

600 Items

Lighting, Signing, Markings, and Signals

Item 610

Roadway Illumination Assemblies



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and install roadway illumination assemblies.
- **Relocation.** Remove and relocate existing roadway illumination assemblies.
- **Removal.** Remove existing roadway illumination assemblies.
- **Replace Luminaires (Light Fixtures).** Remove and replace existing luminaires.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 616, "Performance Testing of Lighting Systems"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"

Fabrication plants that produce roadway illumination poles, including luminaire arms, must be approved in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication and Plant Qualification." This includes fabricators of aluminum roadway illumination poles and luminaire arms. The Construction Division maintains a list of approved fabrication plants of roadway illumination poles.

Furnish light fixtures from new materials that are in accordance with DMS-11010, "Roadway Illumination Light Fixtures."

Provide prequalified light fixtures from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

Do not provide shop drawings for complete assemblies that are fabricated in accordance with this Item and the details shown on the plans. Electronically submit shop drawings in accordance with Item 441, "Steel Structures," for optional multi-sided steel pole designs; optional aluminum pole designs; and non-standard designs, required when basic wind speeds or pole base mounting heights at the installation locations are in excess of those shown on the Roadway Illumination Pole (RIP) standard. Manufacturers may request that the Department add their submitted shop drawings and design calculations to a pre-approved list of optional and non-standard pole designs, maintained by the Traffic Operations Division.

Hot-dip galvanize fabricated pole sections and associated parts in accordance with Item 445, "Galvanizing." Punch or drill holes in steel parts or members, when allowed, before galvanizing.

Paint poles, when shown on the plans, in accordance with Item 441, "Steel Structures" for uncoated structures and in accordance with Item 445, "Galvanizing" for galvanized structures.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item. Permanently mark roadway illumination pole base plates, at a visible location when erected, with the fabrication plant's insignia or trademark. Sample fixtures for testing in accordance with Tex-1110-T.

Use established industry and utility safety practices when installing, relocating, or removing poles or luminaires located near overhead or underground utilities. Consult with the appropriate utility company before beginning work.

Prevent scarring or marring of the poles, luminaire arms, and luminaires. Replace damaged components. Repair damaged galvanizing in accordance with Section 445.3.5., "Repairs." Repair damaged painted areas of a roadway illumination assembly in accordance with Item 441, "Steel Structures" or Item 445, "Galvanizing."

Stake, install, and align each roadway illumination assembly as shown on the plans.

The Engineer may shift an assembly's location, if necessary, to secure a more desirable location or avoid conflict with utilities.

Construct foundations for roadway illumination assemblies in accordance with Item 416, "Drilled Shaft Foundations," and the details shown on the plans.

- 3.1. **Installation.** Fabricate and install roadway illumination assembly components in accordance with the details, dimensions, and requirements shown on the plans. Do not use screw-in type foundations. Install anchor bolts and coat anchor bolt threads in accordance with Item 449, "Anchor Bolts." Erect structures after foundation concrete has attained its design strength as required on the plans and Item 421, "Hydraulic Cement Concrete." Tighten anchor bolts for poles with shoe bases and concrete traffic barrier base poles in accordance with Item 449, "Anchor Bolts." Do not place grout between base plate and foundation. Test installed roadway illumination assemblies in accordance with Item 616, "Performance Testing of Lighting Systems."

- 3.2. **Relocation.** Relocate roadway illumination assembly components in accordance with the details, dimensions, and requirements shown on the plans. Do not use screw-in type foundations. Install existing structures on new foundations in accordance with Section 610.3.1., "Installation." Do not place grout between base plate and foundation. Test installed roadway illumination assemblies in accordance with Item 616, "Performance Testing of Lighting Systems."

Disconnect and remove conductors from abandoned circuits. Remove abandoned conduit or ducts to a point 6 in. below final grade. Reconnect conduit, ducts, and conductors to be reused. Replace damaged conduit, ducts, and conductors.

Unless otherwise shown on the plans, remove abandoned concrete foundations and replace surfacing in accordance with Section 610.3.3., "Removal." Do not remove existing concrete bridge lighting brackets.

Furnish and install new internal conductors, fused and unfused connectors, and lamps. Furnish and install new transformer bases that meet AASHTO and plan requirements when relocating transformer base poles. Destroy existing transformer bases to prevent reuse.

Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

- 3.3. **Removal.** Remove roadway illumination assembly components in accordance with established industry and utility safety practices.

Remove transformer bases from transformer base poles. Destroy removed transformer bases to prevent reuse. Remove luminaires and luminaire arms from the pole shaft. Stockpile pole shafts, luminaire arms, and assembly hardware at a location designated by the Department. Pole shafts, luminaire arms, and assembly hardware will remain Department property unless otherwise shown on the plans or as directed.

Disconnect and remove conductors from abandoned circuits. Remove abandoned conduit and ducts to a point 6 in. below final grade.

Unless otherwise shown on the plans, remove abandoned concrete foundations, including steel, to a point 2 ft. below final grade. Backfill the hole with material that is equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition. Do not remove existing concrete bridge lighting brackets.

Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

- 3.4. **Replace Luminaires.** Remove existing luminaires. Fabricate and install luminaire components in accordance with the details, dimensions, and requirements shown on the plans. Test installed luminaires in accordance with **Item 616, "Performance Testing of Lighting Systems."**

4. MEASUREMENT

This Item will be measured as each roadway illumination assembly installed, relocated, or removed; or by each luminaire replaced.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Roadway Illumination Assemblies" of the types specified, "Relocate Roadway Illumination Assemblies" of the types specified, "Remove Roadway Illumination Assemblies" of the types specified, or "Replace Luminaires" of the types specified. The Department will pay for electrical energy consumed by the lighting system.

New drilled shaft foundations will be paid for under **Item 416, "Drilled Shaft Foundations."** New concrete riprap placed around foundations will be paid for under **Item 432, "Riprap."** New conduit will be paid for under **Item 618, "Conduit."** New conductors, except the conductors internal to the pole, will be paid for under **Item 620, "Electrical Conductors."** New duct cable will be paid for under **Item 622, "Duct Cable."** New ground boxes will be paid for under **Item 624, "Ground Boxes."** New electrical services will be paid for under **Item 628, "Electrical Services."**

- 5.1. **Installation.** This price is full compensation for furnishing, installing, and testing luminaires; furnishing and installing lamps, luminaire arms, brackets, poles, anchor bolt assemblies, templates, internal conductors, and connections; conducting system performance testing; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Relocation.** This price is full compensation for salvaging and relocating the existing conduit, duct cable, and conductors; removing existing foundations, backfilling, and surface placement; removing, erecting, connecting, and testing illumination assemblies; furnishing and installing new anchor bolt assemblies, templates, transformer bases, lamps, connections, and conductors; replacing damaged components; disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.
- 5.3. **Removal.** This price is full compensation for removing, salvaging, disassembling, and stockpiling illumination assemblies; salvaging and relocating existing conduit and conductors; removing existing foundations; backfilling and surface placement; splicing existing conductors; disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

- 5.4. **Replace Luminaires.** This price is full compensation for removing, salvaging, disassembling, and stockpiling existing luminaires; furnishing and installing new luminaires, connections, and conductors internal to the pole; replacing damaged components; disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

DRAFT

Item 613

High Mast Illumination Poles



1. DESCRIPTION

Furnish and install high mast illumination poles.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 432, "Riprap"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 618, "Conduit"

Use alloy steel or medium strength mild steel anchor bolts that comply with Section 449.2.1., "Bolts and Nuts."

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans, and the requirements of this Item. Provide components that fit together properly.

Use established industry and utility safety practices when installing high mast poles located near overhead or underground utilities. Consult with the appropriate utility company before beginning work.

- 3.1. **Standard Design.** Fabricate poles in accordance with this Item and the plans. Alternate designs are not permitted.
- 3.2. **Shop Drawings.** Do not submit shop drawings for high mast illumination poles fabricated in accordance with this Item and the plans.
- 3.3. **Fabrication.** Fabricate and weld in accordance with Item 441, "Steel Structures," AWS D1.1, *Structural Welding Code—Steel*, and the requirements of this Item. Match-mark pole shaft sections as shown on the plans.

Furnish high mast illumination poles from approved fabrication plants listed in the Department's MPL in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication and Plant Qualification."

