

DETAILED SPECIFICATIONS FOR ELECTRICAL CONSTRUCTION
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DEFINITIONS & ABBREVIATIONS

Whenever in the specifications, or in any documents or instruments in construction operations where the specifications govern, the following abbreviations, terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Abbreviations

AASHTO	The American Association of State Highway and Transportation Officials
ANSI	The American National Standards Institute
ASTM	The American Society of Testing and Materials
AWG	American wire gauge
HDPE	High-density polyethylene
IES	Illuminating Engineering Society
LED	Light emitting diode
NEMA	The National Electrical Manufacturer's Association
NRTL	Nationally Recognized Testing Laboratory
NEC	National Electrical Code
PVC	Polyvinyl chloride
SDR	Standard dimension ratio
UL	Underwriters Laboratories, Inc.
WisDOT	Wisconsin Department of Transportation

Definitions

1. Change Order shall be understood to mean a written order by the authorized representative of the Owner covering work not otherwise provided for, revision in or amendments to the Contract, or conditions specifically prescribed in the specifications as requiring contract change orders. Such document becomes part of the Contract.
2. City, Municipality, Owner shall be understood to mean the City of Fond du Lac, Wisconsin.
3. Contractor shall be understood to mean the individual, firm, partnership or corporation or a combination of any or all jointly submitting a proposal to whom the Contract is awarded by the Owner or its heirs, executors, administrators, successors, or assigns.
4. Contract shall be understood to mean the written agreement between the Owner and the Contractor setting forth the obligations of the parties to the contract, including, but not limited to, performance of the work, furnishing of labor and materials, and basis of payment. The Contract includes the advertisement for bids, proposal, contract form, performance bond, detailed specifications, special provisions, addenda, general plans, detailed plans, notice to proceed, and contract change orders and agreements required to complete the construction of the work in an acceptable manner, including authorized extensions, all of which constitute one instrument.
5. Engineer shall be understood to mean the City Engineer of the City of Fond du Lac, Wisconsin or any person designated by the City Engineer to perform a particular task. The Engineer shall have the full decision-making authority on behalf of the City as described or reasonably implied in this Contract.
6. Plans shall be understood to mean all drawings or reproductions of drawings, including profiles, sections, and sketches which have been made for the purpose of representing the work to the Contractor, all of which are to be considered a part of the Contract. Plans and drawings are used synonymously.
7. Special Provisions shall be understood to mean the special body of directions, provisions, or requirements peculiar to a project, and otherwise not thoroughly or satisfactorily detailed or

described in the specifications. The requirements of these Special Provisions shall govern the work and shall take precedence over the specifications or plans whenever they conflict.

GENERAL REQUIREMENTS FOR ELECTRICAL CONSTRUCTION

Scope

This section describes general requirements for electrical construction.

General Requirements

Specifications

Any items not covered within the Detailed Specifications for Electrical Construction, Special Provisions, or the standard detail drawings shall conform to the requirements in latest edition of the WisDOT *Standard Specifications for Highway and Structure Construction* and the WisDOT standard detail drawings. All work shall conform to the current edition of the NEC adopted by the State of Wisconsin.

Locating and Protecting Facilities

The Contractor shall be responsible for protecting and locating the electrical conduit and wiring for Diggers Hotline locates until acceptance of the electrical system by the Owner.

Project Closeout Requirements – Record Drawings

The Contractor shall provide as-built street lighting, traffic signal, fiber optic and communication system plans to be approved by the Owner, which include all plan changes after the project is complete before final payment will be made. Required information is the final location of electrical services, street lights, traffic signals, access boxes, pull boxes, and conduit; conduit size and type; and wire and cable type and location. All changes to the plan details shall be redlined and labeled on the record drawings.

Materials

Submittals

The Contractor shall submit to the Engineer 2 copies of current manufacturer's specifications, mix designs, sieve and fracture analyses and construction details for review prior to installation or fabrication. All submittals shall be provided a minimum of 2 weeks before a proposed material will be used or a structure will be constructed or installed. Each submittal shall indicate the proposed material or structure, compliance with specified standard(s), supplier and manufacturer's name, address and phone number. The Contractor may consider a submittal reviewed upon receiving written approval from the Engineer. Any submittal rejected by the Engineer shall be resubmitted for approval prior to installation or fabrication. No materials subject to construction detail review shall be ordered prior to receipt of an approved submittal. Materials installed shall match approved submittals. The Owner reserves the right to randomly sample and test at any time during the project.

Material Certification

Provide UL or NRTL listed electrical materials or obtain the Engineer's approval for materials that do not have a UL or NRTL standard.

Substitution of Materials

Whenever, in any part of the Contract documents, an article, material, or equipment is defined by a proprietary product, or by using the name of a manufacturer or vendor, the term "or equal", if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired and shall not be construed in such manner as to exclude manufacturer's products of comparable quality, design, and efficiency.

The Contractor shall submit plans, manufacturer's data, shop drawings, specifications, test results, certifications, or other pertinent data for any materials other than those covered by the contract documents. In all cases the proposed substitute must be approved by the Engineer in writing. The Engineer shall have the sole discretion to make this determination. In the event of such substitution, the Owner may require from the Contractor a credit deduction from the contract amount equal to any saving in material cost resulting from use of the proposed substitute.

Construction

Salvaged Lighting and Traffic Signal Equipment

Whenever the plans and/or Special Provisions call for lighting or traffic signal equipment to be salvaged and returned to the Owner or reinstalled, arrange for an inspection of all equipment by the Owner no later than 5 business days prior to removal. This inspection is intended to provide an inventory and assessment of the original condition of the equipment and to determine what equipment the Owner would like to retain or reinstall.

At the direction of the Engineer, carefully disconnect, disassemble, remove and stockpile all lighting and traffic signal equipment. Dispose of any lighting and traffic signal equipment that the Owner does not want to retain or reinstall. Stockpile any lighting and traffic signal equipment to be reinstalled at an approved location. Replace any lighting and traffic signal equipment to be retained or reinstalled that is damaged in the removal, storage or reinstallation process with equipment that is of equal quality to that of the damaged piece. Remove from the right-of-way and dispose of any damaged equipment. Remove and dispose of all other equipment from the right-of-way. Contact the Engineer to coordinate an acceptable location to stockpile lighting and traffic signal equipment to be retained for the Owner to pick up.

