTENDENT			
DEPUTY SUPERINTENDENT			
SIZE:	SCALE:	DATE:	
11" x 17"	NONE	8/30/03	

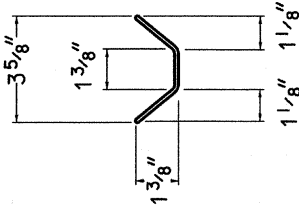


SECTION A-A

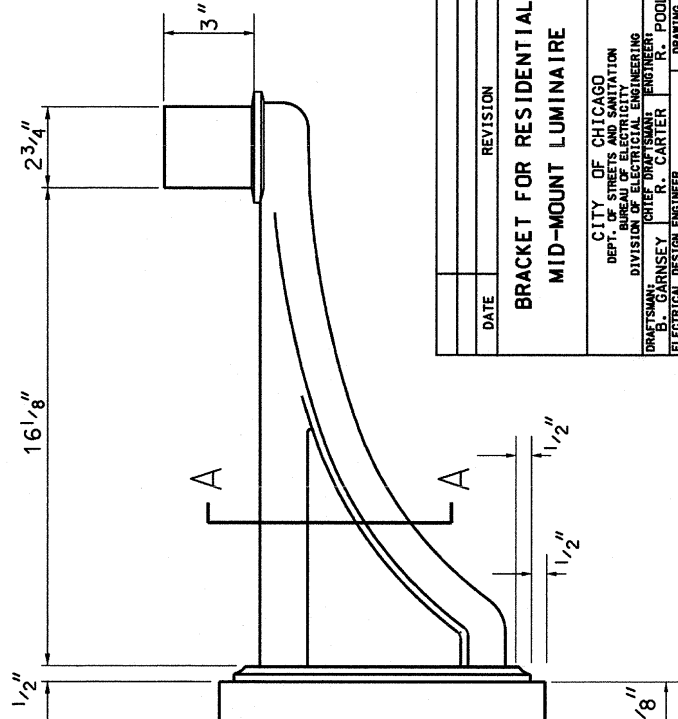
MATERIAL : GALVANISED STEEL PLATE, 1/8" THICKNESS



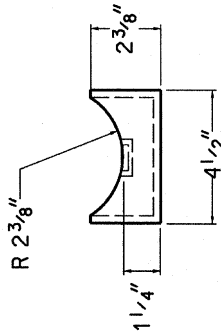
MOUNTING PLATE



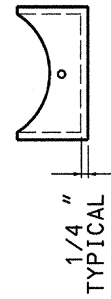
TOP VIEW



ARM BRACKET



TOP VIEW



BOTTOM VIEW

DATE	REVISION
BRACKET FOR RESIDENTIAL MID-MOUNT LUMINAIRE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY ENGINEERING	
DRAFTSMAN B. GARNSEY	CHECKED R. CARTER
ELECTRICAL DESIGN ENGINEER	
ENGINEER OF ELECTRICITY GENERAL SUPERVISOR	
DEPUTY COMMISSIONER	
SIZE 11" x 22"	SCALE NONE
DRAWING NO. 959	DATE 02/01/06

BACK OF ARM BRACKET

HEX HEAD BOLD
1/4" - 20 x 1 1/4"

1/4" - ALUMINUM
THICKNESS

11"

2 3/8"

1 1/2"

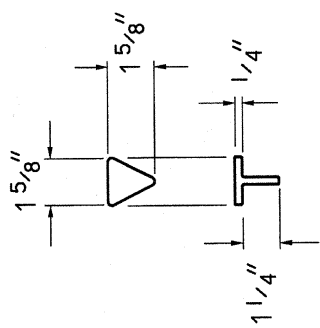
1 1/2"

1/2"

16 1/8"

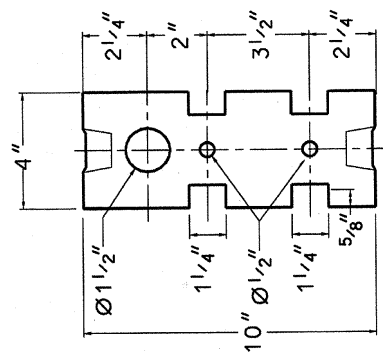
2 3/4"

3"

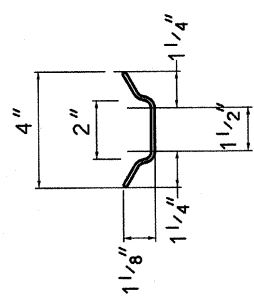


SECTION A-A

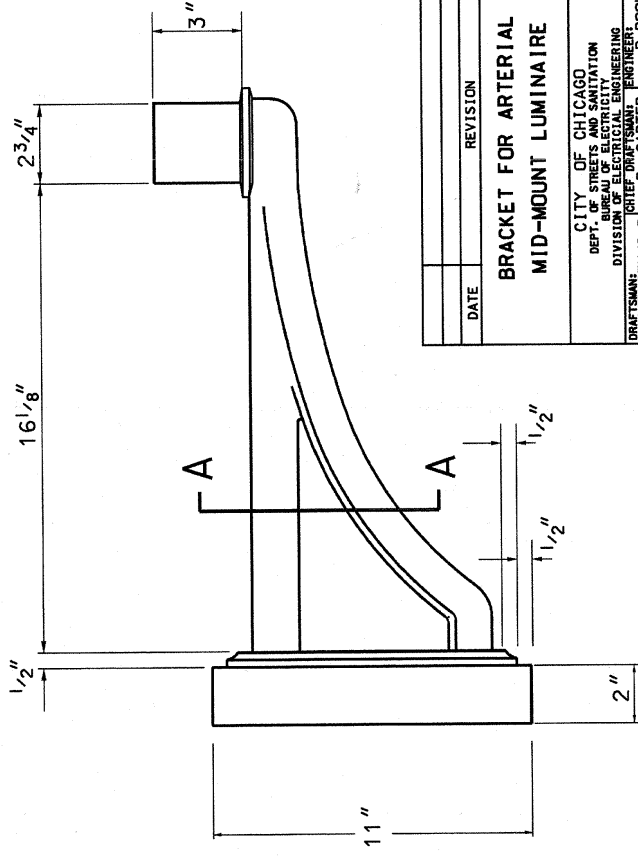
MATERIAL : GALVANISED STEEL PLATE, 1/8" THICKNESS



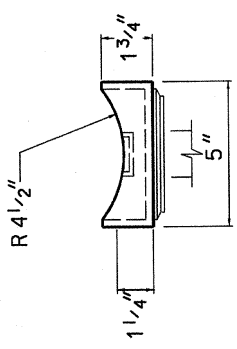
MOUNTING PLATE



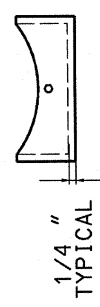
TOP VIEW



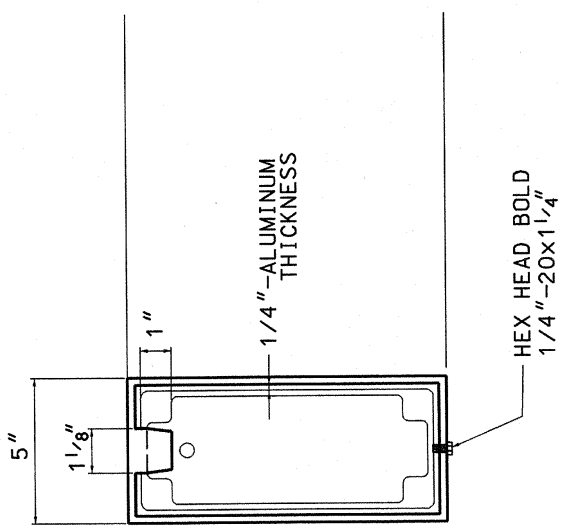
ARM BRACKET



TOP VIEW



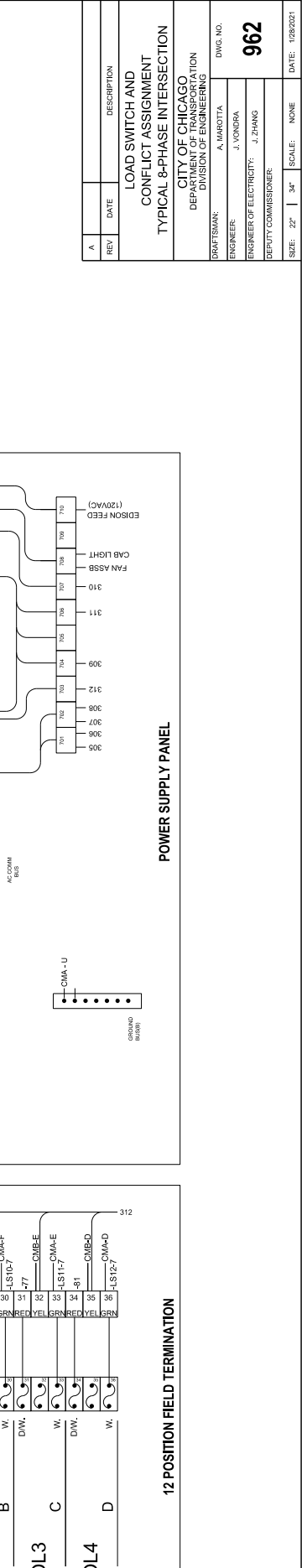
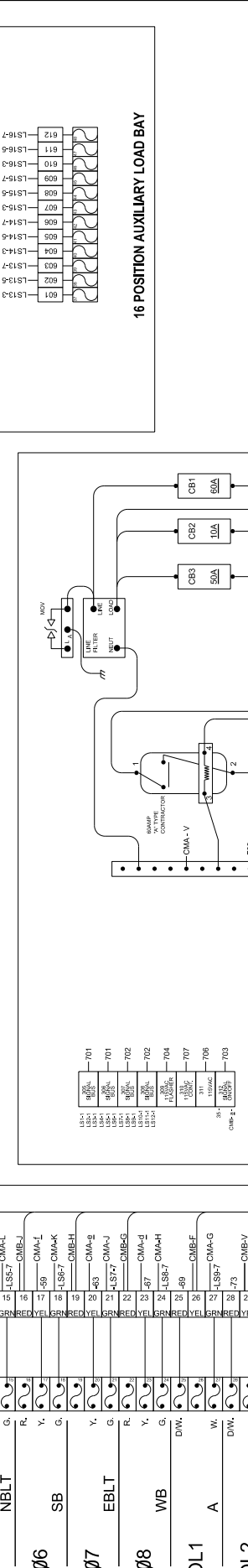
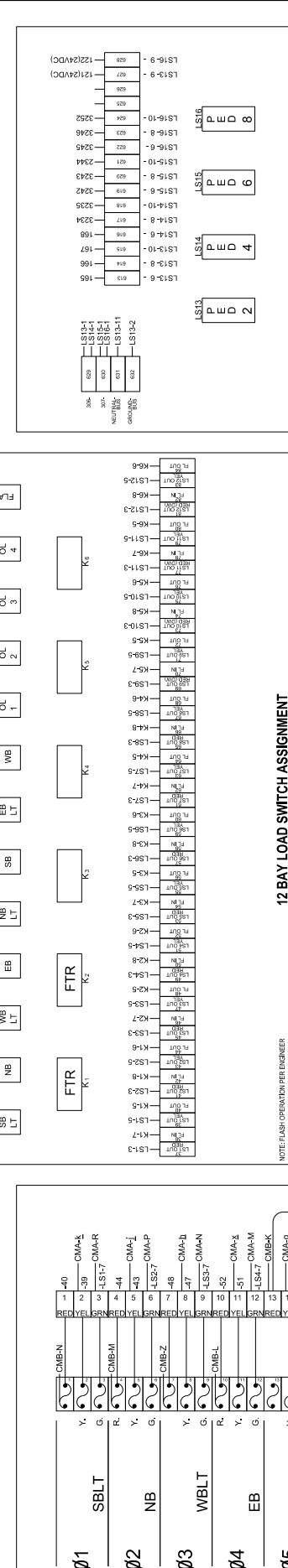
BOTTOM VIEW



BACK OF ARM BRACKET

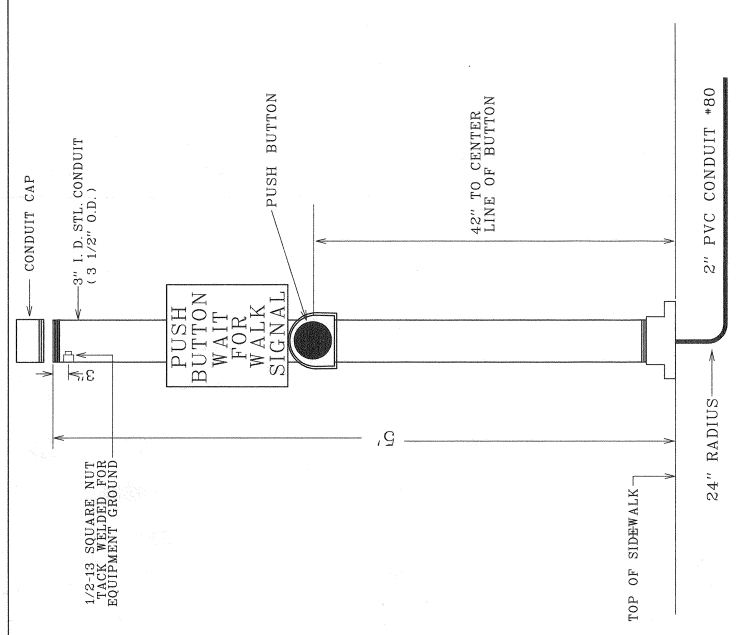
DATE	REVISION
BRACKET FOR ARTERIAL MID-MOUNT LUMINAIRE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION DIVISION OF ELECTRICAL ENGINEERING	
DRAFTSMAN: B. GARNSEY/S.R.	ENGINEER: R. CARTER
CHEF DRAFTSMAN	DRAWING NO.
ELECTRICAL DESIGN ENGINEER	
ENGINEER OF ELECTRICITY H. [Signature] GENERAL SUPERINTENDENT	
DEPUTY COMMISSIONER	
SCALE: 1" = 2"	DATE: 02/01/06
959A	

Ø1	SBLT	1-40	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL1	OL2	OL3	OL4
Y.	G.	R.	Y.	G.	Y.	R.	Y.	R.	Y.	G.	DWL.	DWL.	DWL.	DWL.
Ø1	SBLT	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL1	OL2	OL3	OL4		
Ø1	SBLT	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL1	OL2	OL3	OL4		
Ø1	SBLT	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL1	OL2	OL3	OL4		

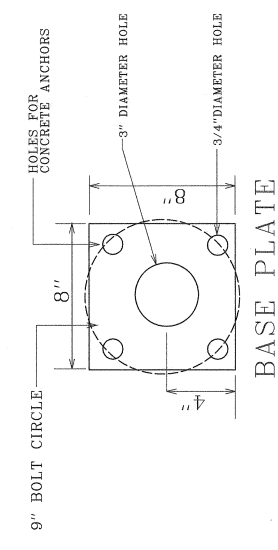


Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL1	OL2	OL3	OL4
Y.	G.	R.	Y.	G.	Y.	R.	Y.	G.	DWL.	DWL.	DWL.

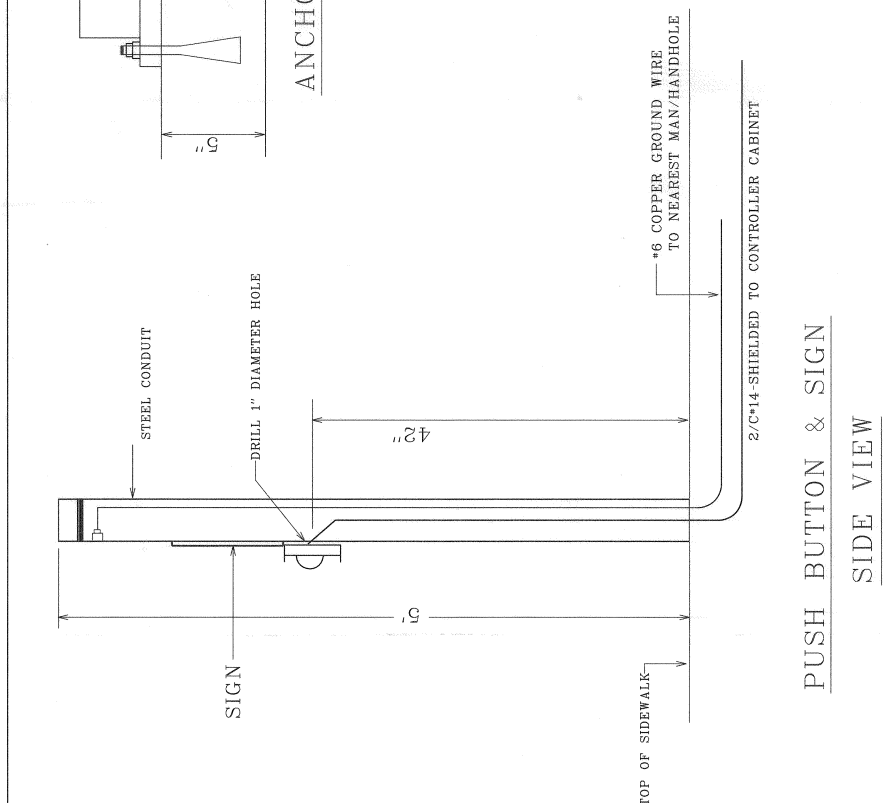
Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL1	OL2	OL3	OL4
Y.	G.	R.	Y.	G.	Y.	R.	Y.	G.	DWL.	DWL.	DWL.