Provide circumferential welds only at the top attachment and base plates. Grind or smooth the longitudinal seam welds to the same radius as contacted shaft corners for the length of the lap plus at least 6 in. at each slip joint splice. Ensure acceptable seam weld profiles for the remainder of the pole exterior. Provide full-penetration longitudinal seam welds for a length of 1.5 diameters plus at least 6 in. in outer sections at splices and base plates. Provide 85% minimum penetration in longitudinal seam welds at other pole sections.

Provide longitudinal seam weld and fit-up that will minimize acid entrapment during later galvanizing. Use at most 2 longitudinal seam welds in each section.

Permanently mark each pole base plate with the insignia or trademark of the fabrication plant. Place the mark on the pole base plate adjacent to the handhole access compartment.

Hot-dip galvanize fabricated pole sections and associated parts in accordance with **Item 445, "Galvanizing."** Punch or drill holes in steel parts or members, when allowed, before galvanizing. Fabrication tolerances are given in Table 1.

Provide ultrasonic testing (UT) of the shaft to base plate weld joint with a procedure approved by the Department. Perform UT at this joint after galvanizing.

**Table 1
Fabrication Tolerances**

Part	Dimension	Tolerance (in.)
Pole shaft	Length (unassembled sections)	±1
	Shaft Thickness ¹	+0.12, -0.02
	I.D. of outside slip fitting	+1/8, -1/16
	O.D. of inside slip fitting	+1/32, -1/8
	Difference between flats or diameter	±1/4
	Straightness	1/8 in 10 ft.
	Attachment locations	±1
Assembled pole shaft	Perpendicular to base plate	1/8 in 24 in.
	Shaft centered on base plate	±1/4
	Twist in shaft ²	4° in 100 ft.
	Position of winch channel	±1/4
Base plate	Overall	±1/4
	Thickness	+1/4, -1/16
	Deviations from flat	3/16 in 24 in.
	Spacing between holes	±3/16
	Bolt hole size	±1/16
Anchor bolt templates	Outside diameter	±1/8
	Inside diameter	+1/4
	Thickness	+1/4, -1/32
	Spacing between holes	±1/16
Anchor bolts	Bolt hole size	±1/16
	Length	±1/2
	Threaded Length	±1/2
Misc.	Galvanized Length	-1/4
	Bolt hole spacing	±1/16

1. Adjust pole diameter if shaft thickness exceeds nominal thickness by 0.02 in. or more. Change the splice length for this adjustment.
2. The Department may accept an excessive twist for individual pole sections, provided the top of pole is within twist tolerance for assembled sections.

3.4. **Installation.** Stake and install high mast illumination poles as shown on the plans. The Engineer may shift the assembly locations, within design guidelines, where necessary to secure a more desirable location or to avoid conflict with utilities.

Use established industry and utility safety practices when installing poles located near overhead or underground utilities. Consult with the appropriate utility before beginning work.

Prevent scarring or marring of the poles. Repair galvanized surfaces damaged in assembly, transit, or installation; or for steel parts or members welded after galvanizing in accordance with **Section 445.3.5., "Repairs."**

Provide riprap around pole foundations in accordance with **Item 432, "Riprap,"** and the details shown on the plans.

- 3.4.1. **Foundations.** Construct foundations for high mast illumination poles in accordance with **Item 416, "Drilled Shaft Foundations,"** and the details shown on the plans.

Before placing concrete for the drilled shaft foundation, inspect anchor bolts to verify proper projecting length of bolts, bolt pattern, orientation of pattern, bolt alignment, and bolt galvanizing are as shown on the plans. Orient anchor bolts to provide 2 bolts on the reference line as shown on the plans. Ensure the anchor bolts are electrically bonded to the reinforcing steel as shown on the plans.

Ensure anchor bolts and templates are rigidly held in position during concrete placement. Positioning devices may be tack welded to steel template, but not to any portion of the anchor bolts. Hold conduit in place with a bar attached to the upper template and cap conduit before placing concrete. Ream conduit to remove burrs and sharp edges after placing concrete. Install bell ends or bushings on the conduit.

- 3.4.2. **Pole Assembly.** Assemble poles on blocking using a minimum of two hydraulic rams at the splices. Support the free end of the section being assembled with hoist equipment. Apply assembly force using hydraulic rams with sufficient capacity to properly draw the sections together with little or no remaining gaps. Mark poles with permanent ink to indicate designed lap length. Ensure splices are a minimum of 90% or a maximum of 110% of the planned lap. Mark the 90% and 110% locations before assembling the pole. Obtain written approval from the Department for splices that do not meet lap tolerances before erecting the pole.

- 3.4.3. **Pole Installation.** Install structures after foundation concrete has attained its design strength as required on the plans and **Item 421, "Hydraulic Cement Concrete."** Coat anchor bolt threads and tighten anchor bolts in accordance with **Item 449, "Anchor Bolts."** Erect and align the poles within 12 in. of vertical. Use enough temporary slings, chains, or wire rope to prevent unintentional separation of the pole sections. Orient poles so a worker can see into the access hole while facing oncoming traffic.

After the high mast pole has been plumbed and all nuts are tight, tack-weld each anchor bolt nut to its washer in 2 places and tack-weld each washer to the base plate in 2 places. Tack weld in accordance with **Item 441, "Steel Structures,"** the AWS D1.1, *Structural Welding Code—Steel*, and the requirements of this Item. Never weld components to the bolt. Repair galvanizing damage on bolts, nuts, and washers in accordance with **Section 445.3.5, "Repairs,"** after tack welding. Do not grout between the base plate and foundation.

4. MEASUREMENT

This Item will be measured as each high mast illumination pole installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "High Mast Illumination Poles" of the wind design and height specified. This price is full compensation for furnishing, fabricating, galvanizing, assembling and installing the pole on a foundation; anchor bolts, nuts, washers, and templates; conduit, ground rods, and wiring; and materials, equipment, labor, tools, and incidentals.

New drilled shaft foundations will be paid for under **Item 416, "Drilled Shaft Foundations."** New riprap will be paid for under **Item 432, "Riprap."** New high mast illumination assemblies will be paid for under **Item 614, "High Mast Illumination Assemblies."** New ground boxes will be paid for under **Item 624, "Ground Boxes."** New electrical services will be paid for under **Item 628, "Electrical Services."**

Item 614

High Mast Illumination Assemblies



1. DESCRIPTION

Furnish and install high mast illumination assemblies.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 616, "Performance Testing of Lighting Systems"
- Item 620, "Electrical Conductors"

Furnish light fixtures from new materials that are in accordance with DMS-11020, "High Mast Light Fixtures."

Furnish other high mast components from new material that are in accordance with DMS-11021, "High Mast Illumination Assembly Kits."

Furnish high mast rings and support assemblies from fabrication plants approved under DMS-7380, "Steel Non-Bridge Member Fabrication and Plant Qualification." The Construction Division maintains a list of approved high mast ring and support assembly fabrication plants. Do not provide shop drawings for high mast ring and support assemblies fabricated in accordance with this Item and the details on the plans. For proposed deviations that do not affect the basic structural behavior of the high mast ring and support assembly, electronically submit shop drawings in accordance with Item 441, "Steel Structures." The submission of shop drawings is only required the first time each proposed deviation is used.

Provide prequalified high mast illumination assembly kits and light fixtures from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item. Permanently mark each high mast ring and support assembly with the insignia or trademark of the fabrication plant. Place the mark at an approved location. Galvanize the ring assemblies, assemble the ring halves in the shop to ensure proper fit, and match-mark the ring halves before shipping. Prevent scarring or marring of the ring assemblies. Replace damaged components.

Repair damaged galvanized areas of the ring assembly in accordance with Section 445.3.5., "Repairs."

Before installation, sample and test fixtures in accordance with Tex-1110-T. Test installed fixtures in accordance with Item 616, "Performance Testing of Lighting Systems."

4. MEASUREMENT

This Item will be measured as each high mast illumination assembly installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "High Mast Illumination Assemblies" of the types specified. This price is full compensation for furnishing, installing and testing light fixtures, ballasts, lamps, wire rope, rings and ring support assemblies; aiming light fixtures; furnishing and installing obstruction lights, hoisting assemblies, power drive assemblies, transformers, electrical equipment, electrical cord, junction boxes and enclosures; conducting system performance testing; and materials, equipment, labor, tools, and incidentals.

New poles for high mast illumination assemblies will be paid for under **Item 613, "High Mast Illumination Poles."** New electrical services will be paid for under **Item 628, "Electrical Services."** The Department will pay for electrical energy consumed by the lighting system.