Sign Clearance

Whenever signs will be mounted on street light or traffic signal poles, the Contractor shall ensure that the signs, pedestrian signals and traffic signals all maintain a minimum clearance of 7 feet from the final ground surface to the bottom of the sign, pedestrian signal or traffic signals, unless approved otherwise by the Engineer.

Unused Pole Connection Points

Plug any existing holes in poles if a connection point is in a different location using a watertight cap of the same color as the pole as approved by the Engineer.

Final Hookup

Upon completion of the conduit, wire and cable, pole, and service installations; hard wiring of the luminaires; electrical testing; and inspection and approval by the City of Fond du Lac Electrical Division, the Contractor will connect the service and light the system.

Basis of Payment

No separate payment will be made for work covered in this section, unless noted otherwise. All costs shall be included in the unit price of work it is associated with. The word installation is used in the names of bid items where some or all of the materials will be provided by the Owner as specified in the basis of payment for that work item.

ELECTRICAL STRUCTURES

Scope

This section describes providing and installing electrical and fiber optic access boxes and pull boxes.

General Requirements

The Contractor shall submit manufacturer's data for the access boxes and pull boxes.

Materials

Foundation Materials

Use well graded coarse aggregate conforming to the following gradation requirements:

Table 1
Foundation Material (AASHTO M43 – Size No. 4)

U.S. Standard Sieve Size	Percent Passing by Weight
2 Inch	100
1½ Inch	90-100
1 Inch	20-55
¾ Inch	0-15
⅝ Inch	0-5

Plastic Electrical Access Box Assemblies

1. Use a plastic electrical access box listed below:
 - A. Black, 12 inch high, Highline Energy Products Standard Electric Boxes with black snap lock lid by Oldcastle Infrastructure.
2. Use a plastic access box listed below whenever the plans require the use of a large plastic electrical access box:
 - A. Black Highline Energy Products Jumbo Electric Boxes with black snap lock lid by Oldcastle Infrastructure.

Polymer Concrete Electrical Access Box Assemblies

1. Use a polymer concrete access box listed below:
 - A. 12 inch long, 12 inch wide, and 12 inch high Highline Energy Products Polymer Concrete Flushmount Pull Boxes by Oldcastle Infrastructure with a Tier 15 load rating.
 - B. 12 inch long, 12 inch wide, and 12 inch high tapered Fiberglass / PCX Polymer Concrete Assembly by Newbasis with “Electric” nameplate installed.
 - C. 15 inch long, 10 inch wide, and 18 inch high flared wall polymer concrete box by Quazite with a Tier 15 load rating.
2. Use a polymer concrete access box listed below whenever the plans require the use of a large polymer concrete electrical access box:
 - A. 24 inch long, 13 inch wide, and 12 inch high Highline Energy Products Polymer Concrete Flushmount Pull Boxes by Oldcastle Infrastructure with a Tier load 15 rating.

- B. 24 inch long, 13 inch wide, and 12 inch high Fiberglass / PCX Polymer Concrete Assembly by Newbasis with “Electric” nameplate installed.
- C. 24 inch long, 13 inch wide, and 18 inch high flared wall polymer concrete box by Quazite with a Tier 15 load rating.

Steel Pull Boxes

1. Use corrugated steel pipe conforming to **AASHTO M36** of the size indicated on the plans.
2. Use grounding lugs and stainless steel mechanical connectors approved for copper wire.
3. Use a Neenah R-5900 series frame, with a solid lid with the word “ELECTRICAL” cast in the cover, and sized to fit the pull box size.

Non-Conductive Pull Boxes

1. Use non-conductive handholes, frames, lids, and extensions listed on the WisDOT electrical qualified products list for “Non-Conductive Pull Boxes.”
2. Non-conductive pull boxes shall meet the requirements of the WisDOT specification “653 Non-Conductive Pull Boxes – Material Specification.”

Fiber Optic Access Boxes

Use one-piece polymer concrete vaults with minimum dimensions of 24 inches by 36 inches and at least 24 inches high, unless indicated otherwise. Lids shall have a 15,000 pound minimum design load, water resistant gaskets, 2 slots measuring ½ inch by 4 inches for a pull out, and enough metal to detect with a metal detector. Lock vault lids with 2 stainless steel bolts with washers.

Fiber Optic Tracer Wire Marker Posts

Use fade resistant, ultraviolet stable, high-impact polycarbonate tracer wire marker posts a minimum of 62 inches long with an outside diameter of 3.5 inches and with “WARNING FIBER OPTIC CABLE BELOW” molded into the marker. Posts shall have stainless steel hardware, 5 standard terminals, a terminal enclosure for cathodic protection, and an anchor bar.

Construction

Access Boxes

1. Use plastic electrical access boxes or non-conductive pull boxes in restoration areas with pervious surfaces.
2. Use polymer concrete electrical access boxes or non-conductive pull boxes in areas with impervious surfaces.
3. Install access boxes on a 12 inch deep granular foundation meeting the gradation requirements of **Table 1**.
4. Place access boxes flush with the proposed finished ground grade.

Pull Boxes & Non-Conductive Pull Boxes

1. Install pull boxes on a 12 inch deep granular foundation meeting the gradation requirements of **Table 1**.
2. Grounding lugs and wire shall conform to the detail drawings.
3. Pull boxes shall not be installed in asphalt pavement. A concrete pad with a width at least 12 inches greater than the outside diameter of the pull box cover shall be placed when pull boxes are within asphalt pavement areas. Concrete pads shall be a minimum of 7 inches in depth in roadways or as directed by the Engineer. Asphaltic overlay of concrete pavement is acceptable.