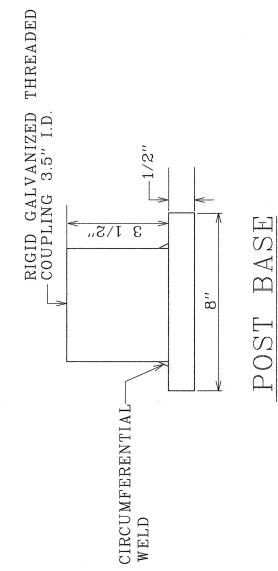
PEDESTRIAN PUSH BUTTON POST



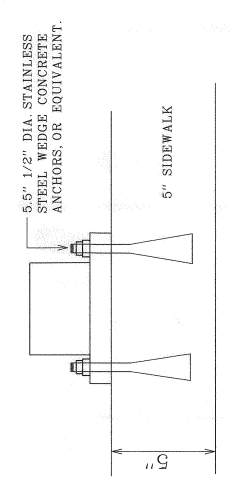
1/2" THICK ASTM A595, GRADE A STEEL



PUSH BUTTON & SIGN
SIDE VIEW



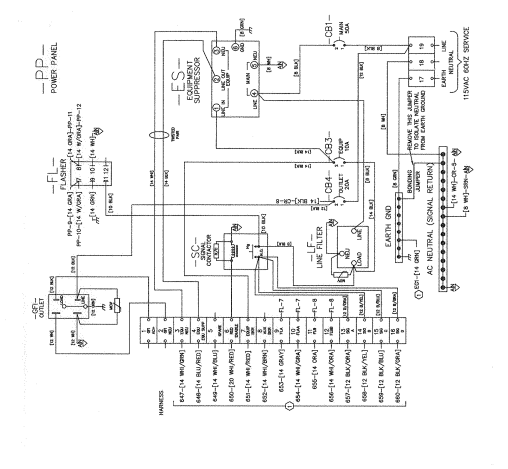
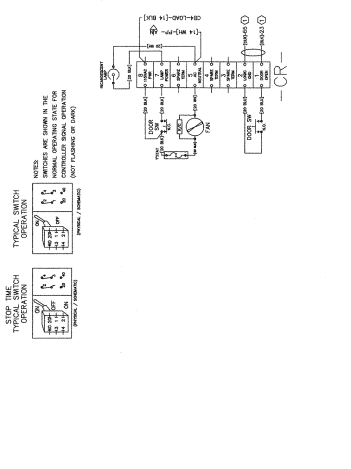
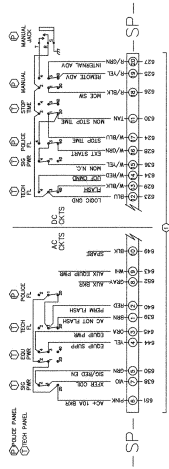
POST BASE



ANCHOR DETAIL

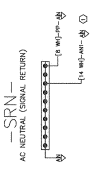
CITY OF CHICAGO DEPT. OF STREET & SANITATION DIVISION OF ELECTRIC UTILITIES		PROJECT: CHRYSLER CENTER BUSINESS: RICK BYRNE	DATE: 2/20/09
PROJECT NO.:	ENGINEER:	DESIGNER:	SCALE: NO SCALE
963	<i>[Signature]</i>	<i>[Signature]</i>	
963			

DETAIL OF PEDESTRIAN
PUSH BUTTON POST



TYPICAL CABLE ASSEMBLY

NO.	MARK	DESCRIPTION	QUANTITY
1	100	FLASH MONITOR 1	100
2	101	FLASH MONITOR 2	100
3	102	FLASH MONITOR 3	100
4	103	FLASH MONITOR 4	100
5	104	FLASH MONITOR 5	100
6	105	FLASH MONITOR 6	100
7	106	FLASH MONITOR 7	100
8	107	FLASH MONITOR 8	100
9	108	FLASH MONITOR 9	100
10	109	FLASH MONITOR 10	100
11	110	FLASH MONITOR 11	100
12	111	FLASH MONITOR 12	100
13	112	FLASH MONITOR 13	100
14	113	FLASH MONITOR 14	100
15	114	FLASH MONITOR 15	100
16	115	FLASH MONITOR 16	100
17	116	FLASH MONITOR 17	100
18	117	FLASH MONITOR 18	100
19	118	FLASH MONITOR 19	100
20	119	FLASH MONITOR 20	100
21	120	FLASH MONITOR 21	100
22	121	FLASH MONITOR 22	100
23	122	FLASH MONITOR 23	100
24	123	FLASH MONITOR 24	100
25	124	FLASH MONITOR 25	100
26	125	FLASH MONITOR 26	100
27	126	FLASH MONITOR 27	100
28	127	FLASH MONITOR 28	100
29	128	FLASH MONITOR 29	100
30	129	FLASH MONITOR 30	100
31	130	FLASH MONITOR 31	100
32	131	FLASH MONITOR 32	100
33	132	FLASH MONITOR 33	100
34	133	FLASH MONITOR 34	100
35	134	FLASH MONITOR 35	100
36	135	FLASH MONITOR 36	100
37	136	FLASH MONITOR 37	100
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42	141	FLASH MONITOR 42	100
43	142	FLASH MONITOR 43	100
44	143	FLASH MONITOR 44	100
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73	172	FLASH MONITOR 73	100
74	173	FLASH MONITOR 74	100
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93	192	FLASH MONITOR 93	100
94	193	FLASH MONITOR 94	100
95	194	FLASH MONITOR 95	100
96	195	FLASH MONITOR 96	100
97	196	FLASH MONITOR 97	100
98	197	FLASH MONITOR 98	100
99	198	FLASH MONITOR 99	100
100	199	FLASH MONITOR 100	100



TRAFFIC CONTROLLER CABINET
BACK PANEL & POWER SUPPLY
2 OF 2

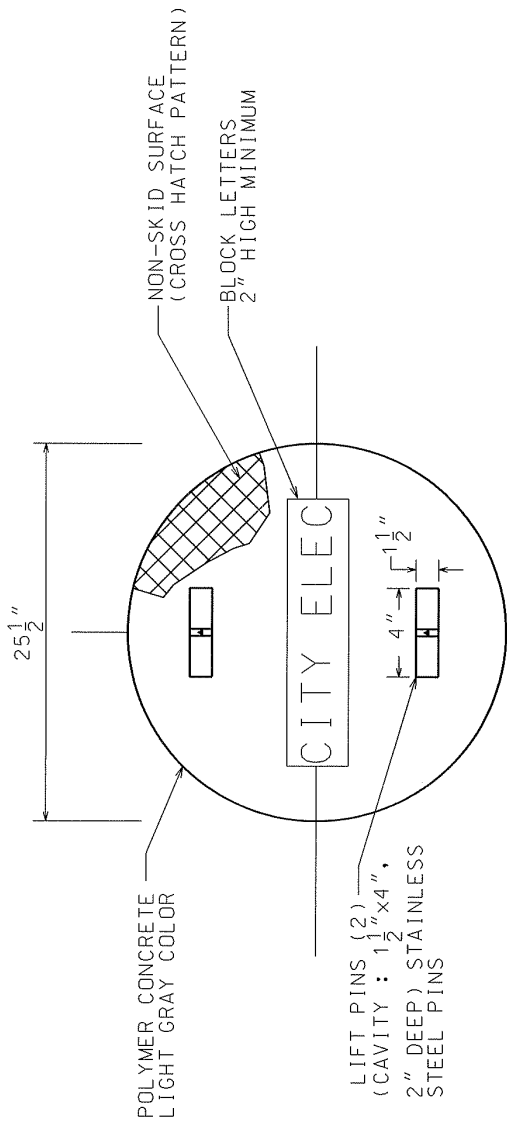
CITY OF CHICAGO
OFFICE OF THE CITY ENGINEER
DIVISION OF ELECTRIC ENGINEERING

DESIGNED BY: A. BAUTISTA
CHECKED BY: SUPERVISING ENGINEER
DATE: 12/15/08
PROJECT NO.: 08010010

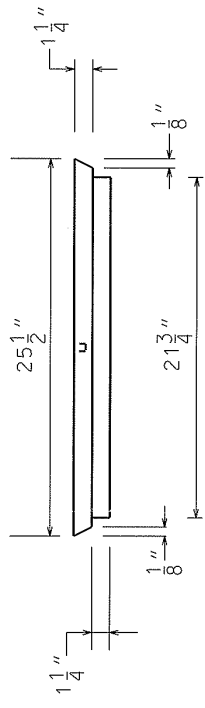
ENGINEER-IN-CHARGE: R. POOL
DATE: 12/15/08
PROJECT NO.: 08010010

965

DATE: 5/16/2008
PROJECT: TRAFFIC CONTROLLER CABINET



COVER - TOP VIEW



COVER - SIDE ELEVATION

DATE	REVISION
A	

**POLYMER CONCRETE
24" MANHOLE COVER**

CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
DIVISION OF ELECTRICAL OPERATIONS

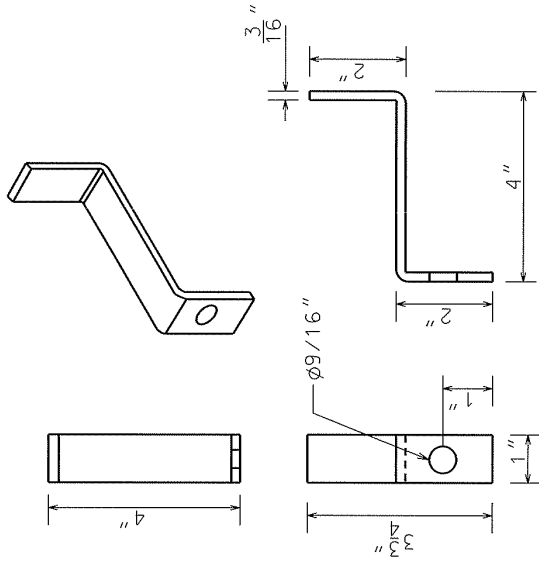
DRAWN BY: C. M. PADLIAR
ENGINEER: R. POOL
SUPERVISING ENGINEER: D. LETAMENDI
ENGINEER OF ELECTRICITY:

DEPUTY COMMISSIONER: *[Signature]*

SIZE: 11" x 17" SCALE: NONE

DWG. NO. **966**

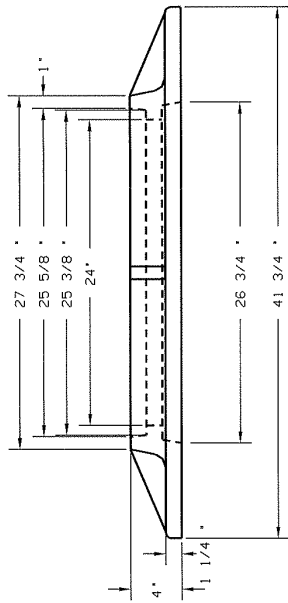
DATE: 03-08-11



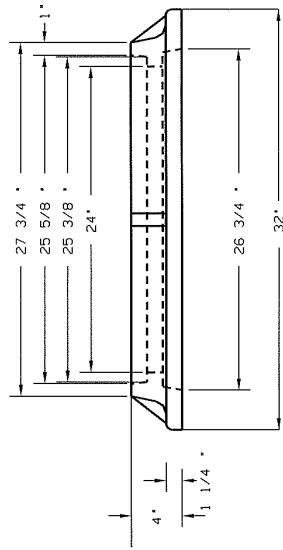
BRACKET DETAIL

DATE	REVISION
A	

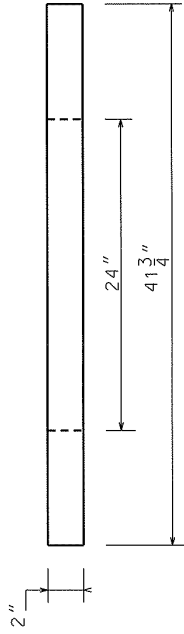
BRACKET DETAIL FOR 30" F FIBERGLASS HAND HOLE	
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION DIVISION OF ELECTRICAL OPERATIONS	
DRAFTSMAN:	C. M. PADILYAR
ENGINEER:	R. POOL
SUPERVISING ENGINEER:	G. LETAMENDI
ENGINEER OF ELECTRICITY:	
DEPUTY COMMISSIONER:	<i>[Signature]</i>
SIZE: 11" x 17"	SCALE: NONE
DWG. NO.	967
DATE: 03-08-11	



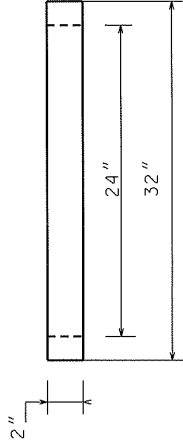
FRAME - SIDE ELEVATION
FOR CONCRETE MANHOLES/HANDHOLES



FRAME - SIDE ELEVATION
FOR FIBERGLASS HANDHOLES



FRAME EXTENSION - SIDE ELEVATION
FOR CONCRETE MANHOLES/HANDHOLES



FRAME EXTENSION - SIDE ELEVATION
FOR FIBERGLASS HANDHOLES

DATE	REVISION
A	

**POLYMER CONCRETE
24" FRAMES**

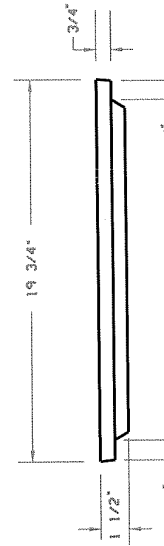
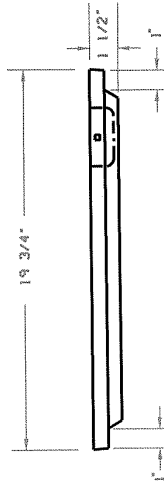
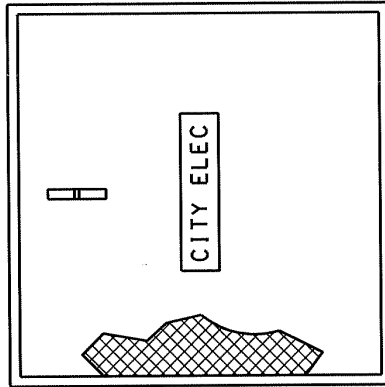
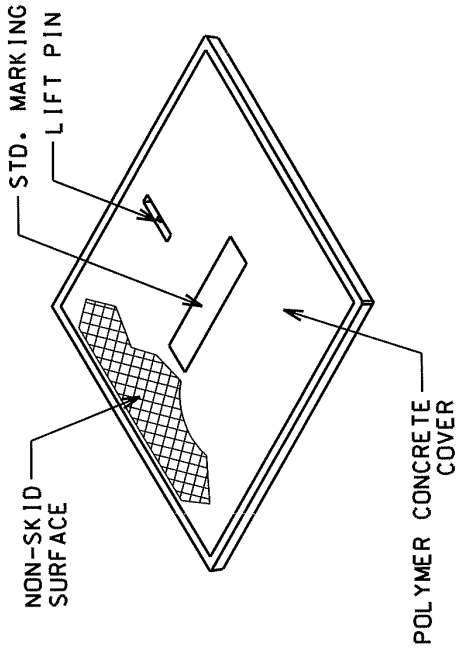
CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
DIVISION OF ELECTRICAL OPERATIONS

DRAWN BY: G. M. PADILYAR
ENGINEER: R. POOL
SUPERVISING ENGINEER: D. LETAMENDI
ENGINEER OF ELECTRICITY: *Robert C. Meyer*
DEPUTY COMMISSIONER

DWG. NO. **968**

DATE: 07-21-11

SIZE: 11" x 17" SCALE: NONE



DATE	REVISION

**SQUARE COMPOSITE COVER
FOR CHICAGO PARK DISTRICT MANHOLES**

CITY OF CHICAGO
DEPARTMENT OF INSPECTION
DIVISION OF ELECTRICAL OPERATIONS

DRAFTSMAN: G. M. PADILYAR

ENGINEER: R. POOL

SUPERVISING ENGINEER: D. LETANENHOI

ENGINEER OF ELECTRICITY: *[Signature]*

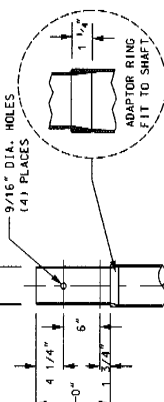
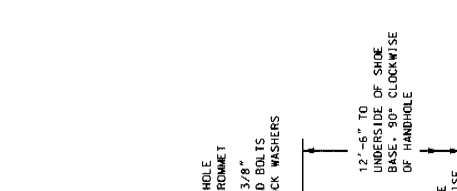
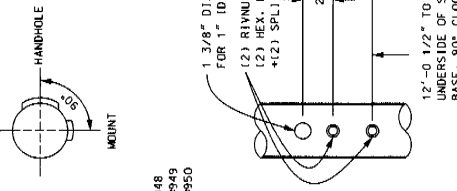
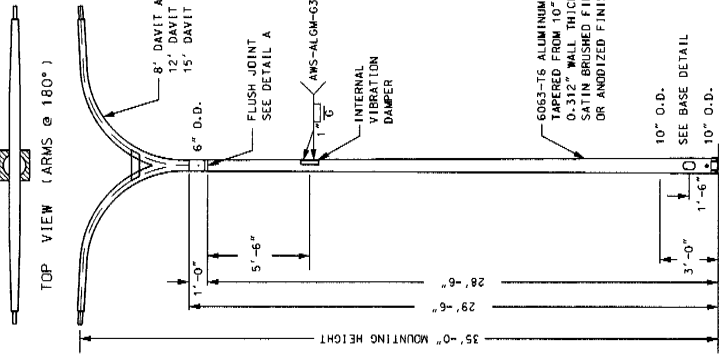
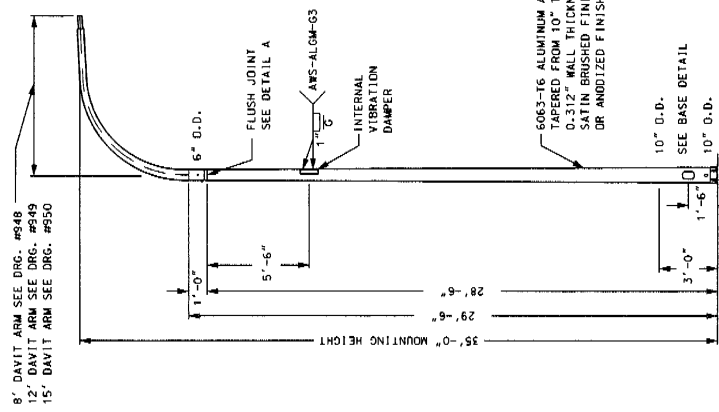
DEPUTY SUPERVISING ENGINEER: *[Signature]*

DMG. NO. 970

DATE: 06-01-2012

APPROX. WT. -40 LBS

DATE: 06-01-2012
FILE: 970.DWG



GENERAL NOTES:

- UNITS SHALL BE MANUFACTURED IN ACCORDANCE WITH THE 1994 ASHRAE STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS.
- DESIGN WIND VELOCITY SHALL BE 80 MILES PER HOUR WITH 1.3 GUST FACTOR.
- LIGHT POLE SHALL BE DESIGNED TO SUPPORT (1) 40 POUNDS LUMINAIRE WITH AN EFFECTIVE PROJECTED AREA OF 1.2 SQUARE FEET MOUNTED ON A 35'-0" SINGLE DAVIT ARM.