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Item 616

Performance Testing of Lighting Systems



1. DESCRIPTION

Test the performance of roadway and high mast lighting systems.

2. CONSTRUCTION

Perform tests on the lighting system and tests required by Item 618, "Conduit," Item 620, "Electrical Conductors," and Item 622, "Duct Cable." Ensure all components are properly installed.

Place the lighting system in operation for a 14-day test period. Burn the lighting system steadily for 48 hr. Then cycle the photocell or other control device for 12 days.

Pass a 14-day performance test of the lighting system.

Replace materials that are damaged or have failed before acceptance. Damaged illumination assemblies, except those damaged by the Contractor, and minor failures of lamps, ballasts, and photocells are not cause for modifying or restarting the performance test.

Replace failed or damaged existing lighting system components when caused by the Contractor.

The Department will relieve the Contractor of maintenance responsibilities upon passing a 14-day performance test of the lighting system and acceptance of the Contract.

3. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to pertinent Items. The Department will pay for electrical energy consumed by the lighting system.

Item 617

Temporary Roadway Illumination



1. DESCRIPTION

Furnish and install temporary roadway illumination.

2. MATERIALS

Furnish new or used materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items, except for measurement and payment:

- Item 416, "Drilled Shaft Foundations"
- Item 610, "Roadway Illumination Assemblies"
- Item 613, "High Mast Illumination Poles"
- Item 614, "High Mast Illumination Assemblies"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 621, "Tray Cable"
- Item 622, "Duct Cable"
- Item 624, "Ground Boxes"
- Item 627, "Treated Timber Poles"
- Item 628, "Electrical Services"

Provide utility-grade aluminum service drop cable consisting of one bare aluminum conductor, steel reinforced (ACSR), supporting 2 insulated conductors for overhead electrical work.

Use materials provided by the Department only in authorized locations on the Contract for which the materials were intended. Materials furnished by the Department and the location for pickup will be shown on the plans or as directed.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans, the NEC, the NESC, and the requirements of this Item.

Use established industry and utility safety practices when installing, relocating, or removing electrical and lighting equipment located near overhead or underground utilities. Consult with the appropriate utility before beginning work.

Tension and sag overhead conductors with guys and anchors in accordance with utility distribution practices.

Install conduit and electrical conductors, tray cable, or duct cable as shown on the plans. Install ground boxes as shown on the plans. Install electrical services as shown on the plans. Install concrete foundations as shown on the plans.

Install roadway illumination assemblies (poles with luminaire arms and light fixtures) as shown on the plans. The Engineer may shift the locations, within design guidelines, where necessary to secure a more desirable location or to avoid conflict with utilities.

Use utility grade materials for overhead electrical work. Maintain a minimum of 22-ft. clearance above the roadway for overhead electrical work. Do not support overhead wiring with existing luminaire poles or breakaway luminaire poles.

Operate and maintain the temporary illumination system. Relocate temporary illumination system as shown on the plans.

Remove temporary illumination system when no longer needed. Remove abandoned concrete foundations to a point 2 ft. below final grade. Backfill the hole with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

Replace materials furnished by the Department that are scarred, battered, broken, or lost. Replace damaged temporary illumination materials intended for permanent installation. Return all Department-owned material not used during the Contract upon completion of the work, in original condition, to the location from which the material was obtained, or as directed.

4. MEASUREMENT

This Item will be measured by each roadway illumination assembly installed or relocated; or by the month the system is operated and maintained.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Roadway Illumination" of the type specified. This price is full compensation for installing, relocating, and removing illumination assemblies temporary wiring, foundations and electrical services; and materials, equipment, labor, tools, and incidentals.

Electrical energy consumed by the Contractor on an existing Department electrical service will be paid for by the Department.

Costs for utility-owned power line extensions, connection charges, meter charges, consumption charges, and other charges will be paid for by the Department. The Department will reimburse the Contractor the amount billed by the utility plus an additional 5% of the invoice cost will be paid for labor, equipment, administrative costs, superintendence, and profit.

Item 618

Conduit



1. DESCRIPTION

Furnish and install conduit.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 400, "Excavation and Backfill for Structures"
- Item 476, "Jacking, Boring, or Tunneling Pipe or Box"

When specified on the plans, provide:

- rigid metal conduit (RMC);
- intermediate metal conduit (IMC);
- electrical metallic tubing (EMT);
- polyvinyl chloride (PVC) conduit;
- high density polyethylene (HDPE) conduit;
- liquidtight flexible metal conduit (LFMC); or
- liquidtight flexible nonmetallic conduit (LFNC).

Furnish conduit from new materials in accordance with DMS-11030, "Conduit."

Provide prequalified conduit from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

Provide other types of conduit not on the MPL that comply with the details shown on the plans and the NEC., Fabricate fittings such as junction boxes and expansion joints from a material similar to the connecting conduit, unless otherwise shown on the plans. Use watertight fittings. Do not use set screw and pressure-cast fittings. Steel compression fittings are permissible. When using HDPE conduit, provide fittings that are UL-listed as electrical conduit connectors or thermally fused using an electrically heated wound wire resistance welding method.

Use red 3-in. 4-mil polyethylene underground warning tape that continuously states "Caution Buried Electrical Line Below."

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans, and the requirements of this Item.

Use established industry and utility safety practices when installing conduit located near underground utilities. Consult with the appropriate utility company before beginning work.

Install conduit a minimum of 18 in. deep below finished grade unless otherwise shown on the plans. Meet the requirements of the NEC when installing conduit. Secure and support conduit placed for concrete encasement in such a manner that the alignment will not be disturbed during placement of the concrete. Cap ends of conduit and close box openings before concrete is placed.

Ream conduit to remove burrs and sharp edges. Use a standard conduit cutting die with a 3/4-in. taper per foot when conduit is threaded in the field. Fasten conduit placed on structures with conduit straps or hangers as shown on the plans or as directed. Fasten conduit within 3 ft. of each box or fitting and at other locations shown on the plans or as directed. Use metal conduit clamps that are galvanized malleable or stainless steel unless otherwise shown on the plans. Use 2-hole type clamps for 2-in. diameter or larger conduit.

Fit PVC and HDPE conduit terminations with bushings or bell ends. Fit metal conduit terminations with a grounding type bushing, except conduit used for duct cable casing that does not terminate in a ground box and is not exposed at any point. Conduit terminating in threaded bossed fittings does not need a bushing. Before installation of conductors or final acceptance, pull a properly sized mandrel or piston through the conduit to ensure that it is free from obstruction. Cap or plug empty conduit placed for future use.

Perform trench excavation and backfilling as shown on the plans or as directed, and in accordance with **Item 400, "Excavation and Backfill for Structures."** Excavation and backfilling will be subsidiary to the installation of the conduit.

Jack and bore as shown on the plans or as directed, and in accordance with **Item 476, "Jacking, Boring, or Tunneling Pipe or Box."**

Place warning tape approximately 10 in. above trenched conduit. Where existing surfacing is removed for placing conduit, repair by backfilling with material equal in composition and density to the surrounding areas and by replacing any removed surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition. Mark conduit locations as directed.

4. MEASUREMENT

This Item will be measured by the foot of conduit.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by **Article 9.2., "Plans Quantity Measurement."** Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Conduit" of the type and size specified and the installation method specified as applicable. This price is full compensation for furnishing and installing conduit; hanging, strapping, jacking, boring, tunneling, trenching, and furnishing and placing backfill; encasing in steel or concrete; replacing pavement structure, sod, riprap, curbs, or other surface; marking location of conduit (when required); furnishing and installing fittings, junction boxes, and expansion joints; and materials, equipment, labor, tools, and incidentals.

Flexible conduit will not be paid for directly, but will be subsidiary to pertinent Items. Unless otherwise shown on the plans, no payment will be allowed under this Item for conduit used on electrical services or in foundations.

Item 620

Electrical Conductors



1. DESCRIPTION

Furnish and install electrical conductors, except conductors specifically covered by other Items.

2. MATERIALS

Provide new materials that comply with the details shown on the plans and the requirements of this Item. Use stranded insulated conductors that are rated for 600 volts; approved for wet locations; and marked in accordance with UL, NEC, and CSA requirements. Furnish electrical conductors in accordance with DMS-11040, "Electrical Conductors."

Provide prequalified electrical conductors from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

Ensure all grounding conductors size 8 AWG and larger are stranded, except for the grounding electrode conductor at the electrical service, which will be a solid conductor.