Fiber Optic Access Boxes

1. Install fiber optic access boxes on a 12 inch deep granular foundation meeting the gradation requirements of **Table 1**.
2. Install any additional openings in vaults according to manufacturer's specifications. Ensure that gaps between the conduit and vault are not greater than ½ inch. Caulk gaps on both the inside and the outside of the vault. Cure caulk according to manufacturer's specifications before backfilling. Install conduit into side of structure when depth allows. Stub conduit 3 inches into structure.
3. Install cable support brackets when required.
4. Place fiber optic access boxes flush with the proposed finished ground grade.

Fiber Optic Tracer Wire Marker Posts

1. Install tracer wire marker posts when required on the plans.
2. Install posts so that they cannot be pulled out or removed manually.
3. Install conduit into the access point and connect the tracer wire to the tracer wire marker post terminals.

Basis of Payment

1. Access boxes, pull boxes, and non-conductive pull boxes shall be measured separately by each individual unit completed and accepted.
2. Payment for the electrical access box bid items is full compensation for providing materials; and for excavating, backfilling, and restoring the grade.
3. Payment for the electrical access box installation bid items is full compensation for providing materials; and for excavating, backfilling, and restoring the grade. The access box will be supplied by the Owner.
4. No additional compensation will be made when a standard size plastic or polymer concrete electrical access box is specified and the Contractor elects to install a non-conductive pull box or a larger sized electrical access box.
5. Payment for the pull box and non-conductive pull box items is full compensation for providing pull boxes; for materials including grounding lugs and wiring; for aggregate, manhole frames and covers; for required pull box extensions; conduit extensions less than 10 feet long including fittings; and for excavating and backfilling.
6. Payment for the fiber optic access box bid items is full compensation for providing materials, including marker posts; and for excavating, backfilling, and restoring the grade.
7. Payment for the fiber optic access box installation bid items is full compensation for providing materials; and for excavating, backfilling, and restoring the grade. The access box and marker posts will be supplied by the Owner.

ELECTRICAL CONDUIT

Scope

This section describes providing and installing electrical conduit for electrical and communications wiring, including excavating and backfilling.

General Requirements

The Contractor shall submit manufacturer's data for the conduit and fittings.

Materials

1. Use materials conforming to the requirements for the class of the material named and specified below:
 - A. Schedule 40 PVC Conduit and Fittings **UL 651**
 - B. Schedule 80 PVC Conduit and Fittings **UL 651**
 - C. HDPE **ASTM F2160**.
2. Fittings shall be PVC, unless noted otherwise. Use PVC fittings of the same schedule as the PVC conduit they adjoin. Use fittings meeting manufacturer's specifications when using HDPE conduit.
3. HDPE conduit shall be red colored, smooth, SDR 13.5, solid-wall conduit rated for outdoor and underground use.
4. Conduit shall be clearly marked as follows at intervals of 5 feet or less:
 - A. Manufacturer's name or trademark.
 - B. ASTM or UL designation and material designation for HDPE conduit.
 - C. Nominal size.
 - D. Type, wall thickness, schedule or dimensional ratio.
 - E. Extrusion date, period of manufacture, or lot number.
5. Packaging, handling, and shipment of electrical conduit and fittings shall be in accordance with manufacturer's instructions and specifications. Any conduit damaged in shipment shall be replaced as directed by the Engineer.
6. Conduit and fittings shall be stored in the supplier's yard or on the project site in accordance with manufacturer's recommendations.

Construction

General

1. Conduit and fittings shall be schedule 40 PVC, unless otherwise noted.
2. Conduit and fittings at meter pedestals or locations exposed to the elements shall be schedule 80 PVC.
3. HDPE conduit shall be used where noted on the plans or approved by the Engineer.
4. Use conduit of the nominal inside diameter the plans show.
5. A tight glued coupling shall be provided at the connection of two straight pieces of PVC conduit.
6. Dead end conduit locations, the ends of conduit at each light pole and any underground openings on poles shall be plugged with an appropriate size PVC plug fitting.
7. The Contractor shall ensure that all curb and gutter is preserved during conduit installation. No additional payment will be made for replacement of damaged curb and gutter or other facilities.
8. Install conduit by plowing or trenching.
9. Use directional drilling when indicated on the plans.
10. A tracer wire shall be installed in any conduit not containing other wire or cable.
11. Repairs are not allowed. Remove broken, chipped, cracked, or impaired lengths of fittings or conduit and replace with new materials.

Staking

The Owner will stake the location of the proposed conduit. Any deviations from the staked location shall be approved by the Owner.

Location and Depth

1. Conduit shall be located where shown on the plans, standard detail drawings, or otherwise directed by the Engineer.

2. Conduit shall be installed along both sides of the street for the entire length of the project and shall extend around intersections to the point of tangency of adjoining streets, unless shown otherwise.
3. Conduit shall be placed across the street at various points as indicated on the plans. At the crossing points, conduit shall intersect with an underground access box.
4. Conduit shall be placed at a minimum 18 inches to a maximum 24 inches behind the back of the curb and gutter, unless directed otherwise.
5. Conduit shall be placed at a minimum 18 inches to a maximum 24 inches depth below the top of the adjacent curb and gutter or drive approach concrete.
6. Conduit installed under public roadways shall be placed a minimum of 24 inches below the road surface measured from the finished roadway grade to the top of the conduit.
7. Conduit installed for fiber optic or communications systems, including conduit designated for future fiber optic or communication cables, shall be placed between 30 inches and 36 inches below the final surface grade.

Hand-Formed Curb and Gutter

At hand formed curb locations, conduit will be placed within 4 inches of the back of the hand formed curb and at a minimum depth of 18 inches. The Contractor shall install the conduit in a manner that does not damage the curb and gutter or adjacent trees and so that the conduit is not placed under the curb and gutter.

Excavation

1. The excavation shall be limited to the size required for the installation of the conduit.
2. Excavate the trenches true to line and grade to provide uniform bearing.