NO.	DATE	REVISION

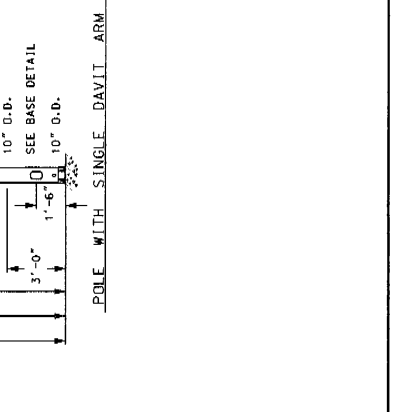
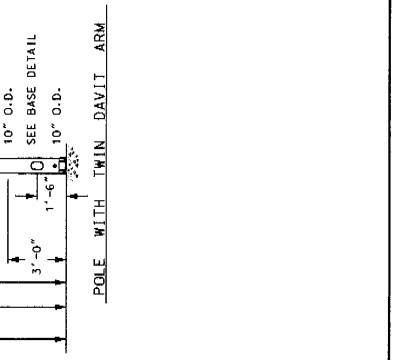
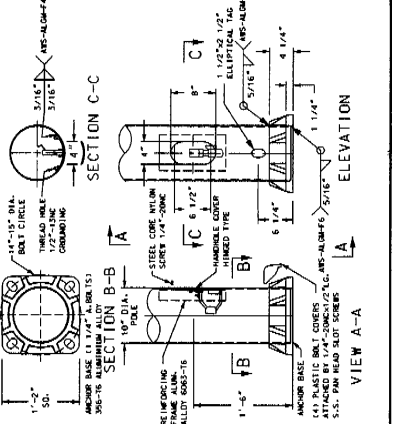
ALUMINUM DAVIT POLE
10" x 6" x 35'
FOR ARTERIAL STREETS

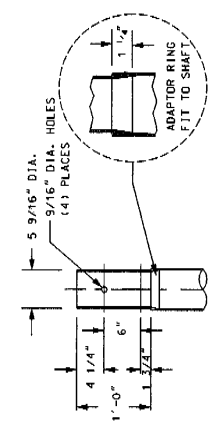
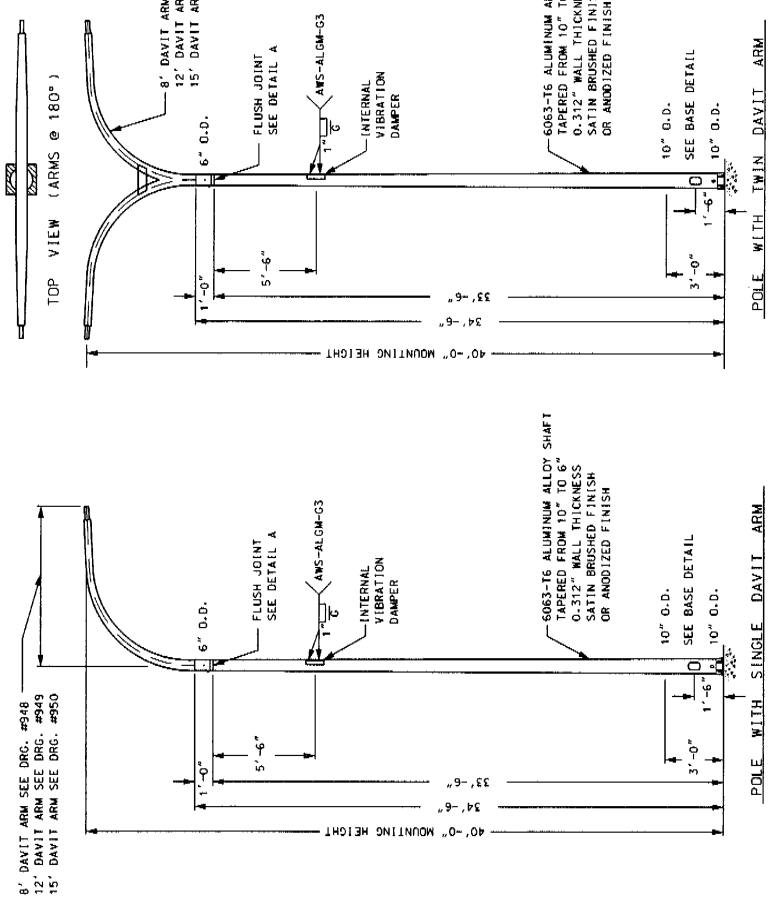
CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING

DRAWN BY: G.M. PAO/YAR
ENGINEER: D. LETAMENDI
SUPERVISING ENGINEER: R. POOL
ENGINEER OF ELECTRICITY: *[Signature]*
DEPUTY COMMISSIONER: *[Signature]*

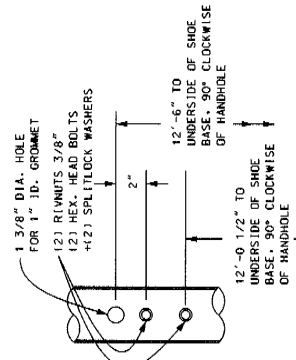
DWG. NO. 971

SCALE: NONE
DATE: 04/15/13



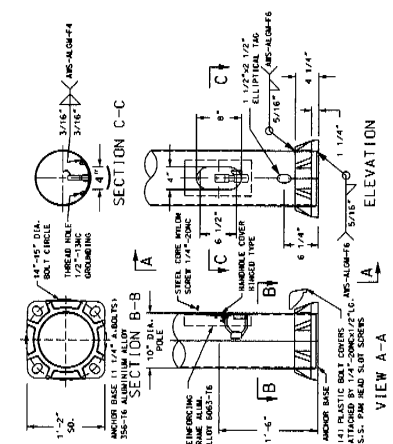


DETAIL A



OPTION : SIDE MOUNT FOR LUMINAIRE

GENERAL NOTES:
 - UNITS SHALL BE MANUFACTURED IN ACCORDANCE WITH THE 1994 AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS.
 - DESIGN AND CONSTRUCTION SHALL BE 80 MILES PER HOUR WITH 1.3 GUST FACTOR.
 - LIGHT POLE SHALL BE DESIGNED TO SUPPORT (1) 40 POUNDS LUMINAIRE WITH AN EFFECTIVE PROJECTED AREA OF 1.2 SQUARE FEET MOUNTED ON A 40'-0" SINGLE DAVIT ARM.



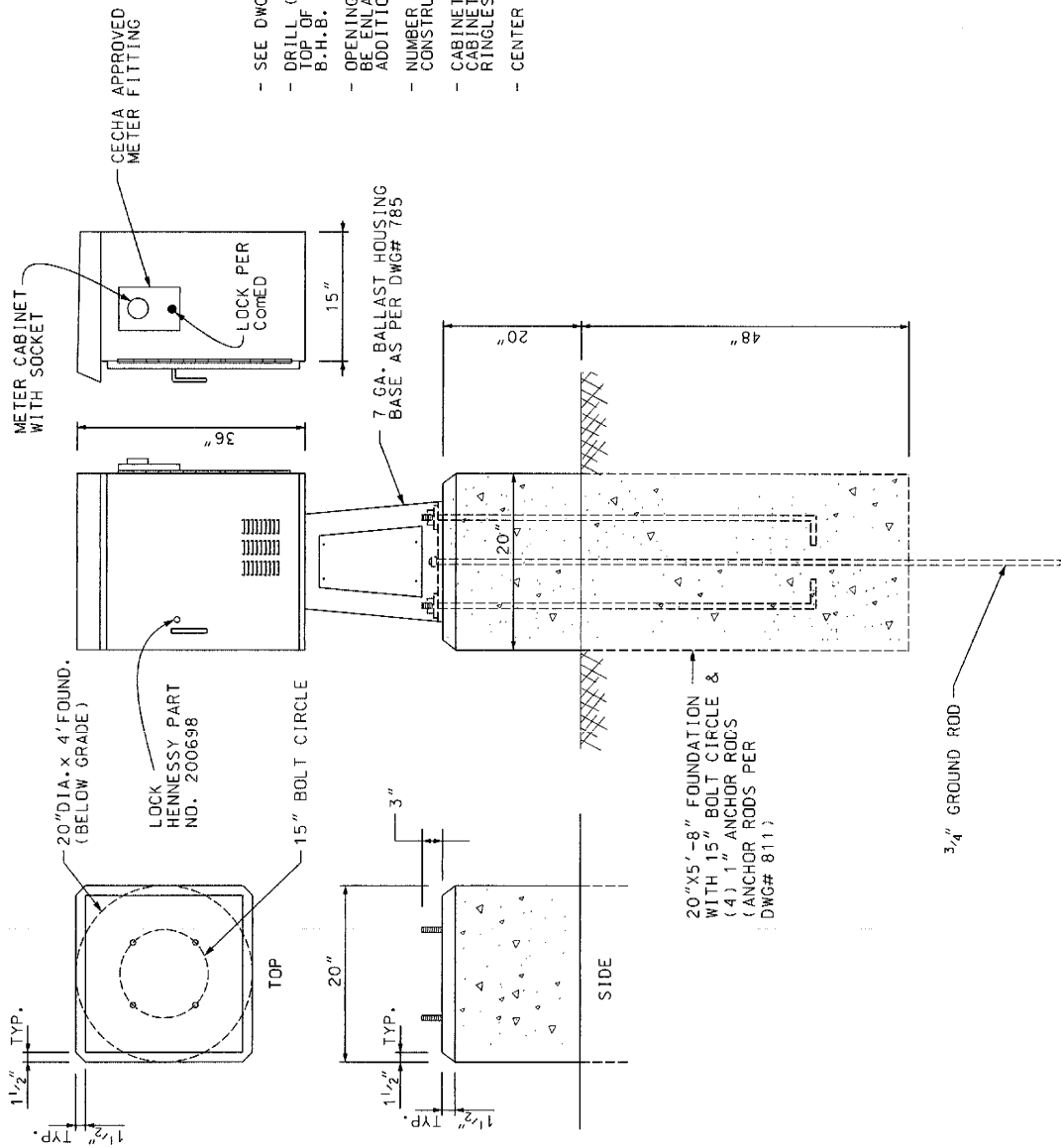
ELEVATION

ALUMINUM DAVIT POLE

10" x 6" x 40'

FOR ARTERIAL STREETS

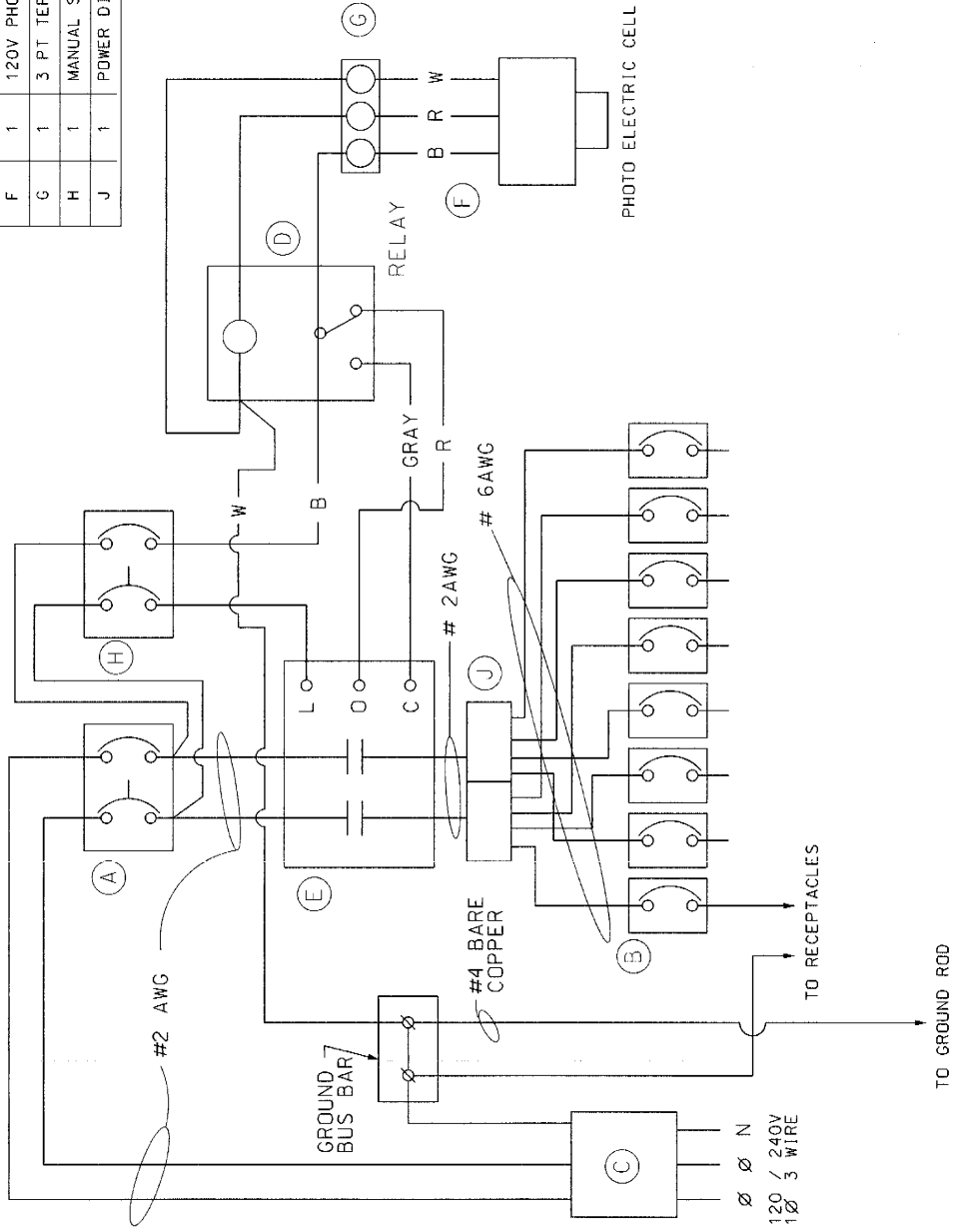
DRP/TEAM :	G.M.PADHYAR	ENG. NO.	972
ENGINEER :	D.LETAMENDI	SCALE :	NONE
SUPERVISING ENGINEER :	R.POOL	DATE :	04/15/13
ENGINEER OF ELECTRICITY :	<i>J. [Signature]</i>		
DEPUTY COMMISSIONER :	<i>David Bank</i>		



- SEE DWG# 974 FOR WIRING DIAGRAM.
- DRILL (4) 1/2" DIA. HOLES IN BOTTOM OF CABINET & TOP OF BALLAST HOUSING BASE, BOLT CABINET TO B.H.B. USING (4) 3/8"x2 1/2" BOLTS.
- OPENINGS IN BOTTOM OF CABINET & TOP OF B.H.B. MAY BE ENLARGED TO A MAX. OF 5"x10" TO FACILITATE ADDITIONAL CABLE.
- NUMBER & SIZE OF CONDUITS TO BE SHOWN ON CONSTRUCTION DRAWINGS.
- CABINET WITH METER SOCKET ATTACHED TO SIDE OF CABINET. METER SOCKET SHALL BE 100 AMP. 4 TERMINAL RINGLESS, 600 VAC., OR EQUIVALENT.
- CENTER OF METER NOT TO BE OVER 60" FROM GRADE.

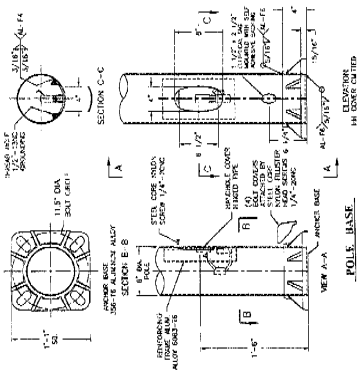
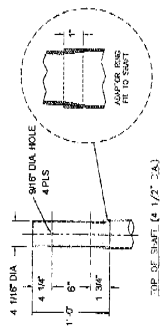
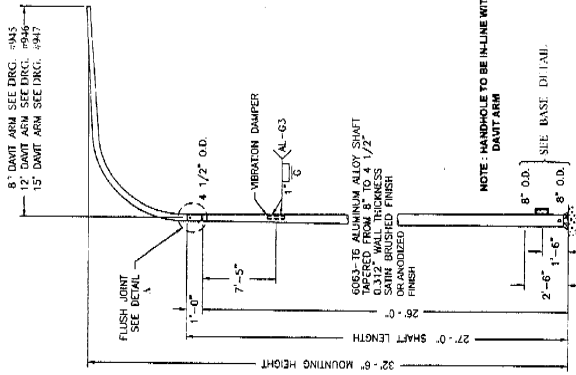
NO.	DATE	REVISION
		100 AMP. BASE MOUNTED RECEPTACLE CONTROLLER CABINET
CITY OF CHICAGO Department of Transportation Department of Public Works		
DESIGNED BY	C.A. QUINN	C.E. ENGINEER
CHECKED BY	J. J. HENNESSY	P.E. ENGINEER
APPROVED BY	<i>[Signature]</i>	<i>[Signature]</i>
DWG. NO.	973	
DATE	5/21/13	

ITEM	QTY	DESCRIPTION
A	1	BREAKER 2P 100 AMP
B	8	BREAKER 1P 20 AMP
C	1	CECHA APPROVED METER FITTING
D	1	POTTER BRUMFIELD PRD5AYO-120 RELAY
E	1	REMOTE CONTROL SWITCH 2P 100 AMP 240V
F	1	120V PHOTOCELL
G	1	3 PT TERMINAL BLOCK
H	1	MANUAL STARTER SWITCH
J	1	POWER DISTRIBUTION BLOCK

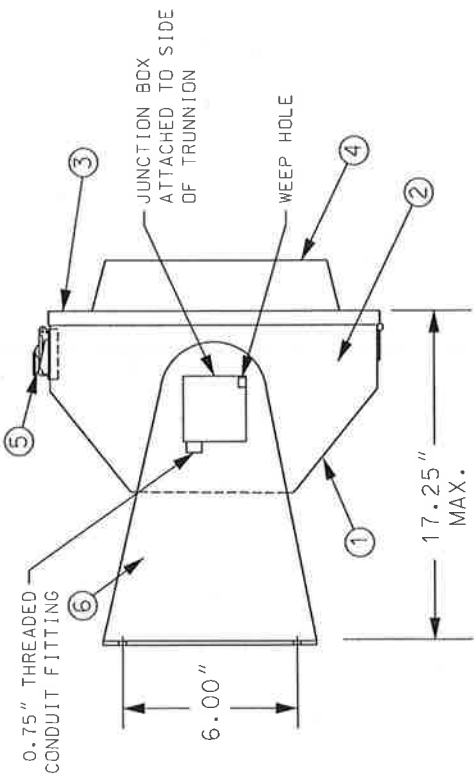


DATE	REVISION
WIRING DIAGRAM 100 AMP / 120 VOLT RECEPTACLE CONTROLLER	
CITY OF CHICAGO Department of Transportation Division of Engineering	
DESIGNED BY D. PASADYAR	CHECKED BY T. B. BROWN
SUPERVISING ENGINEER ELECTRIC DESIGN ENGINEER R. POSE	
ENGINEER OF ELECTRICITY S. J. KELLY	
CITY OF CHICAGO Department of Transportation Division of Engineering S. J. KELLY	
SCALE: NONE	DATE: 5/31/13