Use white insulation for grounded (neutral) conductors, except grounded conductors size 4 AWG and larger may be black with white tape marking at every accessible location. Do not use white insulation or marking for any other conductor except control wiring specifically shown on the plans.

Ensure insulated grounding conductors are green except insulated grounding conductors size 4 AWG and larger may be black with green tape marking at every accessible location. Do not use green insulation or marking for any other conductor except control wiring specifically shown on the plans.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Splice conductors only in junction boxes, ground boxes, and transformer bases, and in poles and structures at the handholes. Splice as shown on the plans. Do not exceed the manufacturer's recommended pulling tension. Use lubricant as recommended by the manufacturer. Install conductors in accordance with the NEC.

Make insulation resistance tests on the conductors before making final connections, and ensure each continuous run of insulated conductor has a minimum DC resistance of 5 megohms when tested at 1,000 volts DC. The Engineer may require verification testing of all or part of the conductor system. The Engineer will witness these verification tests. Replace conductors exhibiting an insulation resistance of less than 5 megohms at no cost to the Department.

4. MEASUREMENT

This Item will be measured by the foot of each single conductor.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Electrical Conductors" of the types and sizes specified. This price is full compensation for furnishing, installing, and testing electrical conductors; furnishing and installing breakaway connectors; and for materials, equipment, labor, tools, and incidentals, except:

- conductors used in connecting the components of electrical services will be paid for under **Item 628, "Electrical Services"**;
- conductors inside roadway illumination assemblies will be paid for under **Item 610, "Roadway Illumination Assemblies"**;
- conductors inside of traffic signal pole assemblies will be paid for under this Item; and
- conductors used for internal wiring of equipment will not be paid for directly, but will be subsidiary to pertinent Items.

DRAFT

Item 621

Tray Cable



1. DESCRIPTION

Furnish and install tray cable.

2. MATERIALS

Provide new materials that comply with the details shown on the plans and meet the requirements of [Item 620, "Electrical Conductors."](#)

Furnish tray cable from new materials in accordance with DMS-11050, "Tray Cable."

Provide prequalified tray cable from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Provide an additional 5 ft. of cable coiled in each ground box when installing cable in underground conduit. Splice tray cable conductors only at locations shown on the plans. Obtain the Engineer's written approval for each splice. Ensure allowed splices are watertight. Test the cable's conductors after installation and before any connection. Remove and replace tray cable exhibiting a DC insulation resistance of less than 5 megohms at 1000 volts DC at no cost to the Department.

4. MEASUREMENT

This Item will be measured by the foot of tray cable.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by [Article 9.2., "Plans Quantity Measurement."](#) Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Tray Cable" of the types and sizes specified. This price is full compensation for furnishing and installing materials and for equipment, labor, tools, and incidentals.

Item 622

Duct Cable



1. DESCRIPTION

Furnish and install duct cable consisting of a complete assembly of conductors enclosed in a high density polyethylene conduit.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, with conductors that meet the material requirements of **Item 620, "Electrical Conductors."** Furnish duct cable from new materials in accordance with DMS-11060, "Duct Cable."

Provide prequalified duct cable from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

Ensure the complete assembly is packaged on reels having sufficient diameter to prevent permanent set or damage to the duct cable. Ensure each reel is clearly and durably marked to show the voltage rating, type of insulation, number of conductors, conductor size, length, duct size, and either the name or the trademark of the manufacturer.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Use established industry and utility safety practices when installing duct cable located near underground utilities. Consult with the appropriate utility company before beginning work.

Install duct cable by open trench methods in accordance with the NEC. Backfill the trench in accordance with **Item 400, "Excavation and Backfill for Structures,"** except for measurement and payment. When removal of existing pavement or concrete surface is allowed, backfill with material equal in composition and density to the surrounding area and replace removed surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition or as shown on the plans.

Splicing the duct is not allowed. Make all connections in ground boxes or pole bases. Form bends with large radii to provide free movement of conductors. After installation, demonstrate the conductors can move freely. Duct cable that has been kinked or in which the conductors cannot move freely is not acceptable and will be repaired or replaced at no cost to the Department. Splice conductors and test insulation in accordance with **Item 620, "Electrical Conductors."**

4. MEASUREMENT

This Item will be measured by the foot of duct cable.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by **Article 9.2., "Plans Quantity Measurement."** Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Duct Cable" of the types and sizes specified. This price is full compensation for furnishing and installing all duct cable; excavating and backfilling the trenches; replacing riprap, pavement structure, topsoil, sod, or other surface; testing insulation resistance; and materials, equipment, labor, tools, and incidentals.

DRAFT

Item 624

Ground Boxes



1. DESCRIPTION

- **Installation.** Construct, furnish, and install ground boxes complete with lids.
- **Removal.** Remove existing ground boxes.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following items:

- Item 420, "Concrete Substructures"
- Item 421, "Hydraulic Cement Concrete"
- Item 432, "Riprap"
- Item 440, "Reinforcement for Concrete"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"

Provide fabricated precast polymer concrete ground boxes in accordance with DMS-11070, "Ground Boxes." Provide prequalified ground boxes from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

Provide other precast or cast-in-place ground boxes that comply with the details shown on the plans.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Use established industry and utility safety practices when installing or removing ground boxes located near underground utilities. Consult with the appropriate utility company before beginning work.

- 3.1. **Installation.** Fabricate and install ground boxes in accordance with the details, dimensions, and requirements shown on the plans. Install ground box to approved line and grade.

Construct precast and cast-in-place concrete ground boxes in accordance with Item 420, "Concrete Substructures," and Item 440, "Reinforcement for Concrete."

Construct concrete aprons as shown on the plans and in accordance with Item 432, "Riprap," and Item 440, "Reinforcement for Concrete."

- 3.2. **Removal.** Remove existing ground boxes and concrete aprons to at least 6 in. below the conduit level. Uncover conduit to a sufficient distance so that 90 degree bends can be removed and conduit reconnected. Clean the conduit in accordance with Item 618, "Conduit." Replace conduit within 5 ft. of the ground box. Remove old conductors and install new conductors as shown on the plans. Backfill area with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

4. MEASUREMENT

This Item will be measured by each ground box installed complete in place or each ground box removed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Ground Box" of the types and sizes specified and for "Remove Ground Box."

- 5.1. **Installation.** This price is full compensation for excavating and backfilling; constructing, furnishing, and installing ground boxes and concrete aprons; and material, equipment, labor, tools, and incidentals. All wiring connections required inside the ground box will be considered subsidiary to this bid item. Conduit will be paid for under **Item 618, "Conduit."** Electrical conductors will be paid for under **Item 620, "Electrical Conductors."**
- 5.2. **Removal.** This price is full compensation for removing and disassembling ground boxes and concrete aprons; excavating, backfilling, and surface placement; removing old conductors; disposal of unsalvageable materials; and materials, equipment, labor, tools, and incidentals. Cleaning of conduit is subsidiary to this Item. Conduit replaced within 5 ft. of the ground box will be subsidiary to this Item. Additional conduit will be paid for under **Item 618, "Conduit."** Installation of conductors will be paid for under **Item 620, "Electrical Conductors."**

Item 625

Zinc-Coated Steel Wire Strand



1. DESCRIPTION

Furnish and install zinc-coated steel wire strand.

2. MATERIALS

Provide new materials in accordance with ASTM A475, Utilities Grade or better, Class A coating. These requirements include, but are not limited to, the properties given in Table 1. Furnish 7 wires per strand.

Table 1
Dimensions and Properties

Nominal Diameter of Strand (in.)	Nominal Diameter of Coated Wires (in.)	Approx. Weight per 1,000 ft. (lb.)	Minimum Breaking Strength (lb.)	Minimum Zinc Coating Wt. Class A (oz./sq. ft.)
3/16	0.065	80	2,400	0.50
1/4	0.080	121	4,750	0.60
9/32	0.093	164	4,600	0.70
5/16	0.109	225	6,000	0.80
3/8	0.120	273	11,500	0.85
7/16	0.145	399	18,000	0.90
1/2	0.165	517	25,000	0.90

Supply new material. Remove drips, runs, sharp points, voids, and damage from the zinc coating. Samples from each roll of each diameter of strand will be taken. Replace strands failing to meet the requirements of this Item.

3. CONSTRUCTION

Install strands as shown on the plans. Splicing is not permitted.