Backfilling

1. Conduit shall be backfilled and compacted with screenings, $\frac{3}{4}$ inch gradation crushed aggregate base course, or sand. Native soils may be used with the permission of the Engineer.
2. Mechanical compaction is required at road crossings and whenever the conduit installation is performed by trench excavation. The Owner shall approve the compaction.

Traffic Signal Conduit

Traffic signal conduit shall be two 3-inch schedule 40 PVC conduits, unless shown otherwise.

Loop Detectors

1. Loop detector and lead-out conduit shall be 1 inch schedule 40 PVC conduit, unless shown otherwise.
2. Lead-in conduit shall be 2 inch schedule 40 PVC conduit.
3. Loop detector conduit shall be installed in the base course and shall be placed above any other conduit for street lighting, traffic signals or other purposes shown on the plans.

Basis of Payment

1. The electrical conduit items shall be measured by the lineal foot completed and accepted.
2. Payment for the electrical conduit items is full compensation for providing the conduit and fittings; for pull wires or ropes; for expansion fittings and caps; for plowing in the conduit; and for excavating, bedding, and backfilling, including any sand, concrete, or other required materials.
3. Payment for the directional drilling electrical conduit items is full compensation for providing the conduit and fittings; for pull wires or ropes; for expansion fittings and caps; for mobilizing directional drilling equipment; and for installing conduit using directional drilling. Directional drilling of conduit

shall be paid per bore where multiple conduit runs are installed in the same bore hole. Electrical wiring shall be paid separately.

4. Conduit at hand formed curb locations shall be paid under the applicable bid items for conduit. Any additional costs to install conduit at hand formed curb locations shall be included in the bid items for hand formed curb and gutter.
5. No additional payment will be made for installing conduit to any of the specified depths.
6. Fittings are considered incidental to the construction of the conduit, and will not be paid separately.
7. Conduit at horizontal or vertical sweeps at electrical services, access boxes, pull boxes, light poles or street light bases is incidental, and will not be paid separately unless noted otherwise.
8. Conduit at horizontal sweeps at light poles shall be paid per lineal foot whenever the distance between the center of the light pole and the conduit running parallel to the curb and gutter exceeds 3 feet.
9. Connections to existing conduit and connections to existing manholes, pull boxes, access boxes, communication vaults or other structures are incidental to the construction of the conduit, and will not be paid separately.

ELECTRICAL WIRING

Scope

This section describes providing and installing electrical wire and cable for traffic signal, roadway lighting, and other underground installations.

General Requirements

1. The Contractor shall submit manufacturer's data for the wire and cable.
2. Coordinate all wire and cable color assignments with the City of Fond du Lac Electrical Division. Unless indicated otherwise grounded conductor wires shall be white and equipment grounding wires shall be green.

Materials

Electrical Wire for Lighting

1. Use 600 volt 7 strand single conductor copper wire, XLP insulated, and USE-2 rated.
2. Provide wire sizes as shown on the plans and standard detail drawings.

Electrical Wire THHN/THWN

1. Use 600 volt 19 strand single conductor copper wire.
2. Provide wire sizes as shown on the plans and standard detail drawings.

Grounded Conductor for Traffic Signals

Use the white wire in the traffic signal cable, unless specified otherwise.

Equipment Grounding Conductor for Traffic Signals

Use 10 AWG or 8 AWG, or both, XLP, USE-2 rated, 600 volt AC, single conductor, stranded copper for conductors.

Tracer Wire

Use 12 AWG THWN stranded copper wire with green insulation or 12 AWG, 600 volt 7 strand single conductor copper wire, XLP insulated, and USE-2 rated.

Cable Type UF

Use type UF cable with ground including the number and size of conductors as shown on the plans and standard details drawings.

Traffic Signal Cable

1. Use 14 AWG cable with the number conductors specified on the plans.
2. Use 14 AWG cable with 7 conductors for wiring that extends from the terminal strip in each signal head to the mounting base.
3. All traffic signal cable shall conform to IMSA specification Number 20-1.

Loop Detector Wire

Use black 12 AWG, XLP insulated, USE-2 rated, single conductor, 7 strand copper wire.

Loop Detector Lead In Cable

Use shielded, 14 AWG, 2 conductor, polyethylene insulated cable, with 16 AWG drain wire conforming to IMSA specification number 50-2.

Emergency Vehicle Preemption Detector Cable

Use Opticom Model 1070 GPS Installation cable.

Video Detection System Cable

1. Provide cables and connectors required to transmit video and camera control data between the camera assembly and the camera controller assembly.
2. Use outdoor rated category 5e, or better, UTP cable with water-blocking flooded core and UV-resistant polyethylene jacket. Use cable consisting of 4-pairs of 24 AWG solid copper conductors and according to ANSI/TIA/EIA 5 68A Category 5e, CENELEC EN50173, ICEA S-90-661, and ISO/IEC 11801.
3. Use outdoor rated CSA, certified for outdoor use, 3-conductor 16 AWG power, UL listed cable in a UV resistant jacket. Furnish MSHA approved and RoHS compliant cable according to CSA flexible cord - C22.2-49.

Communication Cable

Use 6 pair, 18 AWG cable conforming to IMSA specification 20-6. Twist conductors 12 turns per foot by the individual pair.

Direct Burial Terminal Blocks

Use IlSCO PDSS series or Polaris ISPB series direct burial terminal blocks.

Insulated Terminal Blocks

Use IlSCO PBTS series or Polaris IPL series insulated terminal blocks, with an appropriate number of ports for the application.

Fuse Holders

1. Use Eaton Bussmann HEB type fuse holders with insulated rubber boots.
2. Luminaires shall be fused at 5 amps unless otherwise noted.
3. Outlets on decorative poles shall be fused at 15 amps unless otherwise noted.