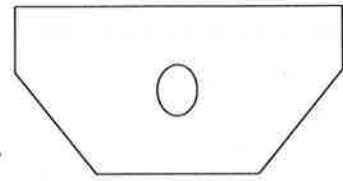
974



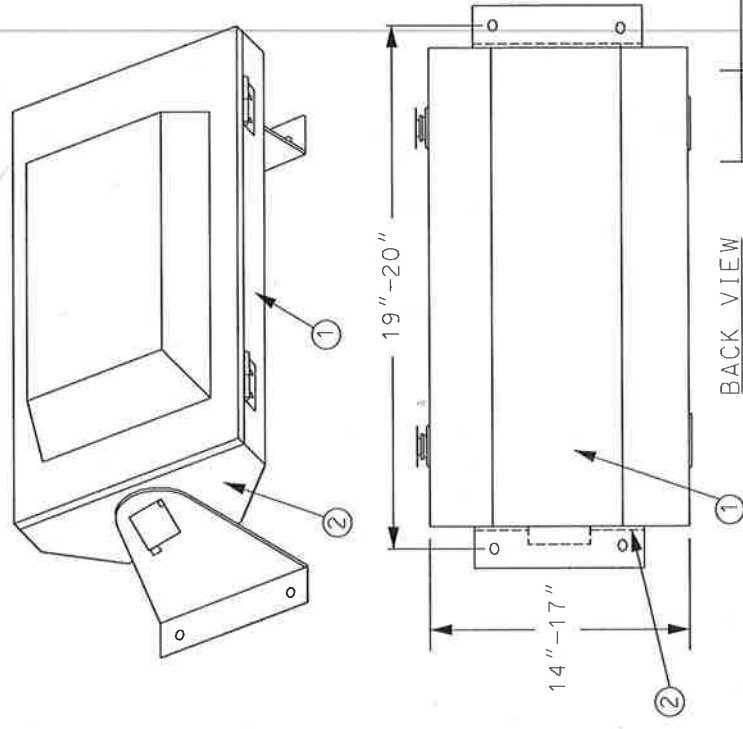
REVISION	
A	DATE
ALUMINUM DAVIT POLE 8" x 4.5" x 27' FOR BRIDGE PARAPET WALL	
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION DIVISION OF ENGINEERING	
DRAFTSMAN	G. M. PADYAR
ENGINEER	G. L. LAMONT
SUPERVISING ENGINEER	R. POOL
ENGINEER OF ELECTRICITY	
DEPUTY COMMISSIONER	<i>Samuel Bank</i>
SIZE	NONE
SCALE	NONE
DATE	10/02/13
DWG. NO.	975



SIDE VIEW



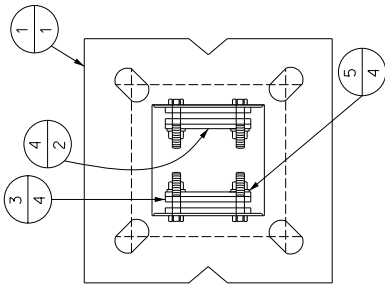
END PANEL



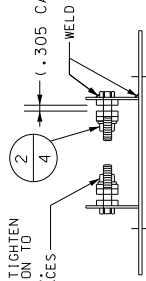
BACK VIEW

- 1) HOUSING
- 2) END PANEL
- 3) LENS DOOR/COVER ASSEMBLY
- 4) LENS
- 5) LATCHES
- 6) END MOUNT TRUNNION BRACKET
- 7) JUNCTION BOX

4/11/19	REVISE LOCATION OF JUNCTION BOX
DATE	REVISION
VIADUCT STRUCTURE LUMINAIRE	
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING	
DESIGNED BY G. M. PAULYAR	CHECKED BY E. KARAGIANES
DRAWN BY D. LETAMENDI	SCALE AS SHOWN
DATE 4/15/04	DWG. NO. 981
APPROVED BY <i>[Signature]</i> DEPUTY COMMISSIONER ELECTRICITY	
SCALE: NONE	MAT. SPEC: 1532

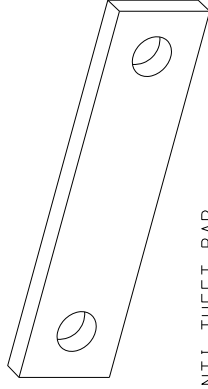
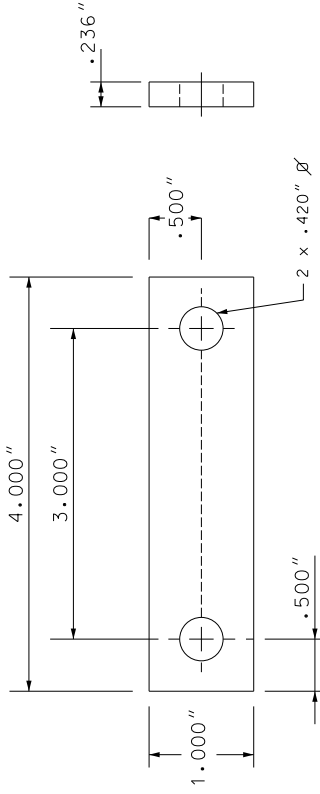


HAND TIGHTEN NUTS ON TO BOLTS IN 4 PLACES



(.305 CABLE THICKNESS)

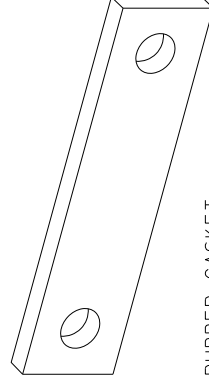
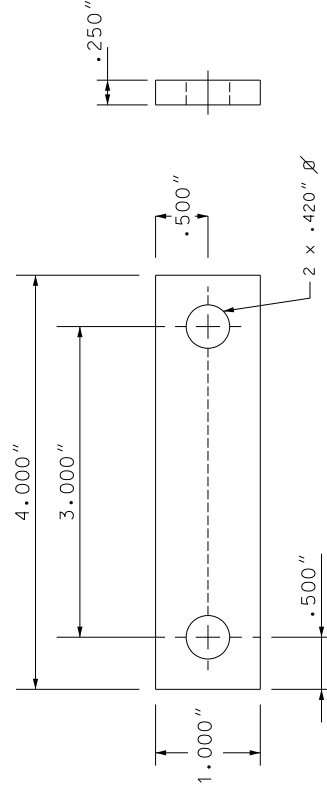
POWDER COAT SILVER OR BLACK



ANTI THEFT BAR

ITEM #	QTY	DESCRIPTION
1	1	ANTI THEFT PLATE W/ WELDED STUDS
2	4	3/8 - 16 SS NUT
3	4	GASKET
4	2	ANTI THEFT BAR
5	4	WASHER

ANTI THEFT PLATE ASSEMBLY



RUBBER GASKET

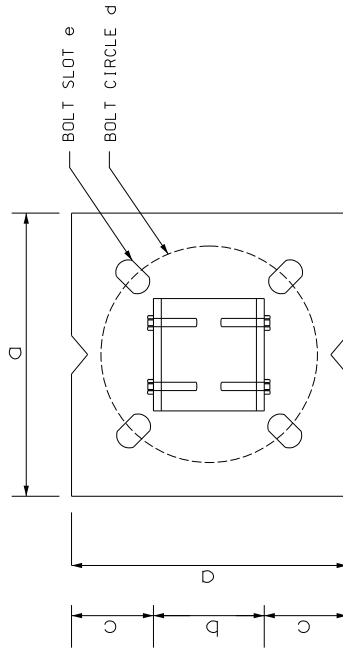
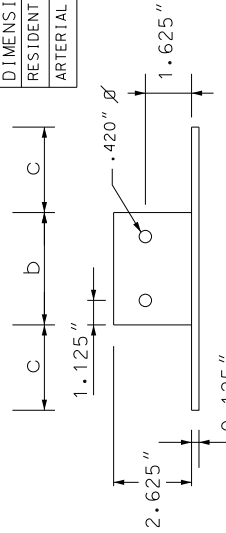


PLATE DIMENSIONS	a	b	c	d	e
RESIDENTIAL	11"	5.25"	2.875"	10"-11"	1.25" x 1.75"
ARTERIAL	14"	5.25"	4.375"	14"-15"	1.40" x 2.00"



A	DATE	REVISION
		CABLE ANTI-THEFT DEVICE FOR HELIX FOUNDATIONS

CITY OF CHICAGO
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

DRAFTSMAN/ENGINEER : G.M. PADLIYAR
SUP. ENGINEER/PM : O. LETAMENDI
PROFESSIONAL ENGINEER : R. POOL
ENGINEER OF ELECTRICITY:
DEPUTY COMMISSIONER:

DWG. NO. 982

SCALE: 16" = 22" NONE DATE: 01/27/2015

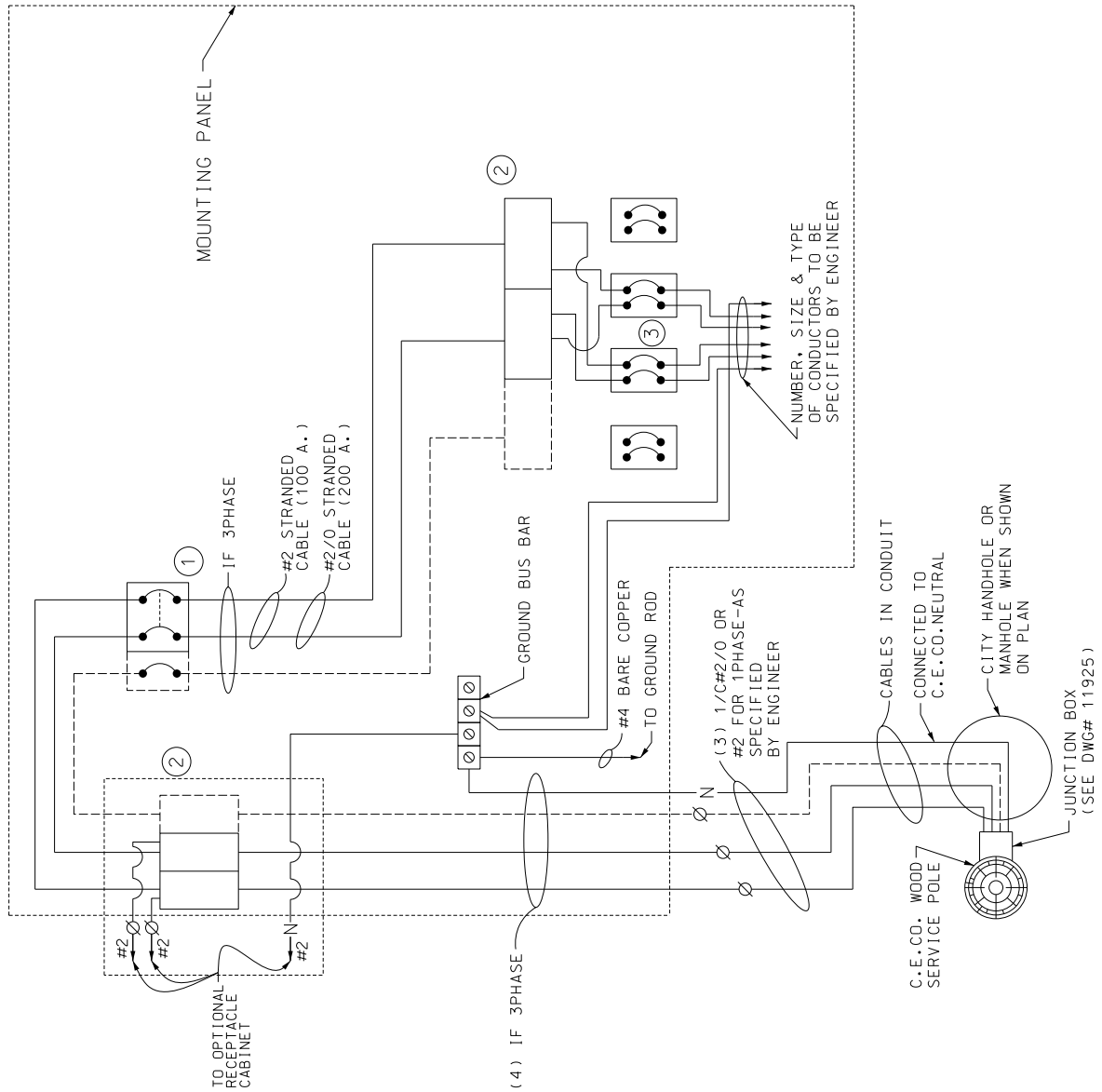
- ① - MAIN CIRCUIT BREAKER, 2 POLE OR 3 POLE
100A "FDB" FRAME OR
2 POLE OR 3 POLE, 200A, "JDB" OR "JDK" FRAME
AS TABLE BELOW
- 100A 1PHASE : C FDB 14KA i.c. AT 240VAC 2P
100A 3PHASE : C FDB 14KA i.c. AT 240VAC 3P
200A 1PHASE : C JDB 25KA i.c. AT 240VAC 2P
200A 3PHASE : C JDB 25KA i.c. AT 240VAC 3P
- ② - POWER DISTRIBUTION BLOCK, AS PER
NEC 376.56(B) 1-4, AND 310.15(B)(16) 75°C
AMPACITIES OPEN STYLE, COPPER CONTACTS,
600VAC RATED
- ③ - BRANCH CIRCUIT BREAKER-2 POLE, 50A., OR 70A.
"EHD" FRAME,
14KA i.r. AT 240VAC 2P
14KA i.r. AT 240VAC 3P

NOTES :

GROUND BUS TO BE MOUNTED ON LEFT SIDE WALL
OF CABINET (SEE DETAIL DRG.NO.984)

SEE DRG.NO.984 FOR DETAIL OF MOUNTING PANEL.

SEE DRG.# 876 FOR CABINET ASSEMBLY (100 AMP.)
SEE DRG.# 880 FOR CABINET ASSEMBLY (200 AMP.)



DATE	REVISION

WIRING DIAGRAM FOR 100/200 AMP.
SINGLE OR THREE PHASE,
STREET LIGHTING CONTROLLER
CONSTANT POWER

CITY OF CHICAGO
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING-ELECTRICAL SECTION

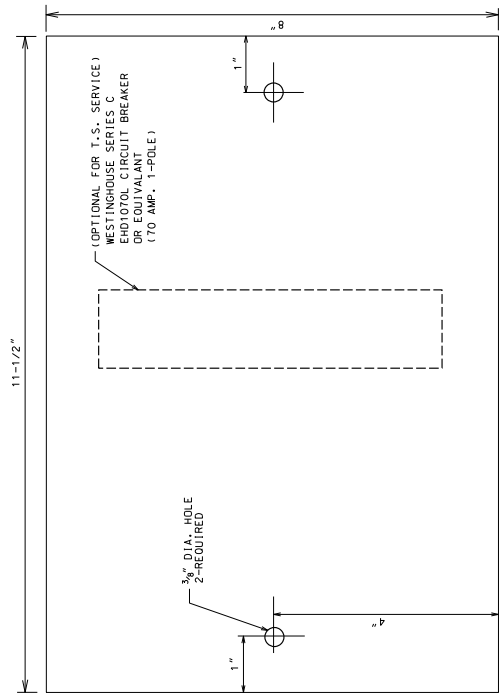
DRAWING ENGINEER : G.M.PADIVAR
SUPERVISING ENGINEER : D.LETAMENOI
PROFESSIONAL ENGINEER : R.POOL
ENGINEER OF ELECTRICITY :
DEPUTY COMMISSIONER :

DWG. NO. 983

SIZE: 16" | 22" SCALE: NONE DATE: 10/23/17

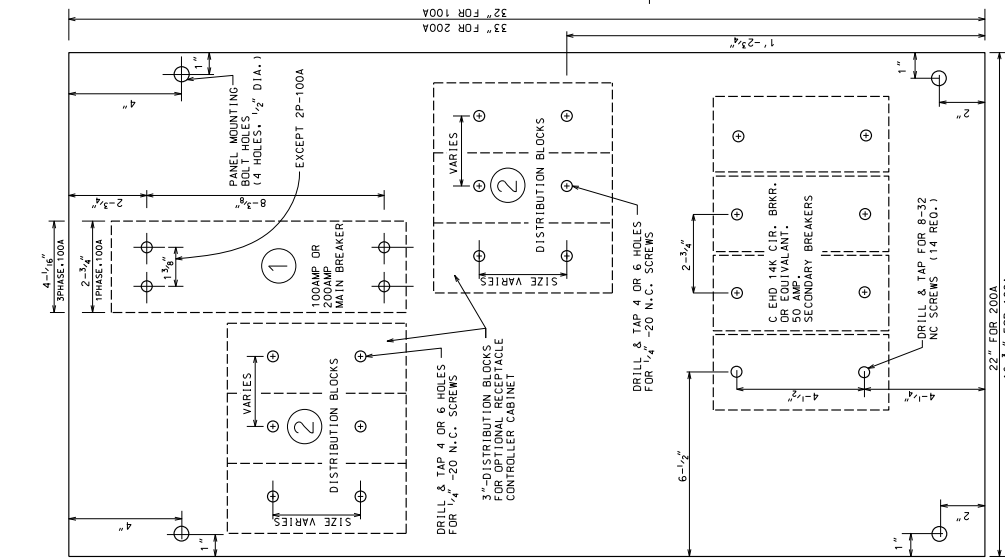
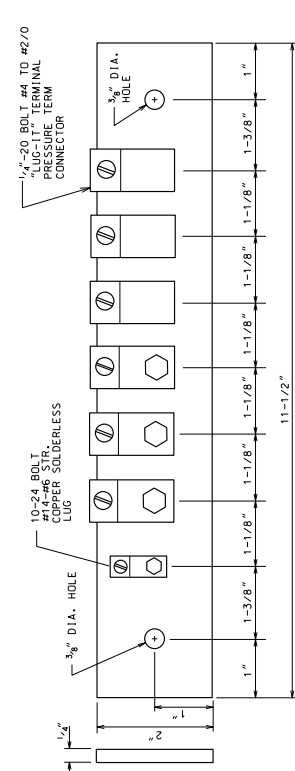
SEE DRG.#880 FOR CABINET DETAIL
SEE DRG# 983 FOR WIRING DIAGRAM

- ① - MAIN CIRCUIT BREAKER
100A 1PHASE : C FDB 14KA 1.F.F. of 240VAC 2P
100A 3PHASE : C FDB 14KA 1.F.F. of 240VAC 3P
200A 1PHASE : C JDB 25KA 1.F.F. of 240VAC 2P
200A 3PHASE : C JDB 25KA 1.F.F. of 240VAC 3P
- ② - POWER DISTRIBUTION BLOCKS
RATED 600V, BASED ON NEC
376-56(B) 1-4, AND 310.15(B)(16)
75°C AMPACITIES