When the strand is used as a messenger cable or span wire, ground it to the grounding conductor at each pole. Metal poles may be used as the grounding conductor. Ensure a resistance less than 1 ohm from the strand to the ground rod.

4. MEASUREMENT

This Item will be measured by foot of wire strand.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Zinc-Coated Steel Wire Strand" of the sizes specified. This price is full compensation for furnishing, installing, and testing wire strands; and materials, equipment, labor, tools, and incidentals.

Item 627

Treated Timber Poles



1. DESCRIPTION

Furnish and install treated timber poles.

2. MATERIALS

Use new treated southern pine timber poles in accordance with ANSI O5.1, *Specifications and Dimensions for Wood Poles*, and the additional requirements of this Item. Use ANSI Class 5 treated timber poles for electrical services and ANSI Class 2 for all other applications, unless otherwise shown on the plans.

Ensure poles are free from pith holes at the tops and butts. Do not use poles that have a trimmed scar with a depth greater than 2 in., if the diameter is 10 in. or less, or 1/5 the pole diameter at the scar location, if the diameter is more than 10 in. Provide poles that do not deviate from straightness by more than 1 in. for each 10 ft. of length. A pole may only have sweep in one plane and one direction (single sweep), provided a straight line joining the midpoint of the pole at the butt and the midpoint of the pole at the top does not at any intermediate point pass through the external surface of the pole. Timber poles with more than one complete twist of spiral grain are not acceptable.

Butt slivering due to felling is permitted if the distance from the outside circumference is at least 1/4 of the butt diameter and the height is not more than 1 ft. Use preservative treatment in accordance with AWPA U1, Commodity Specification D. Furnish poles with a minimum net retention of preservative treatment in accordance with Table 1.

Mark all poles by branding in accordance with Table 2.

Table 1
Retention of Preservative Treatment

Treatment	Minimum Retention
Creosote	9.0 lb./ft. ³
Pentachlorophenol	0.45 lb./ft. ³
CCA	0.6 lb./ft. ³

Table 2
Timber Pole Markings

Marking	Description of Marking
PTC	Supplier's code or trademark (for example, Pole Treating Company).
F-01	Plant location and year of treatment (for example, Forestville, 2001).
SPC	Species and preservative code (for example, southern pine, creosote).
5-35	Class-length (for example, Class 5, 35-ft. pole).

Place the bottom of the brand squarely on the face of the pole 10 ft. (plus or minus 2 in.) from the butt.

Furnish a treatment certification with every shipment of treated timber poles that includes:

- name of treating company,
- location of treating plant,
- applicable product standard (AWPA U1),
- charge number,
- date of treatment,
- contents of charge (poles),

- preservative treatment, and
- actual preservative retention values.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Use established industry and utility safety practices while installing poles located near overhead or underground utilities. Consult with the appropriate utility company before beginning work.

Set the pole a minimum depth in accordance with Table 3, unless otherwise shown on the plans

Table 3
Pole Setting Depth

Pole Length (ft.)	Min. Setting Depth (ft.)
25 or less	4.5
26-30	5.0
31-35	5.5
36-40	6.0
41-45	6.5
46-50	7.0

Locate timber poles as shown on the plans or as directed. Drill holes for setting poles a minimum of 1.5 diameters of the pole butt. Set the poles plumb, unless otherwise shown on the plans. Backfill the holes thoroughly by tamping in 6-in. lifts. After tamping to grade, place additional backfill material in a 6-in. high cone around the pole to allow for settling. Use material equal in composition and density to the surrounding area. Repair surface where existing surfacing material is removed, such as asphalt pavement or concrete riprap, with like material to equivalent condition.

4. MEASUREMENT

This Item will be measured by each timber pole installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Treated Timber Pole" of the various lengths and classes specified. This price is full compensation for furnishing and installing timber poles; and for all hardware; and materials, equipment, labor, tools, and incidentals.

This payment clause excludes payment for Treated Timber Poles when subsidiary to another Item.

Item 628

Electrical Services



1. DESCRIPTION

- **Installation.** Furnish and install electrical services.
- **Relocation.** Relocate existing electrical services.
- **Removal.** Remove existing electrical services.

2. MATERIALS

Provide materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 441, "Steel Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 627, "Treated Timber Poles"
- Item 656, "Foundations for Traffic Control Devices"

For the installation of electrical services, use new materials that meet the requirements of the NEC, UL, CSA, and NEMA, and are in accordance with DMS-11080, "Electrical Services."

Provide prequalified electrical services prequalified from the Department's MPL. Notify the Department in writing of selected materials from the MPL intended for use on each project.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item. Use established industry and utility safety practices when installing, relocating, or removing electrical services located near overhead or underground utilities. Consult with the appropriate utility company before beginning work.

- 3.1. **Installation.** Furnish and install electrical service equipment. Ensure components of the electrical service meet the requirements of the Electrical Detail Standards. Follow NEC and local utility company requirements when installing the electrical equipment. Coordinate the utility companies' work for providing service.
- 3.2. **Relocation.** Coordinate relocation with the appropriate utility company before beginning work. Remove existing electrical service according to "Removal" under this Item. Reinstall existing electrical service according to "Installation" of this Item. Replace or add circuit breakers as noted on the plans.
- 3.3. **Removal.** Coordinate removal with the appropriate utility company before beginning work. Before the removal of the electrical service, disconnect and isolate any existing electrical service equipment in accordance with the utility company's requirements.

Remove existing electrical service support a minimum of 2 ft. below finish grade unless otherwise shown on the plans. Repair the remaining hole by backfilling with material equal in composition and density to the surrounding area. Replace any surfacing such as asphalt pavement or concrete riprap with like material to equivalent condition.

Disconnect conductors and remove them from the conduit. Cut off all protruding conduit 6 in. below finished grade. Abandoned conduit need not be removed unless shown on the plans.

Reconnect conductors and conduit to be reused when shown on the plans. Make all splices in ground boxes unless otherwise shown on the plans.

Accept ownership of unsalvageable materials, and dispose of them in accordance with federal, state, and local regulations.

4. MEASUREMENT

This Item will be measured by each electrical service installed, relocated, or removed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Electrical Services" of the types specified, "Relocate Electrical Services" or "Remove Electrical Services."

- 5.1. **Installation.** This price is full compensation for paying all fees, permits, and other costs; making arrangements with the utility company for all work and materials provided by the utility company; furnishing, installing, and connecting all components including poles, service supports, foundations, anchor bolts, riprap, enclosures, switches, breakers, conduit (from the service equipment including the elbow below ground), fittings, conductors (from the service equipment including the elbow below ground), brackets, bolts, hangers, hardware; and materials, equipment, labor, tools, and incidentals.
- Costs for utility-owned power line extensions, connection charges, meter charges, consumption charges, and other charges will be paid for by the Department. The Department will reimburse the Contractor the amount billed by the utility plus an additional 5% of the invoice cost will be paid for labor, equipment, administrative costs, superintendence, and profit.
- 5.2. **Relocation.** This price is full compensation for disconnecting and isolating the existing electrical service; relocating the service supports; new service support foundation; backfilling holes; paying all fees, permits, and other costs; making arrangements with the utility company for all work and materials provided by the utility company; removing, disconnecting, installing, and connecting all components including poles, service supports, foundations, anchor bolts, riprap, enclosures, switches, breakers, conduit (from the service equipment including the elbow below ground), fittings, conductors (from the service equipment including the elbow below ground), brackets, bolts, hangers, hardware; and materials, equipment, labor, tools, and incidentals.
- Costs for utility-owned power line extensions, connection charges, meter charges, consumption charges, and other charges will be paid for by the Department. The Department will reimburse the Contractor the amount billed by the utility plus an additional 5% of the invoice cost will be paid for labor, equipment, administrative costs, superintendence, and profit.
- 5.3. **Removal.** This price is full compensation for coordinating with the utility company to disconnect and isolate the electrical service; removing the service supports; backfilling holes; and materials, equipment, labor, tools, and incidentals.

Item 636

Signs



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect aluminum signs. Sign supports are provided for under other Items.
- **Replacement.** Replace existing signs on existing sign supports.
- **Refurbishing.** Refurbish existing aluminum signs on existing sign supports.