Construction

Street Light Wiring

1. All street lighting conduit shall include 2 electrical wire 6 AWG ungrounded “hot” conductors, an electrical wire 6 AWG grounded “neutral” conductor and an electrical wire 8 AWG equipment grounding conductor unless indicated otherwise.
2. One of the “hot” conductors shall be black and one red unless indicated otherwise.
3. The street light wiring shall alternate between the black and red conductors so that half of the street lights use the black conductor and half use the red conductor and the lights using each conductor are as evenly spaced as possible.
4. Provide 3 foot loops of each wire in each street light access box, pull box and street light base.
5. When there is more than one multi-wire branch circuit, bundle the circuit conductors with nylon cable ties or engineer approved electrical tape at all access points. At each handhole, identify the line side of each circuit with a tape colored as the plans specify.

Tracer Wire

1. The tracer wire shall be tied into the grounding system.
2. Provide 3 foot loops of tracer wire in each access box and pull box.

Splices

1. Splices shall be avoided at pull boxes and access boxes whenever feasible and made at street lights.
2. All splices made underground or in access and pull boxes shall be made with an approved direct burial terminal block.
3. Splices that are made with tracer wire only may be made with a split bolt rated for underground use. When splicing a tracer wire to an equipment grounding conductor, make a loop in the equipment grounding conductor and use a split bolt to make the connection without adding a splice to the equipment grounding conductor.
4. All above ground splices made in a direct burial light pole handhole, a transformer base, or a decorative pole shall be made with an approved insulated terminal block. Terminal blocks shall be arranged to avoid pooling of water or condensation.
5. Splices of traffic signal cable in a transformer base shall be made with wire nuts. Cables shall not be twisted or taped. Tape may be used below the wire nut. Wire nuts shall be installed upright to prevent pooling of water or condensation.

Fuse Assembly

An in-line fuse holder shall be used between the terminal block and the ungrounded “hot” wire going to a luminaire.

Traffic Signals Wiring

1. Traffic signal conduit shall include a 10 AWG ground wire and traffic signal cable, unless shown otherwise.
2. Home-run connections shall be made to each signal base.
3. Provide a minimum of 3 feet of additional traffic signal cable and wiring, loop detector lead-in cable, video detection cable and communication cable at the control cabinet and at traffic signal bases for connections.
4. Provide an additional 10 feet of traffic signal cable and wiring, loop detector lead-in cable, video detection cable and communication cable at the last pull box before the traffic signal.
5. Provide an additional 3 to 4 feet of traffic signal cable, loop detector lead-in cable, video detection cable and communication cable at any intermediate pull boxes.

6. Provide 20 feet of extra emergency vehicle preemption detector cable in the last pull box before the emergency vehicle preemption location, and 4 feet in each pull box. The total length of emergency vehicle preemption detector cable shall not exceed 250 feet from EVP card to antenna.

Loop Detectors

1. A separate lead in cable shall be provided for each loop. This cable run shall run from the cabinet base to the loop pull box used as the splice point. At the splice point pull box the detector cable shall extend 3 feet above the pull box cover for splicing purposes. At the control cabinet, the detector cable shall extend 3 feet above the top of the control cabinet. Splices shall be made between the loop detector wire and the lead-in cable at the pull box at the side of the road.
2. Install loop wire with the number of turns specified on the plans in each loop.

Basis of Payment

1. The electrical wiring items shall be measured by the lineal foot completed and accepted.
2. Payment for the electrical wiring items is full compensation for providing electrical wire or cable; for making connections; for providing connectors, including wire nuts, fuses, fuse holders, splices, tape, insulating varnish or sealant; and for testing the circuits.
3. Payment for the electrical wiring installation items is full compensation for making connections; for providing connectors, including wire nuts, fuses, fuse holders, splices, tape, insulating varnish or sealant; and for testing the circuits. The electrical wire or cable will be supplied by the Owner.
4. Electrical wire and tracer wire at hand formed curb locations shall be paid under the applicable bid items for electrical wire and tracer wire. Any additional costs to install electrical wire or tracer wire at hand formed curb locations shall be included in the bid items for hand formed curb and gutter.
5. Electrical wire and tracer wire at conduit sweeps, at light poles from the conduit to the handhole of ornamental lights, and extra loops of wire are incidental, and will not be paid separately unless noted otherwise.
6. Electrical wire from the conduit to the handhole of ornamental lights shall be paid per lineal foot whenever the distance between the center of the light pole and the conduit running parallel to the curb and gutter exceeds 3 feet.
7. Electrical wiring in light bases, poles, and arms shall be paid at the length shown on the standard detail drawings or as shown on the plans.
8. The additional traffic signal cable and wire, loop detector lead-in cable, emergency vehicle preemption detector cable, video detection cable, and communication cable required at the control cabinet, traffic signal bases and pull boxes will be paid at the lengths required in the specifications, standard detail drawings, on the plans, or as required by the Engineer.
9. Electrical wiring in pull boxes, lights, and traffic signals required to connect grounding lugs to the equipment grounding conductors is incidental, and will not be paid separately unless noted otherwise.

ELECTRICAL SERVICES

Scope

This section describes providing an electrical service.

General Requirements

1. The Owner will complete the service application with Alliant Energy.
2. All underground meter pedestals shall conform to the Alliant Energy service manual.

Materials

Underground Meter Pedestals

1. Use 200 amp meter sockets.
2. Underground meter pedestals shall be model number U6221-O-200-10GR as manufactured by Milbank.
3. When noted on the plans and/or specifications, use a 100 amp meter socket and a model number U6221-O-100-10GR underground meter pedestal as manufactured by Milbank.

Ground Rods

Use 5/8 inch diameter, 8 foot length copper clad ground rods.

Branch Circuit Breakers

Use 50 amp, 120/240 volt, 22,000-AIC rated circuit breakers.

Construction

1. The Contractor is responsible for installing a 2½ inch PVC conduit from the utility side of the underground meter pedestal to the base of a pre-determined utility pole. The PVC shall terminate at the bottom of the pole just below grade and be plugged.
2. Underground meter pedestals shall be installed a minimum of 12 feet from the utility pole.
3. Ground rods shall be installed in accordance with the NEC.
4. Provide 6 AWG bare copper wire, sleeved in ½ inch or ¾ inch PVC conduit, from the meter to the ground rods. The PVC conduit shall be installed from the bottom of the enclosure to 6 inches below final surface grade.
5. Pedestals shall be buried to the manufacturer's specified depth.
6. Provide an expansion joint for the 2 inch street light conduit between the bottom of the enclosure and the final surface grade.
7. The Contractor shall contact the City of Fond du Lac Inspection Division, at 920-322-3570, after installation. Upon approval of the installation, the Inspection Division will contact Alliant Energy to energize the service. The Contractor shall energize and test the system when ready. The Owner will approve the final installation and operation of the system.