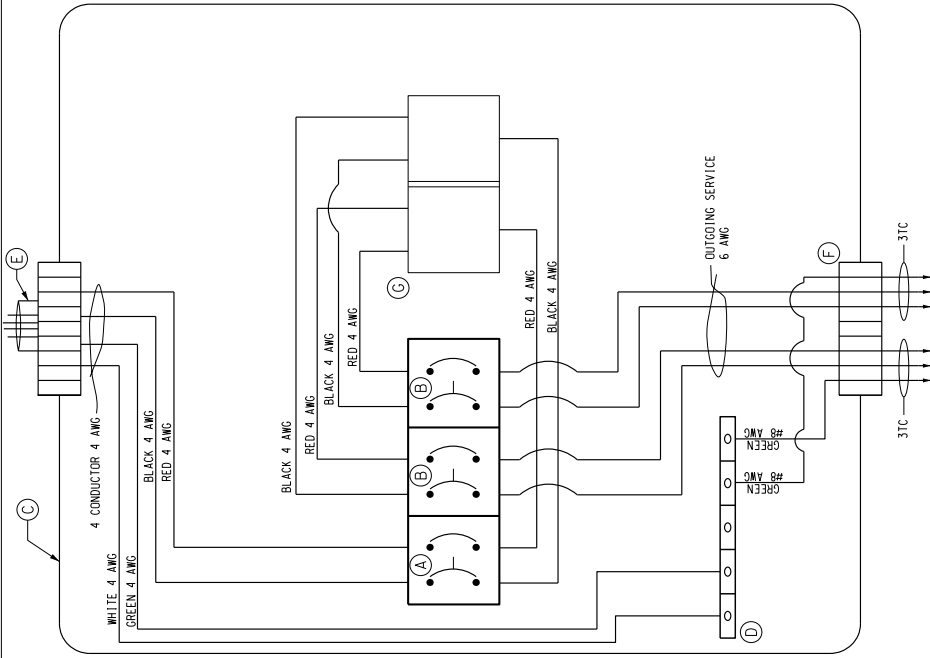
(OPTIONAL) PANEL FOR TRAFFIC SIGNAL SERVICE

1/2" THICK PHENOLIC LINEN BASE PANEL
TO BE MOUNTED ON UPPER LEFT SIDE OF CABINET

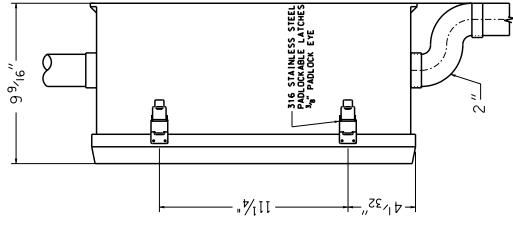


BACK PANEL
1/2" THICK PHENOLIC
LINEN BASE

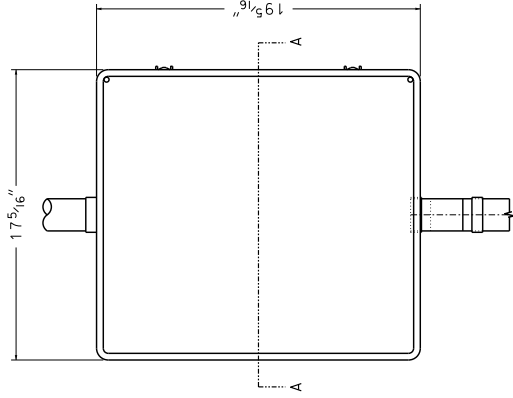
REVISION	
DATE	
PANELS FOR 100A/200A 2 AND 3 POLE EQUIPMENT IN STREET LIGHT CONTROL CABINET - CONSTANT POWER	
CITY OF CHICAGO DEPARTMENT OF TRANSPORTATION DIVISION OF ENGINEERING-ELECTRICAL SECTION	
DRAWING/ENGINEER : GUMPHADYAR	DWG. NO. 984
SUPERVISING ENGINEER : D. LETAMENGI	R. POOL
ENGINEER OF ELECTRICITY :	
DEPUTY COMMISSIONER :	
SIZE: 16" 22"	SCALE: NONE
	DATE: 10/23/17



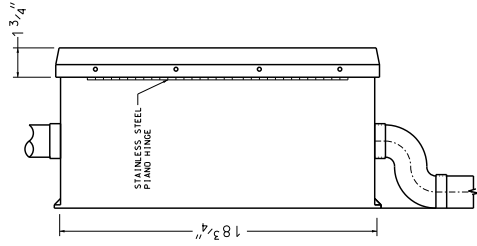
- A - C/H 2P 60A QC2060
- B - C/H 2P 30A QC2030
- C - VYNKIER ENCLOSURE VJ1816
- D - CB101 NEUTRAL BUS
- E - T&B 2564 CORD GRIP
- F - T&B H200GR FITTING
- G - POWER DISTRIBUTION BLOCK, OPEN STYLE, COPPER CONTACTS, 600 VAC RATED.



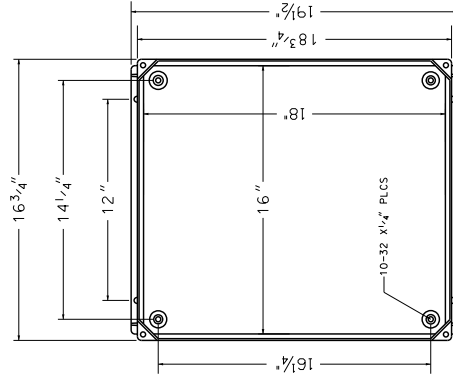
RIGHT SIDE VIEW



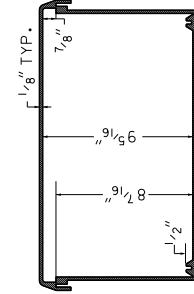
FRONT VIEW WITH COVER



LEFT SIDE VIEW



FRONT VIEW WITH COVER REMOVED

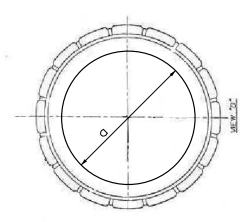


SECTION A-A

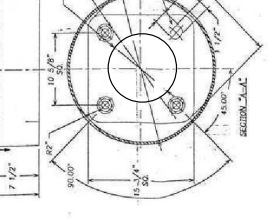
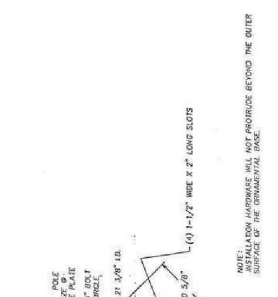
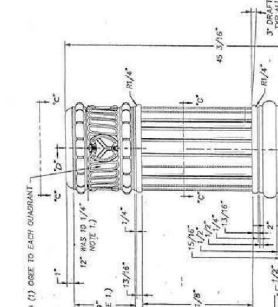
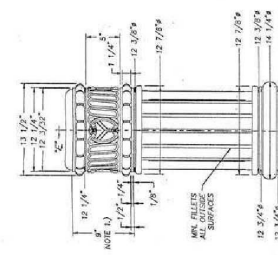
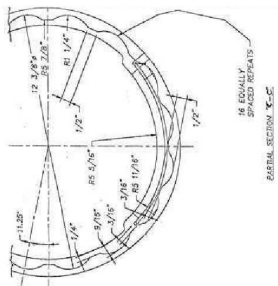
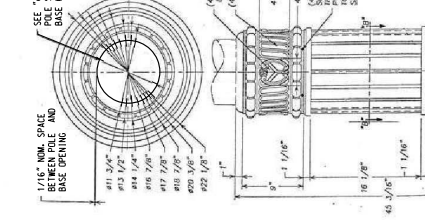
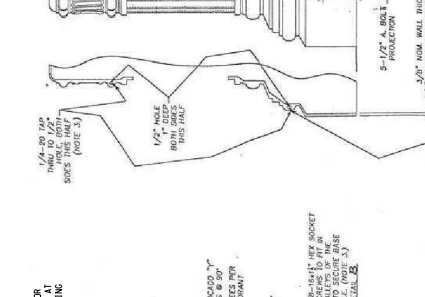
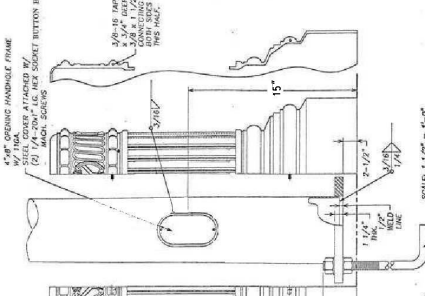
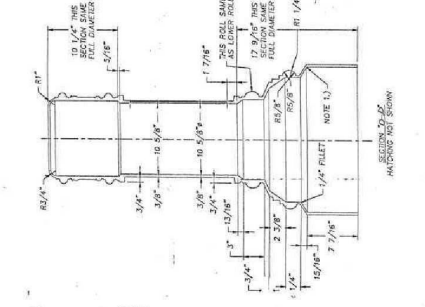
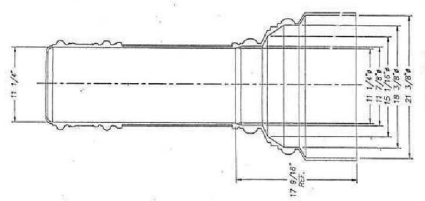
DATE	REVISION
	60 AMP - 240 V RESIDENTIAL LIGHTING CONTROLLER CONSTANT POWER

CITY OF CHICAGO DEPARTMENT OF ENGINEERING-ELECTRICAL SECTION		DWG. NO.
DRAWING ENGINEER : GUNPATIYAR	DESIGNED BY :	985
SUPERVISING ENGINEER :	CHECKED BY :	
PROFESSIONAL ENGINEER :	DATE :	
ENGINEER OF ELECTRICITY :		
DEPUTY COMMISSIONER :		
SIZE: 16" 22"	SCALE: NONE	DATE: 10/23/17

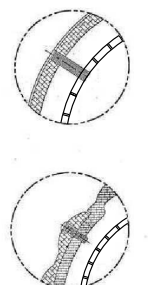
WIRING DIAGRAM



POLE SIZE AT BASE OPENING
 10" : 9-1/2"
 11" : 10-1/2"
 12" : 11-1/2"



MATERIAL SPECIFICATIONS :
 PEDESTAL BASE : FIBERGLASS
 PIPE : ASTM A53 OR B OR A501
 BANNER COUPLINGS : A513 TYPE B
 COLLARS : 1/2" THICK GALVANIZED STEEL
 COLLARS & END ORNAMENTS : CAST ALUMINUM
 FINISH : PAINTED PER SALES ORDER & MEET SPEC. INCLUDES VISIBLE HARDWARE & SEALANT



BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

BASE TO END
 SEE SALES ORDER & MEET SPEC.

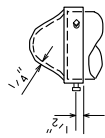
BASE TO END
 SEE SALES ORDER & MEET SPEC.

**CHICAGO 2000 POLE BASE
 FOR STANDRAD 34.5' POLE
 TO DRAWING NUMBERS
 808, 824 & 827**

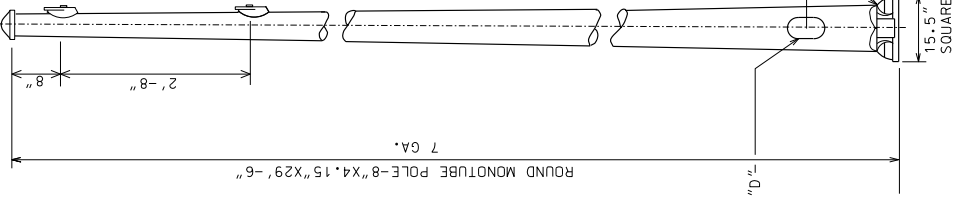
**CITY OF CHICAGO
 DEPARTMENT OF TRANSPORTATION
 DIVISION OF ENGINEERING-ELECTRICAL SECTION**

DRF TSMW/ENGINEER : GJMP/PAV/VR
 SUPERVISING ENGINEER : D. LETAMENOI
 PROFESSIONAL ENGINEER : R. POOL
 ENGINEER OF ELECTRICITY :
 DEPUTY COMMISSIONER :

SCALE : NONE
 DATE : 10/23/17

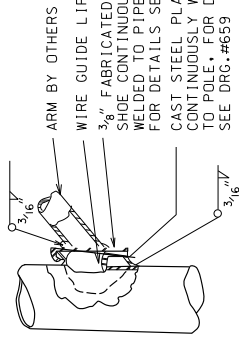


3/8"-16NCX1" LONG
SET SCREWS (3@120°)
POLE CAP
FOR DETAILS SEE
DRG.# 111420-A

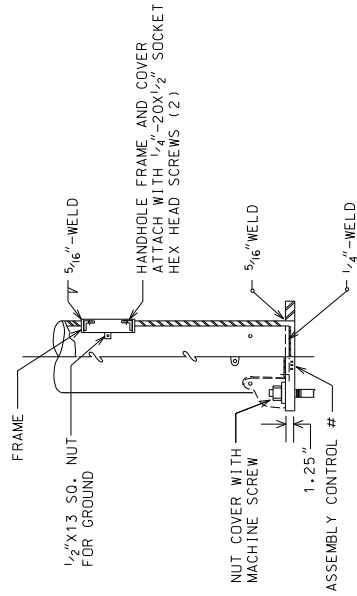


SEE
DETAIL "D"

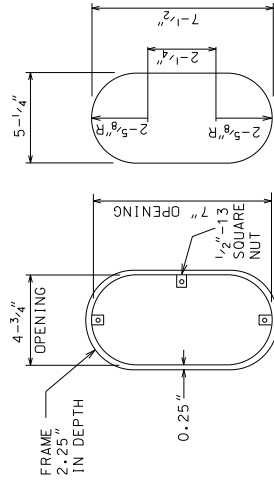
BOLT COVER W/ HEX HD.
ST. STL. MACH. SCREWS



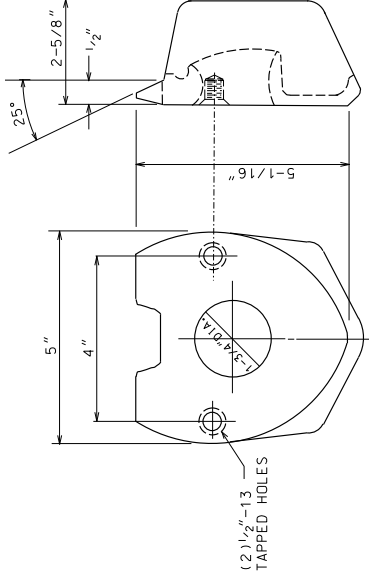
SECTION AT POLE PLATE



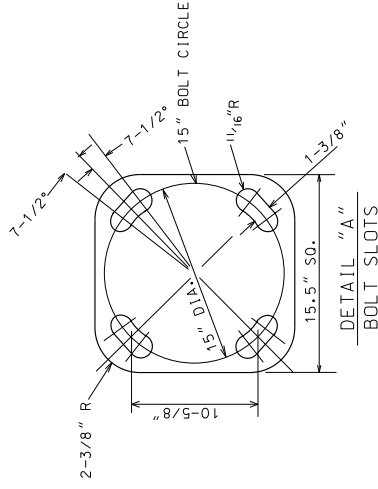
DETAIL "D"



FRAME
HANDHOLE
DOOR
DETAIL



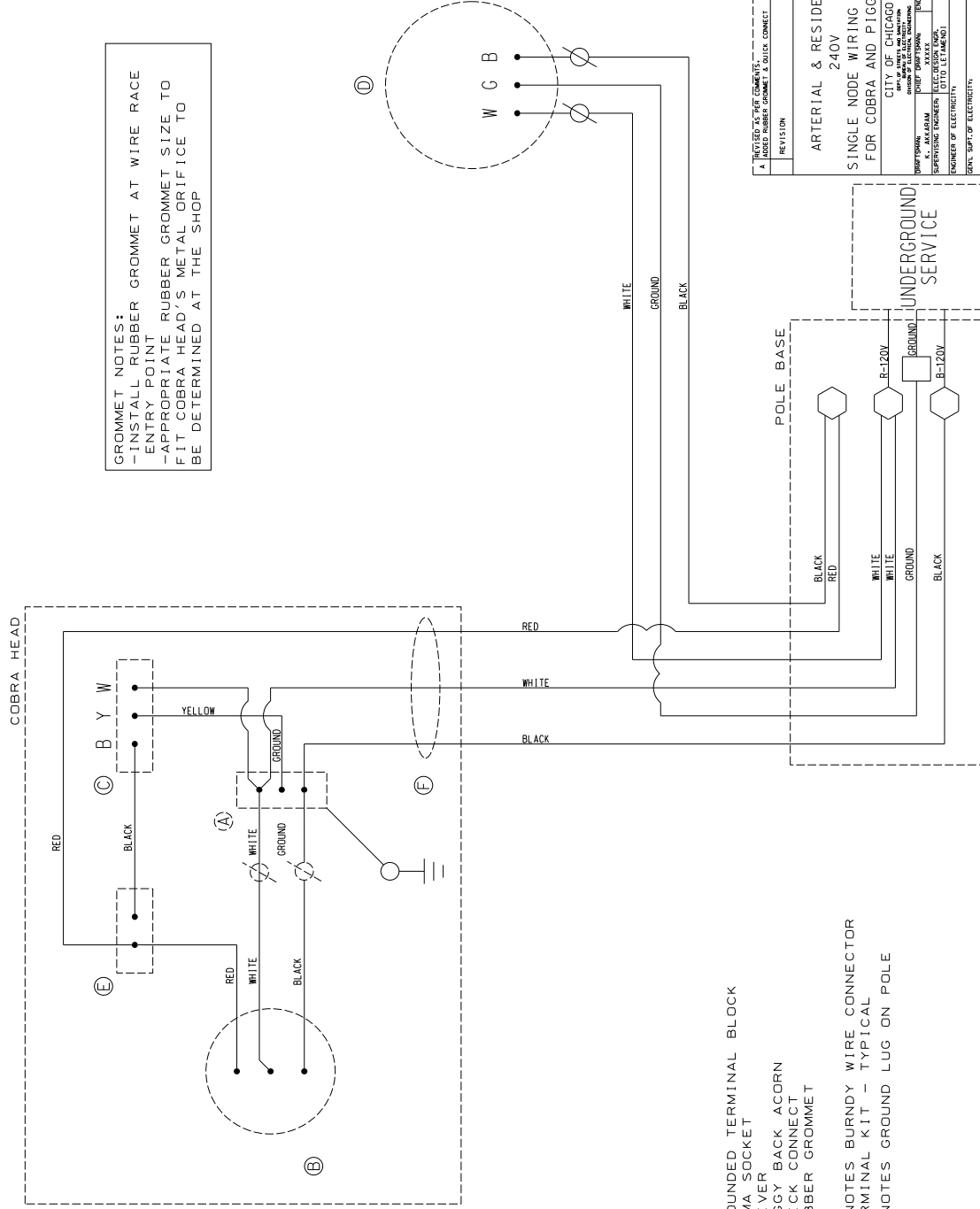
2 BOLT MAST ARM ATTACHMENT
FOR DETAILS SEE DRG.# 659
MATERIAL: CAST STEEL



DETAIL "A"
BOLT SLOTS

A	DATE	REVISION
		4.15" x 8" x 29' -6"
		7 GAUGE
		ANCHOR BASE STEEL POLE
CITY OF CHICAGO		
DEPARTMENT OF TRANSPORTATION		
DIVISION OF ENGINEERING		
DRG. ENGINEER/PM :	G.M.PADLIYAR	DWG. NO.
PROFESSIONAL ENGINEER I.R. POOL	O. LETAMENDI	988
ENGINEER OF ELECTRICITY:		
DEPUTY COMMISSIONER:		
SIZE: 16" 22"	SCALE:	NONE
		DATE: 02/01/2021