2. MATERIALS

- 2.1. **Sign Blanks.** Furnish sign blank substrates in accordance with DMS-7110, "Aluminum Sign Blanks," and in accordance with the types shown on the plans. Use single-piece sheet-aluminum substrates for Type A (small) signs and extruded aluminum substrates for Type G (ground-mounted) or Type O (overhead-mounted) signs.
- 2.2. **Sign Face Retroreflectorization.** Retroreflectorize the sign faces with flat surface reflective sheeting. Furnish sheeting that meets DMS-8300, "Sign Face Materials." Use retroreflective sheeting from the same manufacturer for the entire sign face background. Ensure that sign legend, symbols, borders, and background exhibit uniform color, appearance, and retroreflectivity when viewed both day and night.
- 2.3. **Sign Messages.** Fabricate sign messages to the sizes, types, and colors shown on the plans. Use sign message material from the same manufacturer for the entire message of a sign. Use screen ink and background reflective sheeting that are from the same manufacturer when fabricating signs.
- Ensure that the screened messages have clean, sharp edges and exhibit uniform color and retroreflectivity. Prevent runs, sags, and voids. Furnish screen inks in accordance with DMS-8300, "Sign Face Materials."
 - Fabricate colored, transparent film legend, and retroreflectorized sheeting legend from materials that meet DMS-8300, "Sign Face Materials."
 - Fabricate non-reflective black film legend from materials meeting DMS-8300, "Sign Face Materials."
 - Furnish direct-applied route markers and other attachments within the parent sign face unless otherwise specified on the plans.
- 2.4. **Hardware.** Use galvanized steel, stainless steel, or dichromate-sealed aluminum for bolts, nuts, washers, lock washers, screws, and other sign assembly hardware. Use plastic or nylon washers to avoid tearing the reflective sheeting. Furnish steel or aluminum products in accordance with DMS-7120, "Sign Hardware."

When dissimilar metals are used, select or insulate metals to prevent corrosion.

3. CONSTRUCTION

- 3.1. **Fabrication.** Sign fabrication plants that produce permanent highway signs must be approved in accordance with DMS-7390, "Permanent Highway Sign Fabrication Plant Qualification." Furnish signs from prequalified fabrication plants listed in the Department's MPL.
- 3.1.1. **Sign Blanks.** Furnish sign blanks to the sizes and shapes shown on the plans and that are free of buckles, warps, burrs, dents, cockles, or other defects. Do not splice individual extruded aluminum panels.

Complete the fabrication of sign blanks, including the cutting and drilling or punching of holes, before cleaning and degreasing. After cleaning and degreasing, ensure the substrate does not come into contact with grease, oils, or other contaminants before the application of the reflective sheeting.

- 3.1.2. **Sheeting Application.** Apply sheeting to sign blanks in conformance with the sheeting manufacturer's recommended procedures.

When utilizing orientation non-compliant white sheeting, fabricate signs by applying the sheeting for cut-out legend, symbols, borders, and route marker attachments within the parent sign face with the identification marks or other orientation features in the optimum direction.

Clean and prepare the outside surface of extruded aluminum flanges in the same manner as the sign panel face.

Minimize the number of splices in the sheeting. Overlap the lap-splices by at least 1/4 in. for encapsulated glass bead sheeting unless otherwise recommended by the reflective sheeting manufacturer. Use butt splices for prismatic reflective sheeting. Provide a 1 ft. minimum dimension for any piece of sheeting. Do not splice sheeting for signs fabricated with transparent screen inks or colored transparent films.

- 3.1.3. **Sign Assembly.** Assemble extruded aluminum signs in accordance with the details shown on the plans. Sign face surface variation must not exceed 1/8 in. per foot. Surface misalignment between panels in multi-panel signs must not exceed 1/16 in. at any point.

- 3.1.4. **Decals.** Code and apply sign identification decals in accordance with **Item 643, "Sign Identification Decals."**

- 3.2. **Storage and Handling.** Ship, handle, and store completed sign blanks and completed signs so that corners, edges, and faces are not damaged. Damage to the sign face that is not visible when viewed at a distance of 50 ft., night or day, will be acceptable. Replace unacceptable signs.

Store all finished signs off the ground and in a vertical position until erected. Store finished sheet aluminum substrate signs in a weatherproof building. Extruded aluminum substrate signs may be stored outside.

Stockpile salvageable materials at the location shown on the plans or as directed. Accept ownership of unsalvageable materials and dispose of them in accordance with federal, state, and local regulations.

- 3.3. **Cleaning.** Wash completed signs in the fabrication shop with a biodegradable cleaning solution acceptable to the manufacturers of the sheeting, colored transparent film, and screen ink to remove grease, oil, dirt, smears, streaks, finger marks, and other foreign material. Wash again before final inspection after erection.

- 3.4. **Installation.** Install signs as shown on the plans or as directed.

- 3.5. **Replacement.** Remove the existing signs from the existing supports and replace with new signs, including mounting hardware, as shown on the plans.

- 3.6. **Refurbishing.** Refurbish existing signs by providing and installing new messages and mounting hardware. Install new retroreflectorized legend and supplemental signs as shown on the plans.

- 3.7. **Documentation.** Provide the following documentation from the sign fabricator with each shipment of furnished signs:

- A notarized original of the Signing Material Statement (Form 2273) with the proper attachments for verification of compliance, and
- A notarized certification stating that the completed signs were fabricated in accordance with this Item and the plans.

4. MEASUREMENT

Signs installed or replaced will be measured by the square foot of the sign face. Signs refurbished will be measured by each sign.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Aluminum Signs," "Replacing Existing Aluminum Signs," or "Refurbishing Aluminum Signs," of the type specified.

- 5.1. **Installation.** This price is full compensation for furnishing and installing new signs and hardware; fabrication of sign panels; treatment of sign panels required before application of the background materials; application of the background materials and messages to the sign panels; furnishing and fabricating frames, wind beams and stiffeners; furnishing bolts, rivets, screws, fasteners, clamps, brackets, and sign support connections; assembling and erecting the signs; preparing and cleaning the signs; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Replacement.** This price is full compensation for furnishing and installing new aluminum signs and hardware; removal of existing signs; fabrication of sign panels; treatment of sign panels required before application of the background materials; application of the background materials and messages to the sign panels; furnishing and fabricating frames, wind beams and stiffeners; furnishing bolts, rivets, screws, fasteners, clamps, brackets, and sign support connections; assembling and erecting the signs; preparing and cleaning the signs; salvaging and disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.
- 5.3. **Refurbishing.** This price is full compensation for modifying existing sign messages; removing and replacing existing route markers, reflectorized legend, or supplemental signs attached to the parent sign; preparing and cleaning the signs; furnishing sheeting and hardware; salvaging and disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

Item 643

Sign Identification Decals



1. DESCRIPTION

Furnish and install sign identification decals.

2. MATERIALS

Furnish materials that meet the requirements of DMS-8315, "Sign Identification Decals."

Figure 1 shows the sign identification decal design. Table 1 describes the information required in each row of the decal.

Texas Department of Transportation												
C	Fabrication Date										T	1
J	F	M	A	M	J	J	A	S	O	N	D	2
	201		202		203		204		205			3
	0	1	2	3	4	5	6	7	8	9		4
Sheeting MFR - Substrate												
A	B	C	D	E	F	G	H	J	K	L	M	5
Film MFR												
A	B	C	D	E	F	G	H	J	K	L	M	6
Sheeting MFR - Legend												
A	B	C	D	E	F	G	H	J	K	L	M	7
Installation Date												
				0	1	2	3					8
	0	1	2	3	4	5	6	7	8	9		9
J	F	M	A	M	J	J	A	S	O	N	D	10
	201		202		203		204		205			11
	0	1	2	3	4	5	6	7	8	9		12

Figure 1
Decal Design (row numbers explained in Table 1).

**Table 1
Decal Description
Row Explanation**

1	– Sign Fabricator
2	– Month Fabricated
3	– First 3 Digits of Year Fabricated
4	– Last Digit of Year Fabricated
5	– Manufacturer of the Sheeting Applied to the Substrate
6	– Film (colored transparent or non-reflective black) Manufacturer
7	– Manufacturer of the Sheeting for the Legend
8	– Tens digit of Date Installed
9	– Ones Digit of Date Installed
10	– Month Installed
11	– First 3 Digits of Year Installed
12	– Last Digit of Year Installed

3. CONSTRUCTION

- 3.1. **Sign Fabricator.** Code the decal by punching out the following:
- “C” if fabricated by a commercial sign fabricator or “T” if fabricated by the Department or the Texas Department of Criminal Justice;
 - month fabricated;
 - first 3 digits of the year fabricated;
 - fourth digit of the year fabricated; and
 - sheeting, film, and ink manufacturers. (Codes for these manufacturers are located in the Department’s MPL.)