Basis of Payment

1. Electrical services shall be measured separately by each individual unit completed and accepted.
2. Payment for the electrical service meter pedestal items is full compensation for providing materials including the meter breaker pedestal, conduit and fittings, circuit breakers, grounding electrodes and connections.
3. Payment for the electrical service meter pedestal installation items is full compensation for providing materials including the conduit and fittings, circuit breakers, grounding electrodes and connections. The meter breaker pedestal will be supplied by the Owner.

CONCRETE BASES

Scope

This section describes providing and installing concrete bases for traffic signals, street lights and control cabinets.

Materials

Bar Steel Reinforcement

Use bar steel reinforcement conforming to Section 505.2.4 of the *Standard Specifications for Highway and Structure Construction*.

Concrete

Use Grade A, A-FA, or A-S concrete conforming to Section 501 of the *Standard Specifications for Highway and Structure Construction*.

Anchor Bolts

Use anchor bolts conforming to **ASTM F1554 Grade 105 and Supplementary Specification S4, ASTM A563** nuts, and **ASTM F436** washers. Bolts shall have an "L" bend on one end and be galvanized according to **ASTM A153, class C**, supplemented by **ASTM F2329**.

Control Cabinet Anchors

Use either mechanical or adhesive stainless steel masonry anchors and stainless steel bolts or studs, nuts, and washers.

Construction

Concrete Bases

1. Provide a leveled and troweled surface with a smooth broomed finish to shed water off the perimeter of the concrete base and a 1 inch chamfer around the perimeter.
2. Provide a level surface and a broom or smooth troweled finish.
3. Concrete bases shall be cured by covering the exposed surfaces with polyethylene sheeting or by applying clear curing compound. Avoid coating the anchor bolts and PVC conduit when applying curing compound.
4. Concrete shall meet the requirements of Section 502.3.10 of the *Standard Specifications for Highway and Structure Construction* before erecting the structure on the base.
5. The minimum bending radius of conduit is equal to six times the diameter.
6. Anchor bolts shall be installed with misalignments of less than 1:40 from vertical. Concrete base anchor bolts shall extend out of the concrete 4 inches for "Cobra Head" and "Tear Drop" style lights, 3 inches for traffic signals and 2 inches for "Decorative" style lights. All anchor bolt projections shall be within ¼ inch of the specified height. All threads shall be anti-seized. Concrete bases not meeting these requirements shall be removed and replaced at the contractor's expense.
7. Leveling shall be done with stainless steel shims only, no leveling nuts will be allowed.
8. Concrete bases shall be placed so that the poles mounted on them provide a continuous clear width of pedestrian access of 4 feet minimum on sidewalks and 5 feet minimum at medians and pedestrian refuge islands.

Bar Steel Reinforcement

Welding of the anchor rods to the cage is unacceptable. Coated tie wires shall be used.

Control Cabinet Bases

1. Additional conduit shall be installed for future use as directed by the Owner.
2. Provide a broom finish and a chamfer per plan details.

3. Concrete bases shall be cured by covering the exposed surfaces with polyethylene sheeting or by applying clear curing compound. Avoid coating the PVC conduit when applying curing compound.
4. Concrete shall meet the requirements of Section 502.3.10 of the *Standard Specifications for Highway and Structure Construction* before erecting the structure on the base.

Removal of Concrete Bases

1. Remove existing concrete light pole, traffic signal and control cabinet bases within the excavation limits or where noted on the plans.
2. Backfill and compact crushed aggregate base course meeting the ¾ inch gradation as indicated in Section 305 of the *Standard Specifications for Highway and Structure Construction*.

Basis of Payment

1. The concrete base and remove concrete base items shall be measured separately by each individual unit completed and accepted.
2. Payment for the concrete bases bid items is full compensation for providing concrete bases; for embedded conduit and electrical components; for anchor templates, rods, nuts, and washers; for bar steel reinforcement; and for excavating and backfilling.
3. Payment for concrete bases is included in the bid items for street lights and traffic signals and will not be paid separately unless noted otherwise.
4. Payment for the remove concrete bases bid items is full compensation for removing concrete bases; and for excavating and backfilling.
5. Removal of concrete bases will be paid as common excavation except when outside of the grading limits.

LIGHTS

Scope

This section describes providing and installing street lights and other outdoor lights.

General Requirements

1. The Contractor shall submit manufacturer's data for the poles, bases, arms, and luminaires.
2. LED luminaires shall meet the requirements of the WisDOT specification "Material and Performance Specifications Luminaires Utility and Underdeck LED."

Materials

Cobra Head Street Lights

1. Use aluminum alloy transformer bases with black anodized finish listed on the WisDOT electrical qualified products list for "Transformer Base 11½ inch bolt circle." A black powder coated finish may be used with the permission of the Engineer.
2. Use aluminum alloy poles with an overall height of 30 feet and a black anodized finish listed on the WisDOT electrical qualified products list for "Poles Type 5." Use aluminum bolt covers with black powder coated finish and stainless steel attachment screws. Use different poles when shown on the plans.
3. Use aluminum alloy mast arms with black anodized finish, fitting a 4½ inch diameter pole top and with a 6 foot arm length listed on the WisDOT electrical qualified products list for "Luminaire arm, single member, 4-½ inch, 6 ft." Use multiple arms and different arm length when shown on the plans.