AS PER SPECIFICATION# 1447

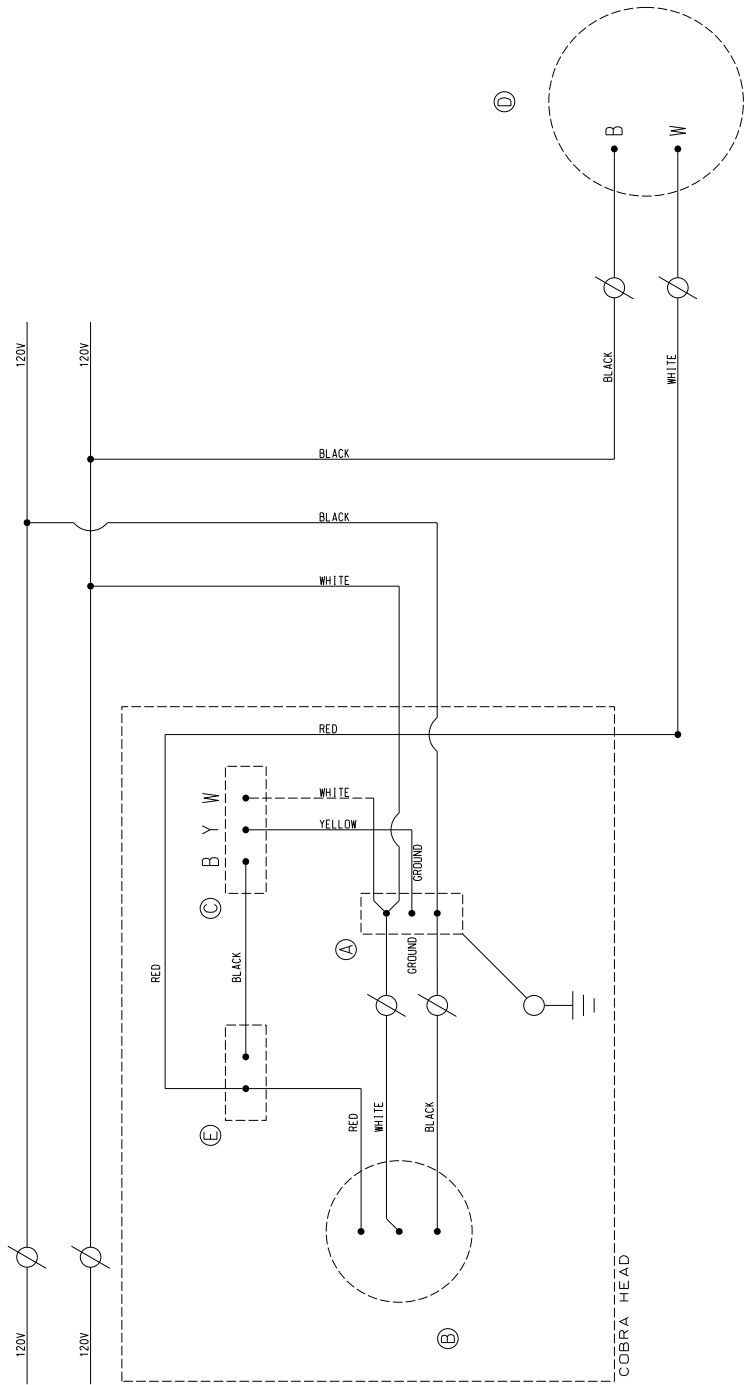


GROMMET NOTES:
 - INSTALL RUBBER GROMMET AT WIRE RACE ENTRY POINT
 - APPROPRIATE RUBBER GROMMET SIZE TO FIT COBRA HEAD'S METAL ORIFICE TO BE DETERMINED AT THE SHOP

NOTES
 A - GROUND TERMINAL BLOCK
 B - NEMA SOCKET
 C - DRIVER
 D - PIGGY BACK ACORN
 E - QUICK CONNECT
 F - RUBBER GROMMET

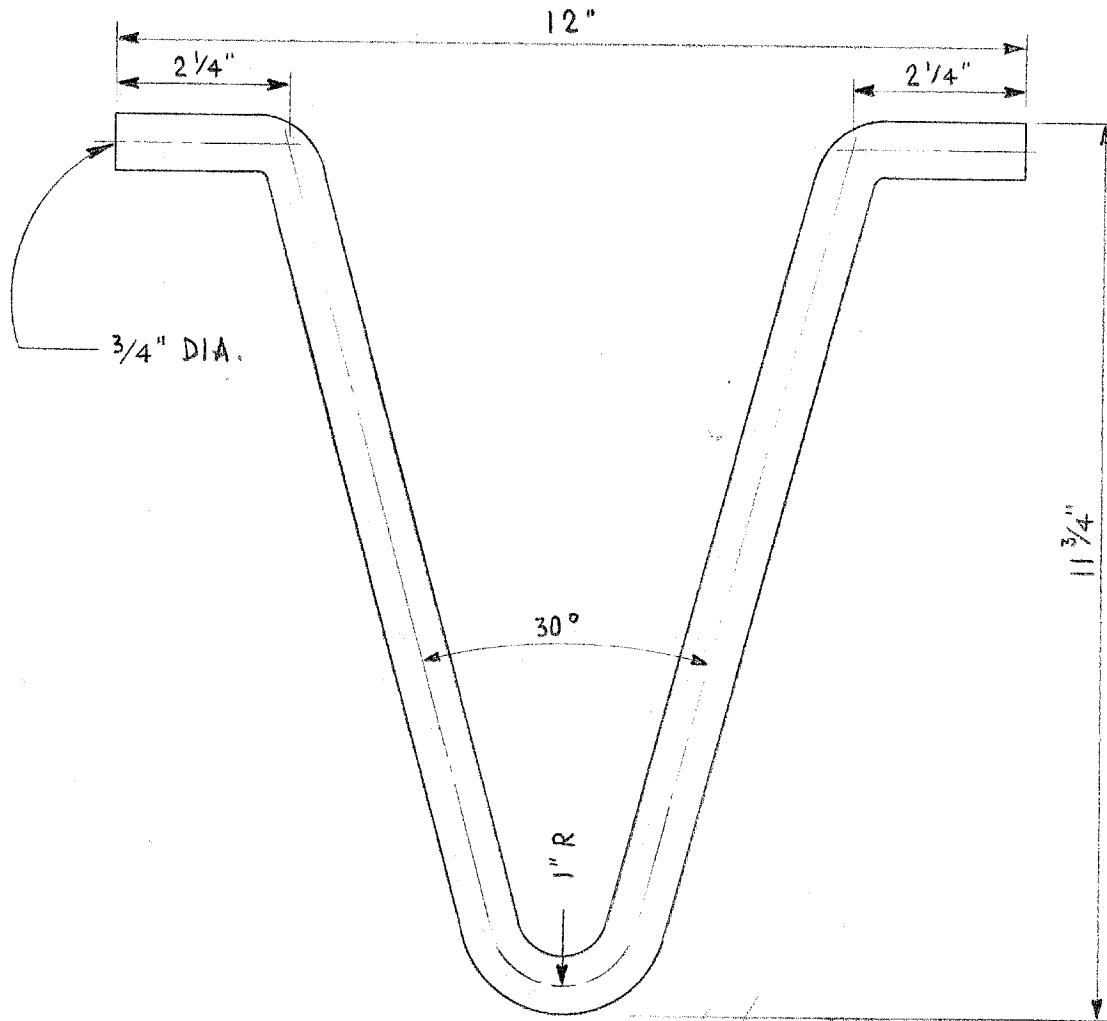
DENOTES BURNDY WIRE CONNECTOR TERMINAL KIT - TYPICAL
 DENOTES GROUND LUG ON POLE

REVISION	DATE
REVISED TO PER COMMENTS, NEMA SOCKET, 03/15/2022	
ARTERIAL & RESIDENTIAL	
SINGLE NODE WIRING DIAGRAM FOR COBRA AND PIGGY BACK	
CITY OF CHICAGO	
OWNER	NO. 989
DESIGNER	DATE
CHECKED BY	PROJECT NO.
APPROVED BY	PROJECT NO.
DEPT. CHIEF	PROJECT NO.
DEPUTY CHIEF	PROJECT NO.
SCALE: NONE	DATE: 03/15/2022



- NOTES
 A- GROUND TERMINAL BLOCK
 B- COBRA SHUNT CAP
 C- DRIVER
 D- PIGGY BACK ACORN
 E- QUICK CONNECT

REVISED BY THE CONSULTANT:	DATE
A	03/15/2022
REVISION	
AERIAL ARTERIAL	
240V	
SINGLE NODE WIRING DIAGRAM	
FOR COBRA AND PIGGY BACK	
CITY OF CHICAGO	
DEPT. OF PUBLIC WORKS	
DIVISION OF ELECTRICAL ENGINEERING	
DESIGNED BY:	ENGINEER
K. AKALAM	E. AKALAM
REGISTERED PROFESSIONAL ENGINEER	REGISTERED PROFESSIONAL ENGINEER
NO. 0417333	NO. 0417333
SUPERVISING ENGINEER	ENGINEER
DR. J. J. J. J.	DR. J. J. J. J.
REGISTERED PROFESSIONAL ENGINEER	REGISTERED PROFESSIONAL ENGINEER
NO. 0417333	NO. 0417333
CHIEF OF ELECTRICAL	CHIEF OF ELECTRICAL
DR. J. J. J. J.	DR. J. J. J. J.
REGISTERED PROFESSIONAL ENGINEER	REGISTERED PROFESSIONAL ENGINEER
NO. 0417333	NO. 0417333
DEPUTY COMMISSIONER	DEPUTY COMMISSIONER
DR. J. J. J. J.	DR. J. J. J. J.
REGISTERED PROFESSIONAL ENGINEER	REGISTERED PROFESSIONAL ENGINEER
NO. 0417333	NO. 0417333
SCALE: NONE	DATE: 03/15/2022



TOP VIEW

MATERIAL:

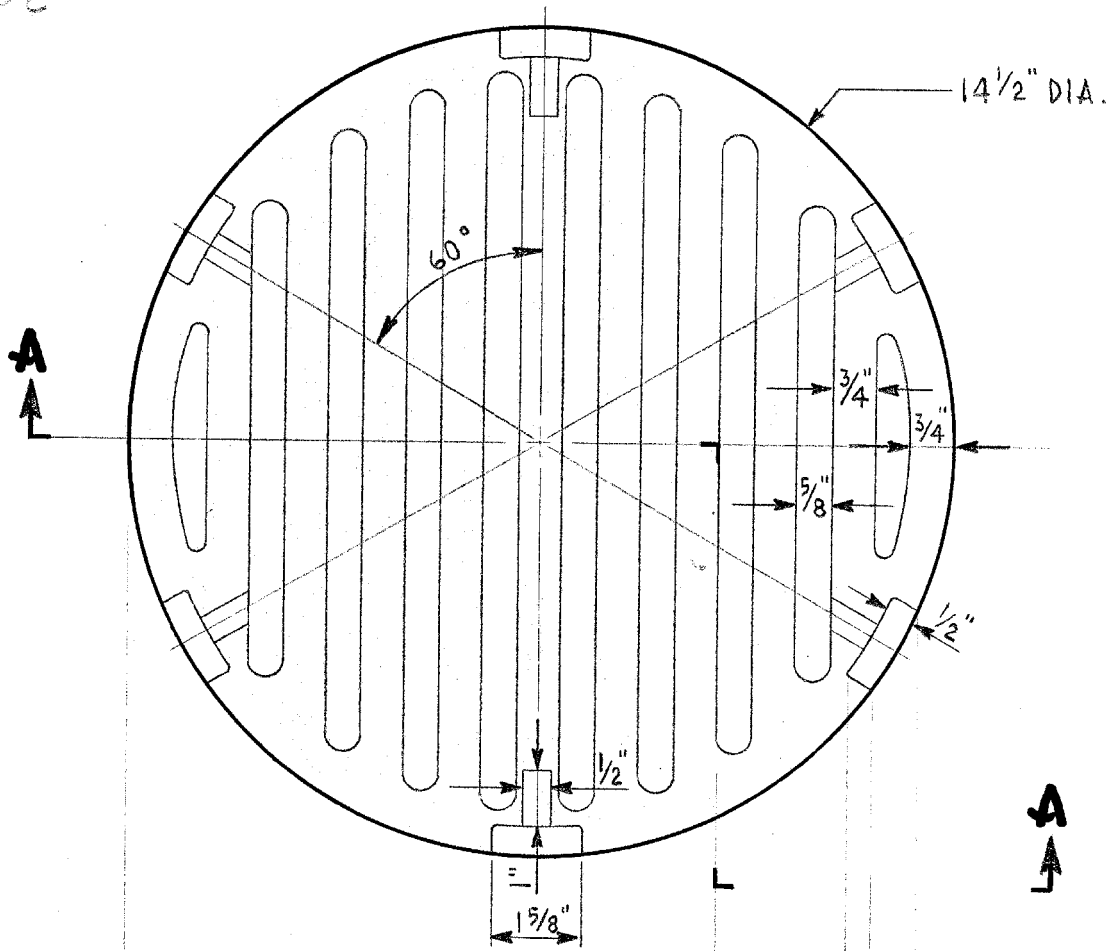
S.A.E. 1035 HOT ROLLED STEEL.
HOT GALVANIZED ZINC COATING
0.002 INCH THICK OVER ENTIRE
SURFACE.

RE-DRAWN

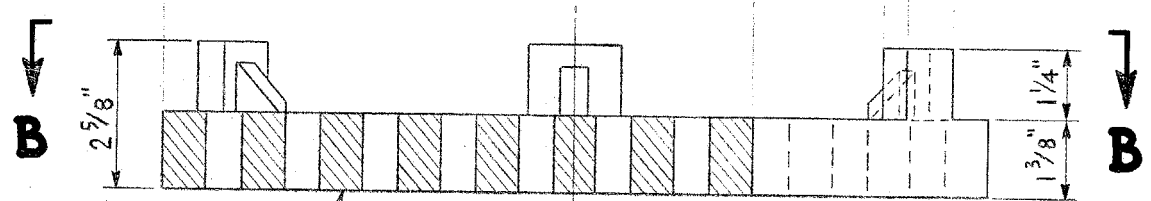
PULLING IRON

REVISED		CITY OF CHICAGO		
		DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
B		DRAWN	CHECKED	ENGINEER
C		E. GERULIS	M. SHANE	J. O'CONNOR
D		ENG. OF ELEC.		DRG. NO.
E		<i>Edward Butler</i> Supt. of Govt.		7878
F		<i>Joseph Fluschey</i> DEPT. COMM.		
G		<i>Charles C. Bumbly</i>		
		SIZE 8 1/2" X 14"	SCALE: 1/2" = 1"	DATE 11-30-73

86



BOTTOM VIEW B-B

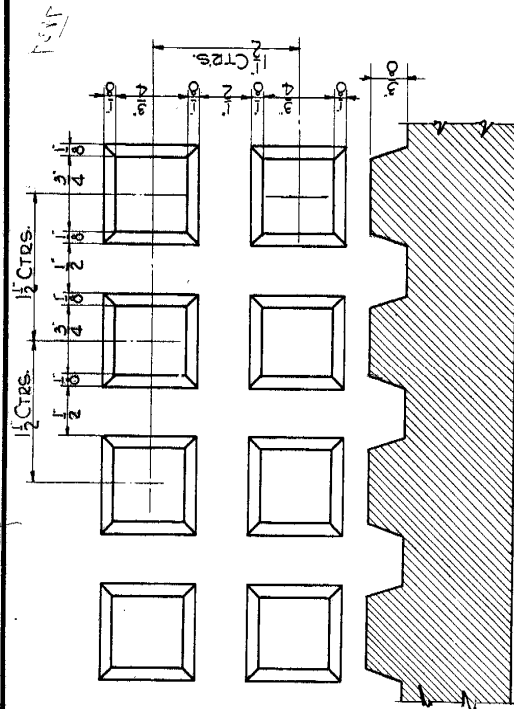


TOP OF GRATE

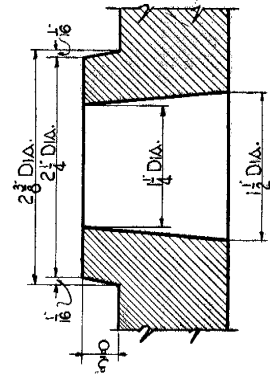
SIDE VIEW A-A

MATERIAL: CAST IRON
 APPROX. WT.: 34 LBS.