Affix decal to lower left corner of the sign back in an upright position.

4. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to pertinent Items.

Item 644

Small Roadside Sign Assemblies



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect small roadside sign assemblies or bridge mounted clearance sign assemblies consisting of the signs, sign supports, foundations (when required), and associated mounting hardware.
- **Relocation.** Relocate existing small roadside sign assemblies or bridge mounted clearance sign assemblies, and furnish and fabricate material as required.
- **Removal.** Remove existing small roadside sign assemblies or bridge mounted clearance sign assemblies.

2. MATERIALS

Furnish all materials unless otherwise shown on the plans. Furnish only new materials. Furnish and fabricate materials that comply with the following Items and details shown on the plans:

- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcement for Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 636, "Signs"
- Item 643, "Sign Identification Decals"
- Item 656, "Foundations for Traffic Control Devices"

Use galvanized steel, stainless steel, dichromate sealed aluminum, or other materials shown on the plans for pipe, bolts, nuts, washers, lock washers, screws, and other sign assembly hardware. When dissimilar metals are used, select or insulate metals to prevent corrosion.

3. CONSTRUCTION

Construct foundations in accordance with **Item 656, "Foundations for Traffic Control Devices."** Plumb sign supports. Do not spring or rake posts to secure proper alignment. Use established safety practices when working near underground or overhead utilities. Consult the appropriate utility company before beginning work.

- 3.1. **Fabrication.** Fabricate sign supports in accordance with **Item 441, "Steel Structures."** Ensure all components fit properly.

Verify the length of each post for each sign before fabrication to meet field conditions and sign-mounting heights shown on the plans.

Hot-dip galvanize fabricated parts in accordance with **Item 445, "Galvanizing."** Punch or drill any holes in steel parts or members before galvanizing. Repair galvanizing for any steel part or member damaged during assembly, transit, erection; or for any steel part or member welded, when permitted, after galvanizing. Perform all galvanizing repairs in accordance with **Section 445.3.5., "Repairs."**

- 3.2. **Installation.** Locate and install sign supports as shown on the plans, unless directed to shift the sign supports within design guidelines to secure a more desirable location or avoid conflict with utilities and underground appurtenances. Stake sign support locations for verification by the Engineer.

Install stub posts of the type, spacing, orientation, and projection shown on the plans. Remove and replace posts damaged during installation at the Contractor's expense.

Connect the upper post sections to the stub post sections as shown on the plans. Torque connection bolts as shown on the plans.

Attach signs to supports in accordance with the plans and pertinent Items.

- 3.3. **Relocation.** Reuse the existing signs as required unless otherwise shown on the plans. Furnish and install new stub posts in new foundations for relocated sign assemblies. Erect the new supports on the new stub posts, and attach the existing signs to the supports in accordance with the plans and pertinent Items. Remove existing foundations to be abandoned in accordance with [Section 644.3.4., "Removal."](#)

- 3.4. **Removal.** Remove abandoned concrete foundations to 2 ft. below finish grade unless otherwise shown on the plans. Backfill the remaining hole with material equal in composition and density to the surrounding area. Replace any surfacing with like material to equivalent condition.

- 3.5. **Handling and Storage.** Handle and store existing signs or portions of signs removed so they are not damaged. Prevent any damage to the various sign assembly components. Replace any portion of the sign damaged by the Contractor designated for reuse or salvage, including messages removed.

Stockpile all removed sign components that will be reused or become the property of the Department at designated locations. Accept ownership of unsalvageable materials, and dispose of them in accordance with federal, state, and local regulations.

- 3.6. **Cleaning.** Wash the entire sign after installation with a biodegradable cleaning solution acceptable to the sign face materials manufacturer to remove dirt, grease, oil smears, streaks, finger marks, and other foreign materials.

4. MEASUREMENT

This Item will be measured as each small roadside assembly or bridge mounted clearance sign assembly installed, removed, or relocated.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Small Roadside Sign Assemblies" of the type specified, "Install Bridge Mounted Clearance Sign Assemblies" of the type specified, "Relocate Small Roadside Sign Assemblies" of the type specified, "Relocate Bridge Mounted Clearance Sign Assemblies" of the type specified, "Remove Small Roadside Sign Assemblies," or "Remove Bridge Mounted Clearance Sign Assemblies."

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, and erecting the supports; constructing foundations including concrete (when required); furnishing complete signs including sign connections and all hardware; attaching the signs to the supports; preparing and cleaning the signs; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Relocation.** This price is full compensation for removing existing sign assemblies and related materials; furnishing and installing new stub posts and new sign supports; constructing foundations including concrete (when required); and new hardware; reinstallation of signs; preparing and cleaning the signs; salvaging;

disposal of unsalvageable materials; removing existing foundations, backfilling, and surface placement; and materials, equipment, labor, tools, and incidentals.

- 5.3. **Removal.** This price is full compensation for removing existing sign assemblies and related materials; salvaging; disposal of unsalvageable materials; removing existing foundations, backfilling, and surface placement; and materials, equipment, labor, tools, and incidentals.

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Item 647

Large Roadside Sign Supports and Assemblies



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect steel supports for large roadside signs.
- **Relocation.** Relocate existing large roadside sign assemblies, and furnish and fabricate materials as required.
- **Removal.** Remove existing large roadside sign assemblies.

2. MATERIALS

Furnish all materials unless otherwise shown on the plans. Furnish only new materials. Furnish and fabricate materials that comply with the following Items and details shown on the plans:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcement for Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"

Use material for perforated fuse plates that does not exceed the ultimate tensile strength shown on the plans.

Use galvanized steel, stainless steel, dichromate sealed aluminum, or other materials shown on the plans for bolts, nuts, washers, lock washers, screws, and other sign-assembly hardware. When dissimilar metals are used, select or insulate the metals to prevent corrosion.

3. CONSTRUCTION

Construct foundations for large roadside sign supports and assemblies in accordance with **Item 416, "Drilled Shaft Foundations,"** and the details shown on the plans. Plumb sign supports. Do not spring or rake posts to secure proper alignment. Use established safety practices when working near underground or overhead utilities. Consult with the appropriate utility company before beginning work.

3.1. **Fabrication.** Fabricate in accordance with **Item 441, "Steel Structures."** Ensure all components fit properly.

Verify the length of each post for each sign before fabrication to meet field conditions and sign-mounting heights shown on the plans. Obtain approval for any necessary field fabrication or adjustments.

Hot-dip galvanize fabricated parts in accordance with **Item 445, "Galvanizing."** Punch or drill any holes in steel parts or members before galvanizing. Repair galvanizing for any steel part or member on which the galvanizing has been damaged during assembly, transit, erection; or for any steel part or member welded when permitted, after galvanizing. Make all galvanizing repairs in accordance with **Section 445.3.5., "Repairs."**

3.2. **Installation.** Locate sign supports as shown on the plans, unless directed to shift the sign supports within design guidelines to secure a more desirable location or avoid conflict with utilities and underground appurtenances. Stake the sign support locations for verification by the Engineer.

Install stub posts of the type and at the spacing, orientation, and projection shown on the plans. Secure the stub posts rigidly in position during concrete placement.

At the Contractor's option, sign supports may be cast in the concrete foundation as a unit. However, if installation is made with the upper post section attached, do not expose the support to traffic until the sign panel is properly affixed, unless otherwise approved.

Connect the upper post sections to the stub post sections as shown on the plans. Ensure a flat washer is positioned on top of the bolt keeper plates between the upper and lower slip base sections, and a flat washer is positioned under the head and nut of each connection bolt. Torque connection bolts as shown on the plans.

Attach signs to supports in accordance with the plans and pertinent Items.

- 3.3. **Relocation.** Reuse the existing supports and shorten or lengthen them as required, unless otherwise shown on the plans. Furnish and install new breakaway stub posts in new foundations for relocated sign assemblies. Erect the supports on the new stub posts and attach the signs to the supports in accordance with the plans and pertinent Items.

Unless otherwise shown on the plans, remove abandoned concrete foundations and replace surfacing in accordance with **Section 647.3.4., "Removal."**

- 3.4. **Removal.** Remove abandoned concrete foundations including steel to 2 ft. below finish grade, unless otherwise shown on the plans. Cut off and remove steel protruding from the remaining concrete. Backfill the remaining hole with material equal in composition and density to the surrounding area. Replace any surfacing with like material to equivalent condition.