4. Use Autobahn LED Roadway series ATB0 luminaires with P303 performance package, multi-volt, 120-277v voltage, roadway type II optics, black paint, and solid state long life photocontrols as manufactured by American Electric Lighting (model number Autobahn ATB0 P303 MVOLT R2 BK P7 PCLL), unless shown otherwise.
5. Use 5 amp fuses for each luminaire.
6. Use 12 AWG USE-2 electrical wire for lighting between the fuse holder and luminaire.
7. Provide all hardware, grommets, splices, etc.

Ornamental Street Lights

1. Use CMT Marathon round tapered direct burial fiberglass reinforced composite poles with an overall height of 19 feet, a mounting height of 15 feet, a 2 7/8 inch tenon mounting, and a black finish as manufactured by Valmont Composite Structures, Inc. (model number TB19X503HST3).
2. Use LED luminaires except when high pressure sodium luminaires are specified on the plans or Special Provisions.
3. Use Holophane Utility Taft Postop LED series luminaires with LED performance package P20; 3000k CCT; MVOLT, 120-277v voltage; black finish; GL3 asymmetric glass refractor optics; a ball finial; a 7-pin NEMA twistlock internally mounted receptacle; a long life DTL twistlock photocontrol for solid state, MVOLT; and a solid 90 degree house side shield as manufactured by Holophane (model number PTUE3 P20 30K MVOLT GL3 BK BL PR7 PCLL PHSS90).
4. Use Tork series model number 5237A photocontrols as manufactured by NSi Industries, unless factory installed photocontrol is provided or lights are controlled by lighting control cabinet.
5. Use a 5 amp fuse.
6. Use 12 AWG USE-2 electrical wire for lighting between the fuse holder and luminaire.

Decorative Street Lights

1. Use Holophane North Yorkshire aluminum alloy poles with an overall height of 14 feet, a black finish, 2 outlets, 4
2. banner arms, and a flagpole holder as manufactured by Holophane for downtown decorative lights.
3. Use Holophane North Yorkshire aluminum alloy poles with an overall height of 14 feet and a bronze finish as manufactured by Holophane for residential decorative lights.
4. Use Holophane Washington Postlite Enhanced LED luminaires with LED performance package 40, 3000k CCT, black finish, IES type III distribution optics, gold band and ribs, and spike finial as manufactured by Holophane (model number WSE2 P40 30K BK GL 6 PSC P7) for downtown decorative lights.
5. Use Holophane Utility Granville series luminaires with a 100 watt mogul base ballast, multitap voltage, bronze finish, and IES type IV distribution optics as manufactured by Holophane for residential decorative lights.
6. Use Tork series model number 5237A photocontrols as manufactured by NSi Industries, unless factory installed photocontrol is provided or lights are controlled by lighting control cabinet.
7. Use a 5 amp fuses for luminaires and 15 amp fuses for outlets.
8. Use 12 AWG USE-2 electrical wire for lighting between the fuse holder and luminaire.
9. Provide all hardware, grommets, splices, etc.

Tear Drop Street Lights

1. Use aluminum alloy transformer bases with black anodized finish listed on the WisDOT electrical qualified products list for "Transformer Base 1 1/2 inch bolt circle." A black powder coated finish may be used with the permission of the Engineer.

2. Use aluminum alloy poles with an overall height of 30 feet and a black anodized finish listed on the WisDOT electrical qualified products list for "Poles Type 5." Use aluminum bolt covers with black powder coated finish and stainless steel attachment screws. Use different poles when shown on the plans.
3. Use Holophane Esplanade Utility Tear Drop LED 2 series luminaires with P30S lumen/wattage package, 3000k CCT, auto-sensing 120-277v voltage, black finish, tear drop glass and door, type 4 asymmetric optics, and 1½ inch NPT pendant mount as manufactured by Holophane (model number ESL2 P30S 30K AH BK TG 4 P).
4. Use a 5 amp fuse.
5. Use 12 AWG USE-2 electrical wire for lighting between the fuse holder and luminaire.
6. Provide all hardware, grommets, splices, etc.

Mounting Hardware

Use bands with a black finish when mounting all traffic signals and signs to street light poles.

Lighting Control Cabinets

Use a factory installed shorting cap on lights controlled by a lighting control cabinet or other alternative to a photocontrol on each light.

Construction

Existing Lights

1. The Contractor shall be responsible for the de-energizing and removal of any existing City owned poles, arms, luminaires, and electrical services which will not remain. Poles, arms and luminaires shall be returned to the City, reinstalled or disposed as directed by the Owner.
2. Existing street lighting shall be maintained until poles must be removed to complete other work.

Street Light Location

Street light poles shall be mounted 3 foot to center behind the back of curb or as shown on standard detail drawings or as directed by the Engineer.

Transformer Bases

Bases shall be bonded to the equipment grounding conductor.

Basis of Payment

1. The street light items shall be measured separately by each individual unit completed and accepted.
2. Payment for the street light bid items is full compensation for providing concrete bases; for embedded conduit and electrical components; for anchor templates, rods, nuts, and washers; for bar steel reinforcement; for excavating and backfilling; for providing transformer bases, pedestal bases, poles, arms, banner arms, flagpole holders, luminaires, and photocontrols including grounding lugs and related mounting hardware; for equipment grounding wires; for leveling shims; for hardware and fittings necessary to install the street light; and for corrosion prevention.
3. Payment for the street light bid installation items is full compensation for providing concrete bases; for embedded conduit and electrical components; for anchor templates, rods, nuts, and washers; for bar steel reinforcement; for excavating and backfilling; for equipment grounding wires; and for assembling and installing street lights. The transformer bases, pedestal bases, poles, arms, banner arms, flagpole holders, luminaires, and photocontrols will be supplied by the Owner. The Contractor shall supply any miscellaneous tools, hardware, and components needed to complete the installation.

4. The removal of existing street lights is incidental and will not be paid separately unless noted otherwise.

TRAFFIC SIGNALS

Scope

This section describes providing and installing traffic signals including transformer bases, pedestal bases, poles, standards, arms, signal faces, controllers and detectors, cameras, push buttons, signal mounting hardware, and control cabinets.