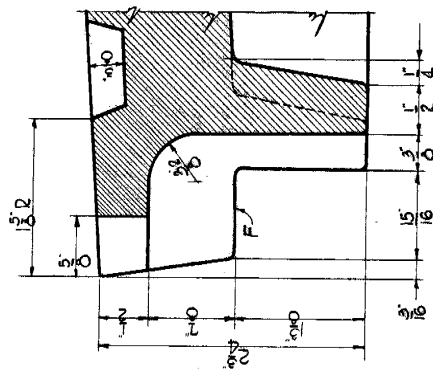
		CITY OF CHICAGO		
		DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
REVISED		DRAWN	CHECKED	ENGINEER
A	11-30-73	E. GERULIS	M. SHINE	J. O'CONNOR
B		ENG. OF ELEC.		DRG. NO.
C		<i>[Signature]</i>		10792
D		Supt. of Const.		
E		DEPT. COMM.		
F		<i>[Signature]</i>		
G		SIZE	SCALE:	DATE
		8 1/2" x 14"	3/8" = 1"	11-30-73



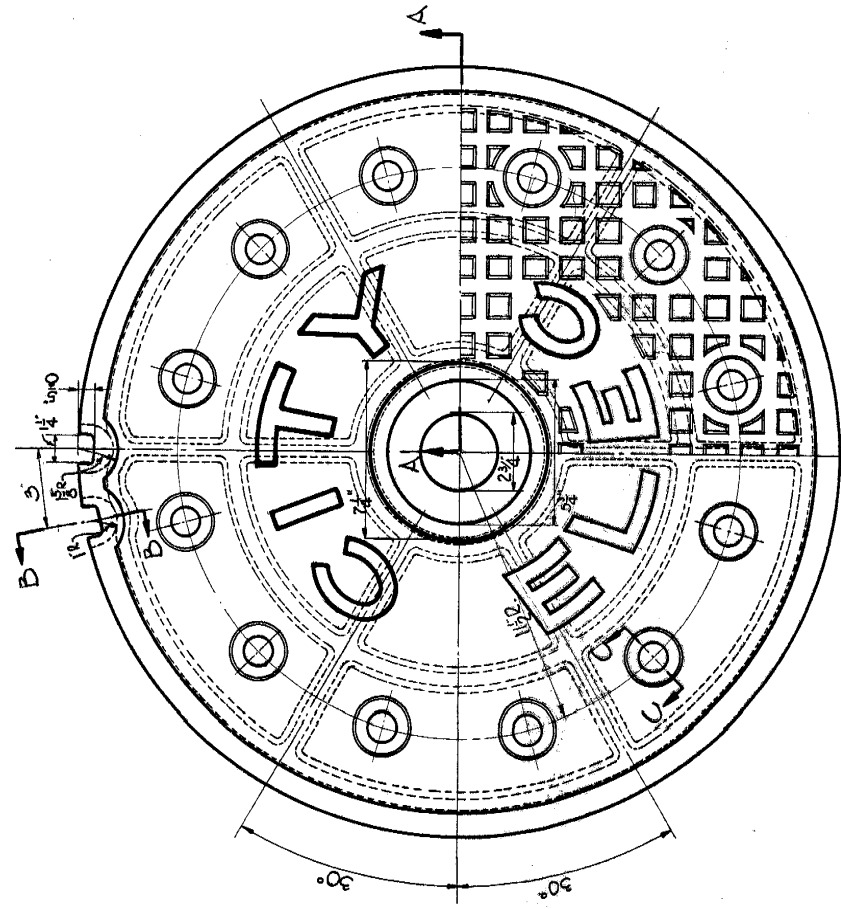
DETAIL OF CORRUGATIONS



SECTION C-C



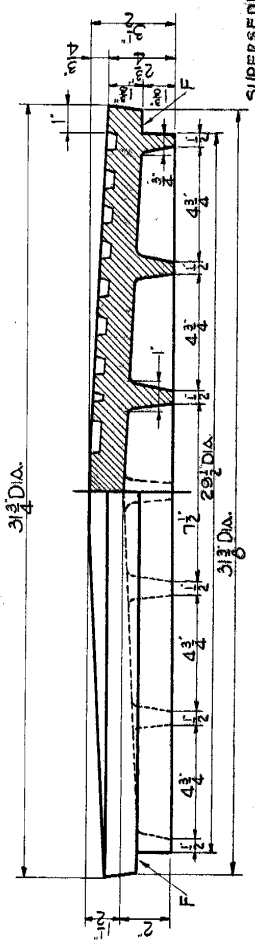
SECTION B-B



PLAN

MATERIAL - CAST IRON
ESTIMATED WEIGHT 315 LB.

F-DENOTES BEARING SURFACE SHALL
BE MACHINED SMOOTH.



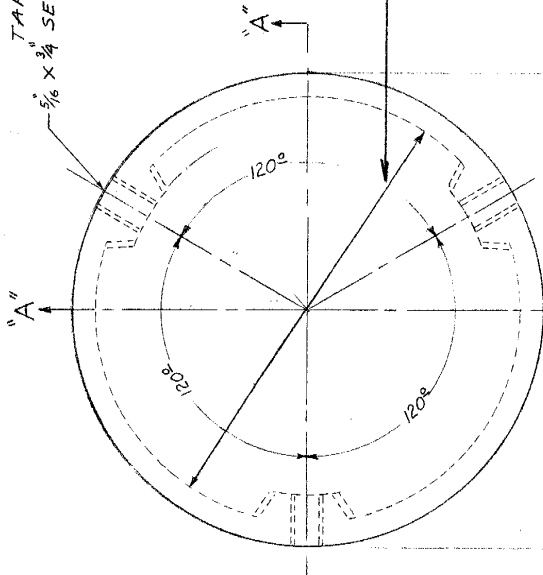
HALF ELEVATION

HALF SECTION A-A

SUPSEDES DRG. 7223-DATED 6-29-10
COMMODITY CODE
02-4574-5630

C	WEIGHT REVISED
B	WEIGHT REVISED
A	IDENTIFICATION LETTERS ON COVER CHANGED
30" CIRCULAR STREET MANHOLE COVER	
REVISED	CITY OF CHICAGO
A 12-7-55	DEPT. OF STREETS AND SANITATION
B 9-7-79	DIVISION OF ELECTRICAL ENGINEERING
C 8-9-85	M. ZOLESKI
D	<i>[Signature]</i>
E	<i>[Signature]</i>
F	<i>[Signature]</i>
G	<i>[Signature]</i>
H	<i>[Signature]</i>
I	<i>[Signature]</i>
J	<i>[Signature]</i>
K	<i>[Signature]</i>
L	<i>[Signature]</i>
M	<i>[Signature]</i>
N	<i>[Signature]</i>
O	<i>[Signature]</i>
P	<i>[Signature]</i>
Q	<i>[Signature]</i>
R	<i>[Signature]</i>
S	<i>[Signature]</i>
T	<i>[Signature]</i>
U	<i>[Signature]</i>
V	<i>[Signature]</i>
W	<i>[Signature]</i>
X	<i>[Signature]</i>
Y	<i>[Signature]</i>
Z	<i>[Signature]</i>
AA	<i>[Signature]</i>
AB	<i>[Signature]</i>
AC	<i>[Signature]</i>
AD	<i>[Signature]</i>
AE	<i>[Signature]</i>
AF	<i>[Signature]</i>
AG	<i>[Signature]</i>
AH	<i>[Signature]</i>
AI	<i>[Signature]</i>
AJ	<i>[Signature]</i>
AK	<i>[Signature]</i>
AL	<i>[Signature]</i>
AM	<i>[Signature]</i>
AN	<i>[Signature]</i>
AO	<i>[Signature]</i>
AP	<i>[Signature]</i>
AQ	<i>[Signature]</i>
AR	<i>[Signature]</i>
AS	<i>[Signature]</i>
AT	<i>[Signature]</i>
AU	<i>[Signature]</i>
AV	<i>[Signature]</i>
AW	<i>[Signature]</i>
AX	<i>[Signature]</i>
AY	<i>[Signature]</i>
AZ	<i>[Signature]</i>
BA	<i>[Signature]</i>
BB	<i>[Signature]</i>
BC	<i>[Signature]</i>
BD	<i>[Signature]</i>
BE	<i>[Signature]</i>
BF	<i>[Signature]</i>
BF	10927
BF	16"x21"
BF	4-534

TAP FOR
5/16" X 3/4" SET SCREWS

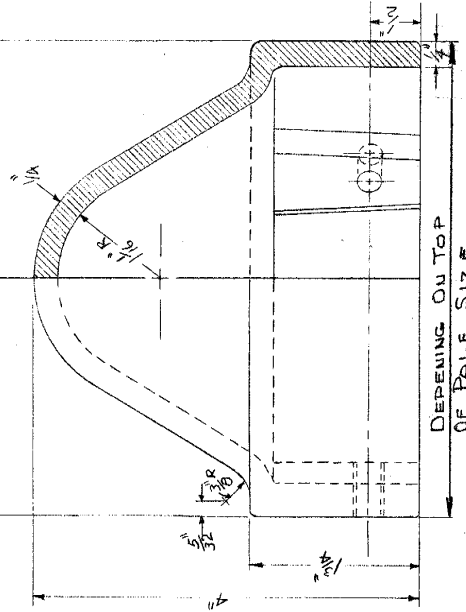


DIA., DEPENDING ON
TOP OF POLE SIZE

MATERIAL - CAST IRON OR
CAST ALUMINUM

NOTES:

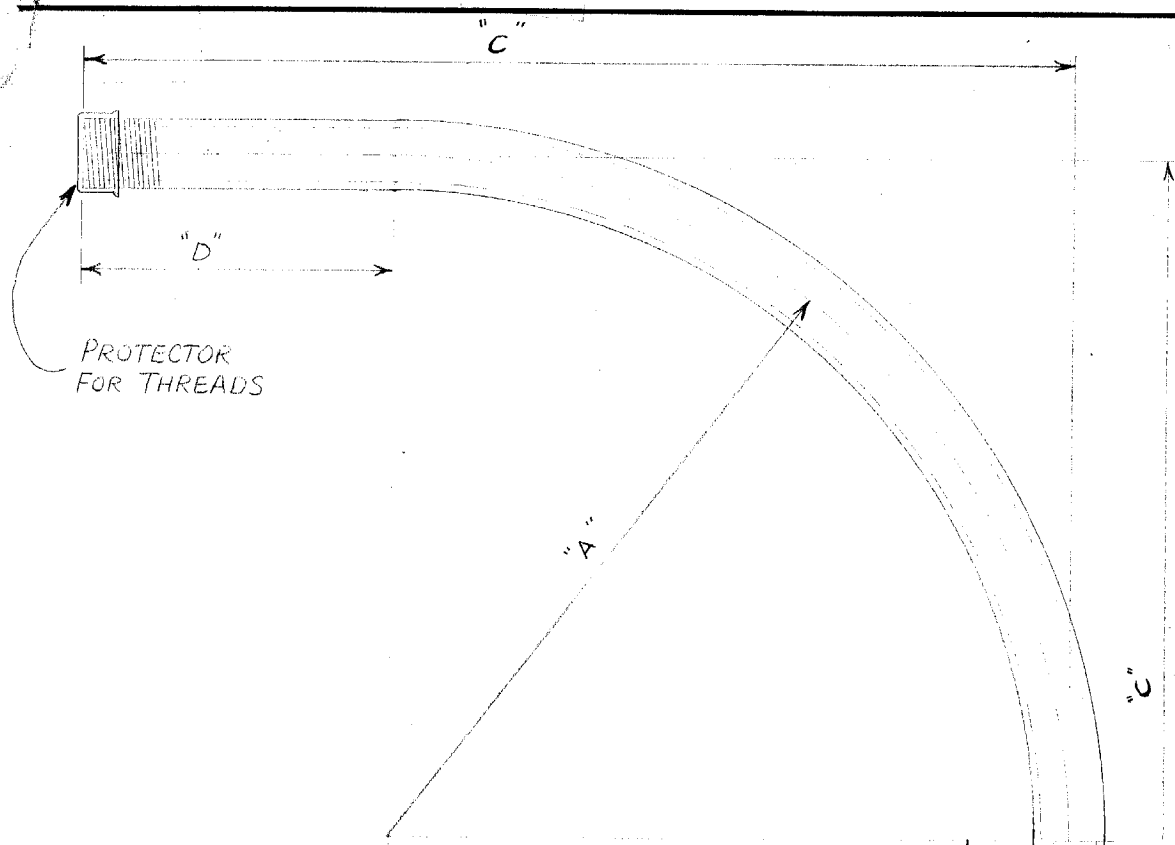
- A 3/8" x 16 x 3/4" STAINLESS STEEL SET SCREWS
TO BE FURNISHED WITH EACH TOP
- B FOR USE ON THE FOLLOWING SIZE POLES:
27'-6" - 3 AND 7 GAUGE
29'-6" - 3 AND 7 GAUGE
32'-6" - 3 AND 7 GAUGE
34'-6" - 3 AND 7 GAUGE 10"; 11" & 12 1/2" BASE DIAM.



SECTION "A-A"

CAST POLE TOP FOR STEEL POLE

REVISED	CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING		
A	2-13-85	DRAWN J. NELLA	ENGINEER A. Sulebky
B		CHECKED A. Sulebky	ENGINEER A. Sulebky
C		DESIGNED A. Sulebky	ENGINEER A. Sulebky
D		IN CHARGE A. Sulebky	ENGINEER A. Sulebky
E		BY A. Sulebky	ENGINEER A. Sulebky
F		BY A. Sulebky	ENGINEER A. Sulebky
G		BY A. Sulebky	ENGINEER A. Sulebky
DATE			10-9-69
SCALE			15" X 21"
NOT TO SCALE			
PROJECT NO.			11420-A



ELBOWS SHALL BEAR THE LABEL OF THE UNDERWRITERS LABORATORIES INC., AND MEET SPECIFICATIONS OF UNDERWRITERS LABORATORIES, INC. NO. 6, UNITED STATES OF AMERICA. STANDARDS INSTITUTE, C80.1 AND FEDERAL SPECIFICATIONS WW-C-581E AND WF-408C WHERE APPLICABLE.

NOTE:
TWO THREAD PROTECTORS TO BE FURNISHED ON EACH ELBOW, PROTECTOR TO COVER A MINIMUM OF TEN THREADS.

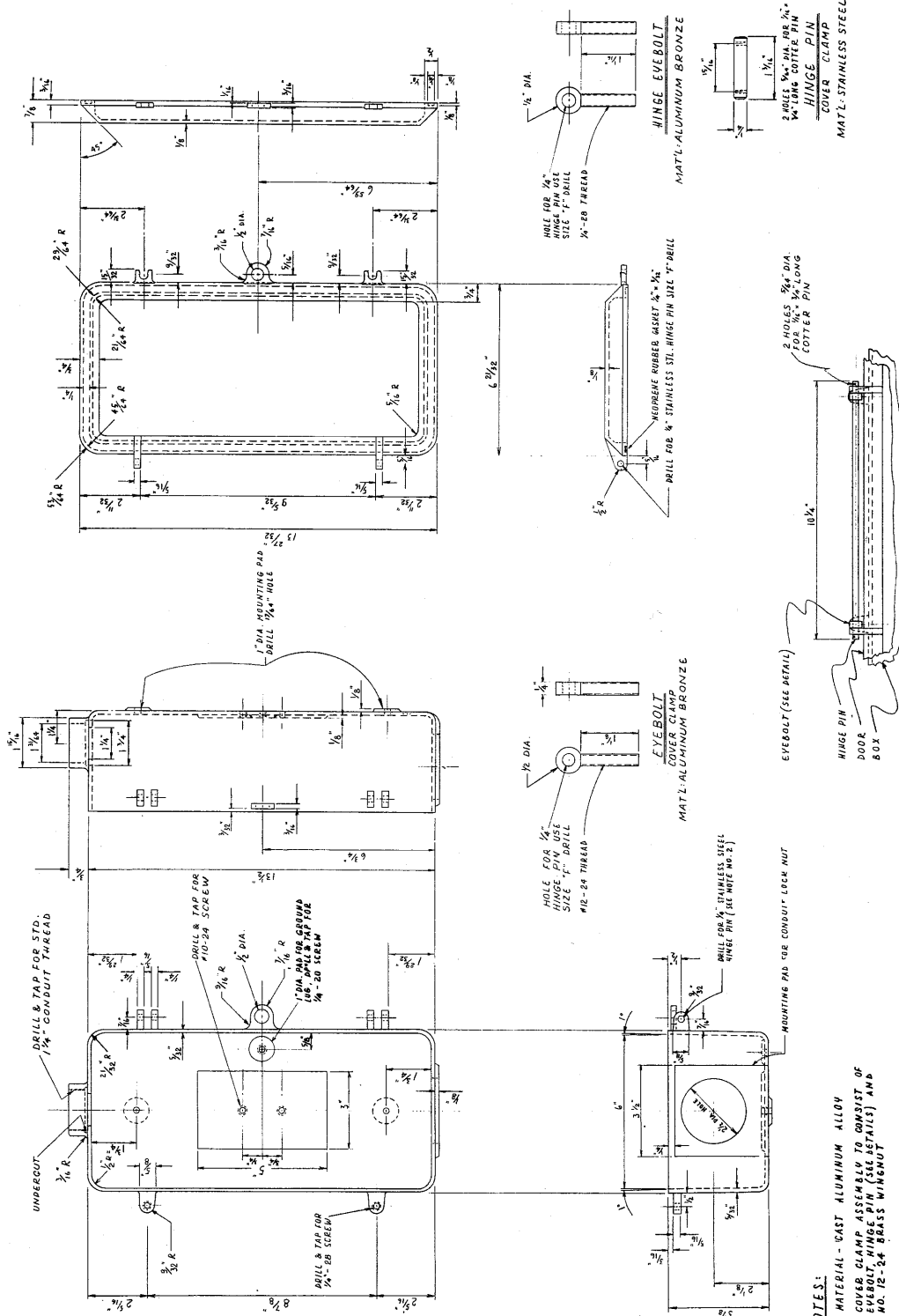
REAM BOTH ENDS TO REMOVE BURRS

TABLE OF DIMENSIONS				
CONDUIT SIZE	DIMENSIONS			COMMODITY CODE
	"A"	"C"	"D"	
1 1/4"	24"	35"	11"	09-4001-0510
1 1/2"	24"	35"	11"	09-4001-0520
2"	24"	35"	11"	09-4001-4126
2 1/2"	24"	35"	11"	09-4001-4128
3"	24"	35"	11"	09-4001-4230
4"	24"	35"	11"	09-4001-0000

B	SPECIFICATIONS REVISED		
A	REVISED DIMENSIONS ON 3" & 4" CONDUIT L.P.		
ELBOW, CONDUIT, RIGID GALVANIZED STEEL, LARGE RADIUS			
REVISED	CITY OF CHICAGO		
DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING			
A	7-22-71		
B	4-3-79		
C	DRAWN LON BURDY	CHECKED M.S.	ENGINEER M. SHINE
D	SUPERVISING ENGINEER		DRG. NO.
E	SUPERVISING ENGINEER		11825
F	SUPERVISING ENGINEER		
G	SIZE 8 1/2" X 14"	DEPUTY COMM. SCALE: 3/16"	DATE 6-2-71

BODY

COVER



- NOTES:**
1. MATERIAL - CAST ALUMINUM ALLOY
 2. COVER CLAMP ASSEMBLY TO CONSIST OF EYEBOLT, HINGE PIN (SEE DETAILS) AND NO. 12-24 BRASS WINGNUT

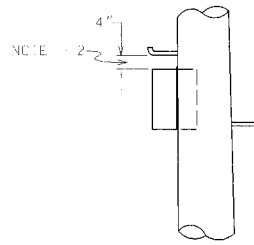
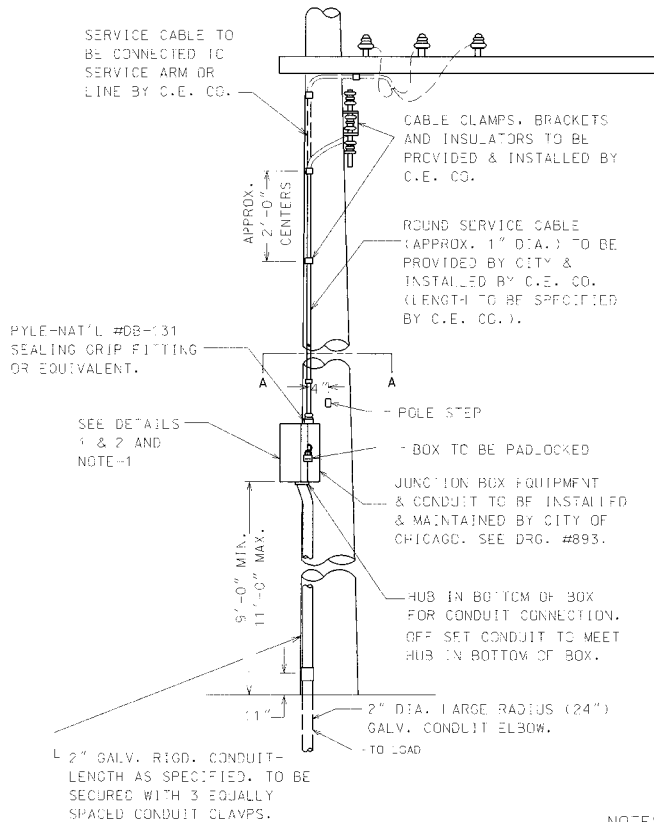
DATE	REVISION	DATE
A 5-7-57	DRIVER LUG & LUG BASE RELOCATED	100
WORK ORDER NO.	DATE	
COST ALLOCATION ACCOUNT	MATERIAL	
APPROPRIATION ACCOUNT	LABOR	

JUNCTION BOX
FOR ARTERIAL STREET
LIGHTING SERVICE
ON C. C. POLE

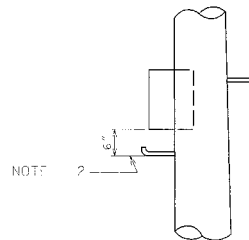
CITY OF CHICAGO
 DEPT. OF PUBLIC WORKS
 DIVISION OF ELECTRICAL ENGINEERING

DESIGNED BY: *[Signature]*
 DRAWN BY: *[Signature]*
 CHECKED BY: *[Signature]*
 APPROVED BY: *[Signature]*

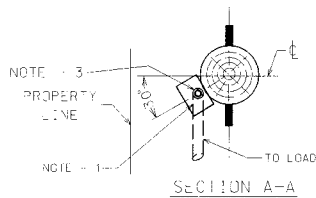
SCALE: 1" = 1"
 DATE: MAR. 1978
 DWG. NO.: 119211



DETAIL-1
BOTTOM POLE STEP ON
SIDE OF POLE OPPOSITE
JUNCTION BOX.

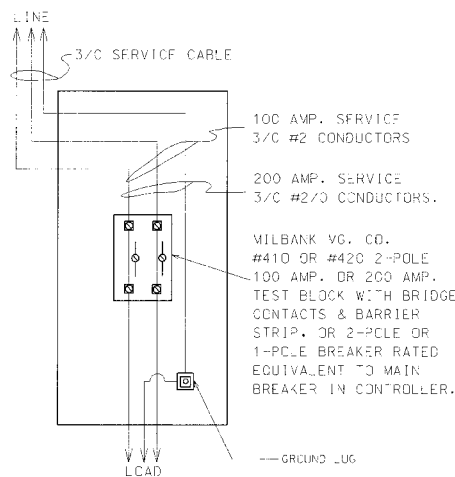


DETAIL-2
BOTTOM POLE STEP ON
JUNCTION BOX SIDE OF
POLE.



NOTES

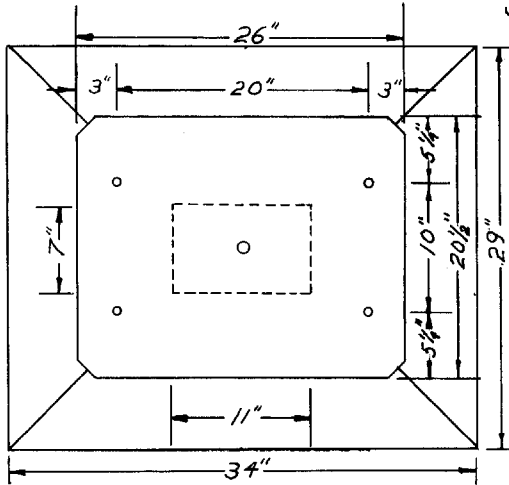
- 1 - WHERE POSSIBLE THE JUNCTION BOX SHALL BE LOCATED FACING THE PROPERTY LINE.
- 2 - BOX SHALL HAVE A MINIMUM CLEARANCE OF 4" BELOW POLE STEP, DETAIL-1, OR 6" ABOVE STEP, DETAIL-2.
- 3 - SERVICE CABLE TO ENTER BOX THROUGH SEALING GRIP FITTING IN TOP.



WIRING DIAGRAM OF
JUNCTION BOX MOUNTED
ON C.E. CO. POLE.

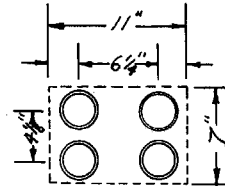
A	9-3-96	REDRAW	MP.
DATE	REVISION		
INSTALLATION OF SERVICE EQUIPMENT ON C.E. CO. WOOD POLES			
CITY OF CHICAGO DEPT. OF STREETS AND SANITATION BUREAU OF ELECTRICITY DIVISION OF ELECTRICAL ENGINEERING			
DRAFTSMAN:	CHIEF DRAFTSMAN:	ENGINEER:	
E. LEMASTER	J. BORE	J. BORE	
SUPERVISING ENGINEER:	ELEC. DESIGN ENGR.	DWG. NO.	
S.W. BERTRAM	<i>[Signature]</i>	11925	
ENGINEER OF ELECTRICITY:	GEN'L SUPT. OF ELECTRICITY:		
<i>[Signature]</i>	<i>[Signature]</i>		
DEPUTY COMMISSIONER:	DATE: 12-26-96		
SIZE:	SCALE:		

CODE	DRG. NO.	MATERIAL	SIZE	REQ'D
0574-6580		SAND		8 BAGS
0581-8470		STONE		12 BAGS
0520-2650		CEMENT		4 BAGS
1412-8640		BOLT	3/4" X 16"	4
0978-9200		GROUND ROD	3/4" X 10'	1
2726-7635	11825	CONDUIT ELBOW	3" X 30'R.	4
3945-7300		CONDUIT NIPPLE	3" X 16"	2
3945-7300		CONDUIT NIPPLE	3" X 20"	2
0911-9140		BUSHING	3"	4



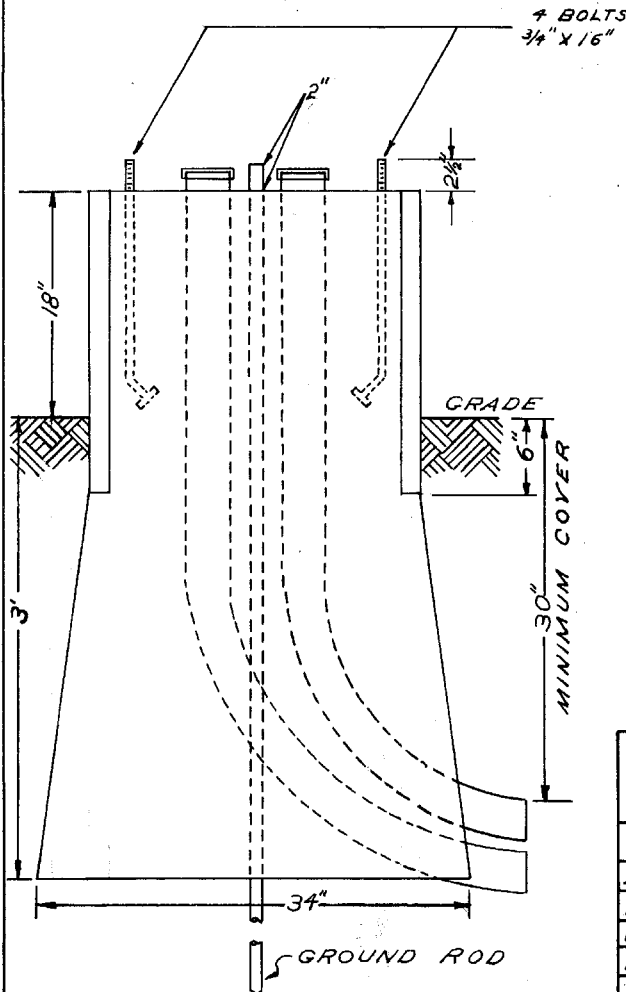
NOTE

CONFINE CONDUIT TO AREA ENCLOSED BY DASHED LINE



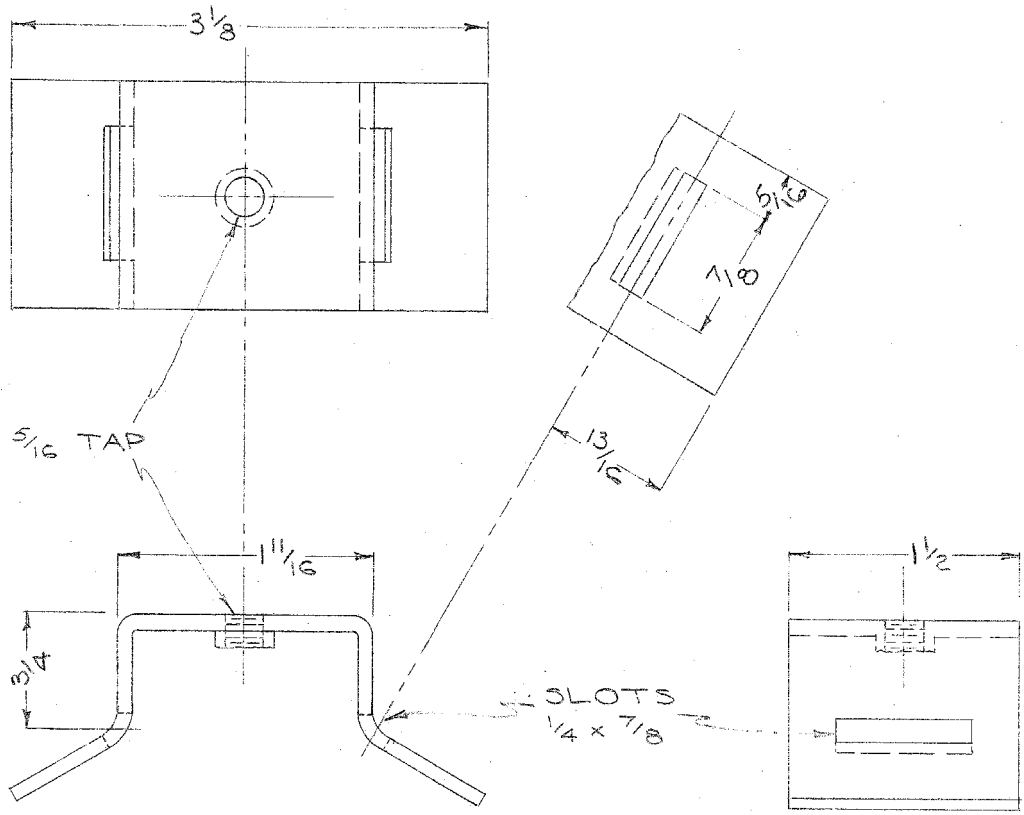
TYPICAL CONDUIT ARRANGEMENT OF 4-3" CONDUITS

CONDUIT TO EXTEND A MINIMUM OF 1" & A MAXIMUM OF 2" ABOVE FOUNDATION



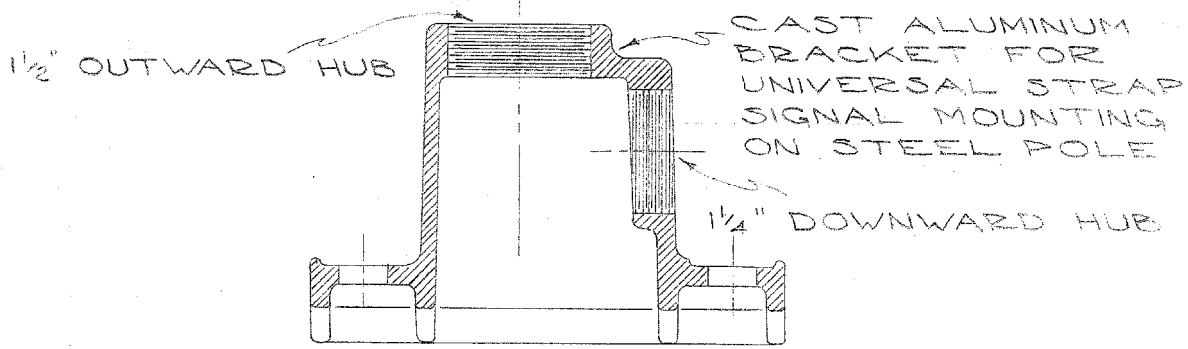
FOUNDATION FOR TYPE-B TERMINAL CABINET			
REVISION	CITY OF CHICAGO		
A	5-13-1981	DEPT. OF STREET & SANITATION	
B		DIVISION OF ELECTRICAL ENGINEERING	
C		DRAWN	CHECKED
D		H. KERR	JOHN W. BRIGHT
E		ENGINEER	
F		R. M. PARTLIN	
G		D.R.G. NO.	
		11972	
		DATE 3-2-59	
		SIZE 8 1/2 X 14"	
		SCALE 1" = 1'	

BANDING FITTING FOR POLE MOUNTING JUNCTION BOX



MATERIAL: STAINLESS STEEL - 4 13/16 x 1/2 x 3/32

BANDING FITTING FOR POLE MOUNTING SIGNALS



MATERIAL: CAST ALUMINUM

CROUSE HINDS
 TL-3301-WITHOUT DOWNWARD
 HUB
 TL-3302 WITH 1/4" DOWNWARD
 HUB

BANDING FITTINGS
 FOR
 POLE MOUNTING
 TRAFFIC SIGNAL

CITY OF CHICAGO
 DEPT. OF STREETS AND SANITATION
 DIVISION OF ELECTRICAL ENGINEERING

DESIGNED BY S. NETTI	CHECKED BY [Signature]	DATE 11-14-27
APPROVED BY [Signature]		PROJECT NO. 11934
TITLE DEPUTY COMM.		SCALE 3/8" x 1/4" 11-14-27

• 7 CONDUCTOR - 7 POINT STRIP.

7	COMMON WHITE
6	WHITE BLK. TR.
5	BLACK - SOLID
4	BLUE - "
3	RED - "
2	ORANGE - "
1	GREEN - "

• 10 CONDUCTOR - 7 POINT STRIP.

7	COMMON - WHITE
6	RED BLK. TR.
5	ORANGE BLK. TR.
4	GREEN BLK. TR.
3	RED - SOLID
2	ORANGE - "
1	GREEN - "

SOLID BLUE
SOLID BLACK
BLUE BLK. TR. } SPliced & TAPED

• 10 CONDUCTOR - 10 POINT STRIP.

10	COMMON - WHITE
9	BLUE BLK. TRACER *
8	BLACK - SOLID *
7	BLUE - SOLID *
6	RED BLK. TRACER
5	ORANGE BLK. "
4	GREEN BLK. "
3	RED - SOLID
2	ORANGE - SOLID
1	GREEN - SOLID

* - SOLID BLUE - GREEN LIGHT } IF USED
* - SOLID BLACK - AMBER
* - BLUE BLK. TR. RED

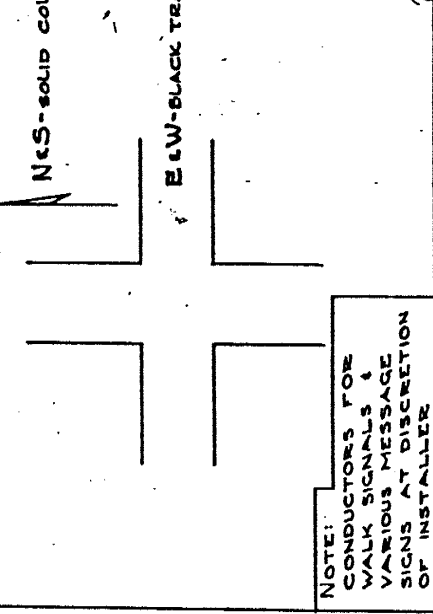
• 14 CONDUCTOR - 10 POINT STRIP.

10	COMMON WHITE
9	RED WHITE TRACER
8	ORANGE "
7	GREEN "
6	RED BLACK TRACER
5	ORANGE "
4	GREEN "
3	RED - SOLID
2	ORANGE - SOLID
1	GREEN - SOLID

• 14 CONDUCTOR - 14 POINT STRIP.

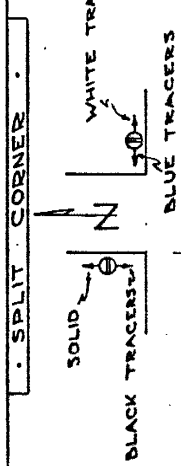
14	COMMON WHITE
13	BLACK
12	RED - BLUE TRACER
11	ORANGE - "
10	GREEN - "
9	RED - WHITE TRACER
8	ORANGE - "
7	GREEN - "
6	RED - BLACK TRACER
5	ORANGE - "
4	GREEN - "
3	SOLID RED
2	SOLID ORANGE
1	SOLID GREEN

• STRAIGHT CORNER.



• 22 CONDUCTOR - CODE.

1	WH	REDY BLACK TR. COMMON
2	WH	REDY GREEN TR. COMMON (SPARE)
3	R	BLACK TR. NO. SOUND
4	A	" " " "
5	G	" " " "
6	R	SOLIDS SO. SOUND
7	A	" " " "
8	G	" " " "
9	BK	NEON OR ARROW
10	R	BLUE TR. EAST SOUND
11	A	" " " "
12	G	" " " "
13	R	WHITE TR. WEST SOUND
14	A	" " " "
15	G	" " " "
16	BL	SOLID - SPECIAL
17	BL	AMBER TR - "
18	BL	WHITE TR - "
19	WH	RED TR - "
20	WH	SOLID - "
21	WH	BLACK TR - "
22	BK	WHITE TR - "



TRAFFIC CONTROL SIGNALS STRIP WIRING LAYOUT

REVISED	CITY OF CHICAGO
A 5-4-61	DEPT OF STREETS AND SANITATION
B 11-10-64	DIVISION OF ELECTRICAL OPERATION
C	DESIGNED BY: <i>W. J. ...</i>
D	CHECKED BY: <i>W. J. ...</i>
E	DATE: <i>12/26/64</i>
F	PROJECT NO.: <i>12268-A</i>
G	DATE: <i>1-9-56</i>