General Requirements

1. The Contractor shall submit manufacturer's data for the poles, standards, bases, arms, signal faces, controllers and detectors, cameras, push buttons, and control cabinets.
2. The City representative or subcontractor will be responsible for setting up the traffic signal timing, sequence of operation, detector logic, and controller logic.

Materials

Transformer Bases

Use aluminum alloy transformer bases with black anodized finish listed on the WisDOT electrical qualified products list for "Transformer Base 11½ inch bolt circle." A black powder coated finish may be used with the permission of the Engineer.

Pedestal Bases

Use aluminum alloy pedestal bases with black anodized finish listed on the WisDOT electrical qualified products list for "Pedestal bases." A black powder coated finish may be used with the permission of the Engineer.

Poles

Use aluminum alloy poles with black anodized finish listed on the WisDOT electrical qualified products list for specified pole type.

Standards

Use aluminum alloy standards with black anodized finish listed on the WisDOT electrical qualified products list for standards.

Arms

Use aluminum alloy arms with black anodized finish listed on the WisDOT electrical qualified products list for specified arm type.

Signal Faces, Push Buttons, and Mounting Hardware

1. Use traffic signal faces, backplates, pedestrian signal faces, and LED modules listed on the WisDOT electrical qualified products list for "Traffic Signal Face", "Backplates Signal Face", "Pedestrian Signal Face" and "LED Modules."
2. Use pedestrian push buttons listed on the WisDOT electrical qualified products list for "Pedestrian Push Buttons."
3. Use signal mounting hardware listed on the WisDOT electrical qualified products list for "Signal Mounting Hardware."
4. Use a black finish on traffic signal backplates and mounting hardware.

5. Use bands with a factory black finish when mounting all traffic signals and signs to poles and standards.

Controllers, Detectors, and Cameras

Use controllers, detectors, and cameras supplied by the Owner, unless noted otherwise.

Control Cabinets

Use control cabinets supplied by the Owner, unless noted otherwise. All traffic control cabinets shall be black.

Construction

Existing Traffic Signals

1. The Contractor shall be responsible for the de-energizing and removal of any existing City owned traffic signals, control cabinets, and electrical services which will not remain. Poles, arms, signals heads, detectors and control cabinets shall be returned to the City, reinstalled or disposed as directed by the Owner.
2. Existing traffic signals shall be maintained until poles must be removed to complete other work. The Contractor is responsible for installing temporary stop signs or other necessary traffic control until new signals are operational.

Transformer Bases

Bases shall be bonded to the equipment grounding conductor.

Control Cabinet

The Contractor is responsible for installing the controller, making all connections and for all testing.

Detection Systems

The Contractor shall install and test detection processors, video detection cameras, and microwave detectors. The Contractor shall coordinate the installation of detectors and cameras and setting up the detection zones with the City of Fond du Lac Electrical Division.

Signal Activation

Cover traffic signal faces and pedestrian signal faces with a hood or turn away from view by the traveling public until the signal is accepted for use and activated.

Basis of Payment

1. The traffic signal items shall be measured separately by each individual unit completed and accepted. Payment for the traffic signal items is full compensation for providing concrete bases; for embedded conduit and electrical components; for anchor templates, rods, nuts, and washers; for bar steel reinforcement; for excavating and backfilling; for providing transformer bases, pedestal bases, poles, standards, arms, signal faces, pedestrian push buttons, luminaires, and photocontrols including grounding lugs and related mounting hardware; for equipment grounding wires; for leveling shims; for hardware and fittings necessary to install the traffic signal; and for corrosion prevention.
2. The traffic signal installation items shall be measured separately by each individual unit completed and accepted. Payment for the traffic signal installation items is full compensation for providing concrete bases; for embedded conduit and electrical components; for anchor templates, rods, nuts, and washers; for bar steel reinforcement; for excavating and backfilling; for equipment grounding

wires; and for assembling and installing traffic signals and luminaires. The transformer bases, pedestal bases, poles, standards, arms, signal faces, pedestrian push buttons, signal mounting hardware, luminaires, and photocontrols will be supplied by the Owner. The Contractor shall supply any miscellaneous tools, hardware, and components needed to complete the installation.

3. The control cabinet items shall be measured separately by each individual unit completed and accepted. Payment for the control cabinet installation items is full compensation for assembling and installing control cabinets. Control cabinets will be supplied by the Owner. The Contractor shall supply any miscellaneous tools, hardware, and components needed to complete the installation.
4. The controllers, detectors, and cameras items shall be measured as a single lump sum unit for each intersection acceptably completed. Payment for the controllers, detectors, and cameras items is full compensation for assembling and installing traffic signal controllers, detectors, and cameras including positioning, setting up, programming and testing. Controllers, detectors, and cameras will be supplied by the Owner. The Contractor shall supply any miscellaneous tools, hardware, and components needed to complete the installation.
5. The removal of existing traffic signals is incidental and will not be paid separately unless noted otherwise.

LIGHTING CONTROL CABINETS

Scope

This section describes providing lighting control cabinets.

General Requirements

The Contractor shall submit manufacturer's data for the lighting control cabinets.

Materials

Lighting Control Cabinets

1. Use lighting control cabinets supplied by the Owner, unless noted otherwise.
2. All lighting control cabinets shall be black in color. Prime all inside and outside surfaces of the cabinet with phosphate treatment and primer. After priming, give all exterior surfaces a minimum of 2 coats of rust resistant powder coated black finish; interior surfaces shall be furnished with rust resistant high gloss white enamel. Continuously weld all seams. The surface shall be smooth, free of marks and scratches.

Construction

The Contractor is responsible for installing the cabinet, circuit wiring connections, hardware, and fittings the plans show.

Basis of Payment

1. Lighting control cabinets shall be measured separately by each individual unit completed and accepted.
2. Payment for the lighting control cabinet items is full compensation for providing cabinets including circuit wiring connections, hardware, and fittings the plans show.
3. Payment for the lighting control cabinet installation items is full compensation for providing materials including circuit wiring connections, hardware, and fittings the plans show. The cabinet will be supplied by the Owner.