- 3.5. **Handling and Storage.** Handle and store existing signs or portions of signs removed so they are not damaged. Prevent any damage to the various sign assembly components. Replace any portion of the sign damaged by the Contractor designated for reuse or salvage, including messages removed.

Stockpile all removed sign components that will be reused or become the property of the Department at designated locations. Accept ownership of unsalvageable materials and dispose of them in accordance with federal, state, and local regulations.

- 3.6. **Cleaning.** Wash the entire sign after installation with a biodegradable cleaning solution acceptable to the sign face material manufacturers to remove dirt, grease, oil smears, streaks, finger marks, and other foreign materials.

4. MEASUREMENT

Installation will be measured by the pound of large roadside sign support steel. Sign assemblies removed or relocated will be measured by each large roadside sign assembly.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by **Article 9.2., "Plans Quantity Measurement."** Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

This work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Large Roadside Sign Supports" of the type specified, "Remove Large Roadside Sign Assemblies," or "Relocate Large Roadside Sign Assemblies."

New drilled shaft foundations will be paid for in accordance with **Item 416, "Drilled Shaft Foundations."** New signs will be paid for in accordance with **Item 636, "Signs."**

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, and erecting the supports and stub posts; furnishing fuse plate and slip base connections; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Relocation.** This price is full compensation for furnishing and installing new stub posts, and new sign supports (when required); removing existing sign assemblies and related materials; modifying existing sign supports; reinstallation of signs and sign supports; preparing and cleaning the signs; hardware; salvaging and disposing of unsalvageable materials; removing existing foundations, backfilling, and surface placement; and materials, equipment, labor, tools, and incidentals.
- 5.3. **Removal.** This price is full compensation for removing existing sign assemblies and related materials; salvaging; disposal of unsalvageable materials; removing existing foundations, backfilling, and surface placement; and materials, equipment, labor, tools, and incidentals.

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Item 650

Overhead Sign Supports



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect overhead sign supports.
- **Relocation.** Remove and relocate existing overhead sign supports.
- **Removal.** Remove existing overhead sign supports.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 618, "Conduit"

Furnish alloy steel or medium-strength mild steel anchor bolts in accordance with Section 449.2.1., "Bolts and Nuts" unless otherwise shown on the plans. Furnish galvanized steel, non-corroding stainless steel, or dichromate-sealed aluminum brackets, clamps, bolts, and other hardware, in accordance with DMS-7120, "Sign Hardware."

Reuse undamaged components when relocating an existing overhead sign structure. Provide new components to replace any damaged during removal or relocation, in accordance with the Items listed in this Article, unless otherwise directed.

3. CONSTRUCTION

- 3.1. **Alternate Design.** Alternate designs of monotube overhead sign supports are not permitted. The Department will consider alternate designs for cantilevered-truss type overhead sign support columns that meet the requirements of this specification and the plans.
- Submit design calculations and a list of proposed materials, including anchor bolts, before submitting shop drawings. Computer-generated design parameters and calculations are not acceptable unless accompanied by the appropriate supporting documentation.
 - Determine the size of pipe to be used for the column from the appropriate Cantilever Overhead Sign Supports (COSS) or High Level Cantilever Overhead Sign Supports (HCOSS) standard plan tables for the height and span specified on the plans.
 - Determine the maximum design parameters from the COSS or HCOSS standard plan tables for that size of pipe.
 - Ensure alternate designs meet or exceed these maximum design parameters.
 - Provide top column dimensions compatible with the sign truss mounting details.
 - Ensure bottom diameter of the column is compatible with foundation details.
 - Limit welds to 2 longitudinal seam welds per column.

- Provide full penetration longitudinal seam welds within 6 in. of circumferential welds, and 85% minimum penetration seam welds at other column locations.
- Provide longitudinal seam weld and fit-up that will minimize acid entrapment during later galvanizing.

- 3.2. **Shop Drawings.** Electronically submit shop drawings for overhead sign supports in accordance with **Item 441, "Steel Structures."** Include details for anchor bolts, highway and dynamic message sign sizes and positions, walkways, and other required attachments on shop drawings.

Submit only 1 drawing for 2 or more supports of identical design and dimensions. Submit shop drawings to the Bridge Division, unless otherwise shown on the plans.

- 3.3. **Fabrication.** Fabricate and weld in accordance with **Item 441, "Steel Structures,"** AWS D1.1, *Structural Welding Code—Steel*; and the requirements of this Item.

Fabrication plants that produce overhead sign support structures must be approved in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication and Plant Qualification." The Construction Division maintains a list of approved overhead sign support structure fabrication plants.

For cantilevered-truss type overhead sign support columns with diameters exceeding 30 in., one circumferential weld splice is permitted per column. Locate the splice at the height of 1/2 the column length. Provide mounting channels for the installation of traffic control devices unless otherwise shown on the plans.

Permanently mark sign support base plates with the fabrication plant's insignia or trademark. For monotube type supports, place the mark on the base plate adjacent to the hand hole access compartment.

Conformance to plans and other approved drawings does not relieve the Contractor of responsibility for proper fit of components.

- 3.4. **Galvanizing.** Punch or drill permitted holes in steel parts or members before galvanizing. Hot-dip galvanize all fabricated parts in accordance with **Item 445, "Galvanizing."**

- 3.5. **Galvanizing Repair.** Repair galvanizing for steel parts or members damaged in assembly, transit, or erection; for permitted field-drilled holes; or for steel parts or members welded after galvanizing in accordance with the pertinent requirements of **Section 445.3.5., "Repairs."**

- 3.6. **Installation.** Stake sign support locations for verification by the Engineer. Install overhead sign support structures at verified locations.

Use established industry and utility safety practices when erecting sign supports near overhead or underground utilities. Consult with appropriate utility companies before beginning work.

Construct concrete overhead sign support columns, spans, or both, as shown on the plans and in accordance with **Item 420, "Concrete Substructures."**

Construct foundations for new overhead sign supports in accordance with **Item 416, "Drilled Shaft Foundations,"** and the details shown on the plans. Orient anchor bolts as shown on the plans. Cap conduit before concrete placement. Ensure the anchor bolt and template assembly is held in position during concrete placement. Use bracing attached to the upper template to ensure conduit is held in place during concrete placement. Remove top template after the concrete achieves initial set.

Erect structures after foundation concrete has attained its design strength as required in the plans and **Item 421, "Hydraulic Cement Concrete."** Coat anchor bolt threads and tighten anchor bolts in accordance with **Item 449, "Anchor Bolts."** Ensure that the structure is plumb. Do not use springing or raking of columns, towers, or anchor bolts to achieve plumb.

Tack weld each anchor bolt nut to its washer in 2 places and tack weld each washer to the base plate in 2 places after the overhead sign support has been plumbed and all nuts are tight. Tack weld in accordance with **Item 441, "Steel Structures,"** AWS D1.1, *Structural Welding Code—Steel*; and the requirements of this Item. Do not weld components to the bolt. Repair galvanizing damage on bolts, nuts, and washers after tack welding in accordance with **Section 445.3.5., "Repairs."** Do not grout between the base plate and foundation.

Ensure sign faces are vertical.

- 3.7. **Relocation.** Disconnect and isolate electrical power supplies before removing the structure. Remove existing overhead sign support structures as directed. Ensure the structures or attached components suffer no undue stress or damage. Signs, sign walkways, mounting brackets, etc., may be left on the structures, unless otherwise shown on the plans or as directed. Repair or replace damaged components as directed.

Remove abandoned concrete foundations and replace surfacing in accordance with **Section 650.3.8., "Removal,"** unless otherwise shown on the plans

Move existing overhead sign supports to locations shown on the plans or as directed. Construct foundations for relocated overhead sign supports in accordance with **Item 416, "Drilled Shaft Foundations,"** and the details shown on the plans. Install existing structures on new foundations in accordance with **Section 650.3.6., "Installation."**

Never reuse or replace lighting materials. Reuse other existing components, with the exception of conductors, unless otherwise directed. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

- 3.8. **Removal.** Disconnect and isolate electrical power supplies before removing the structure. Remove sign panels, walkways, lighting fixtures, lighting brackets, ballast boxes, and other accessories from overhead sign supports. Remove and store items designated for reuse or salvage at locations shown on the plans or as directed. Store sign panels above the ground in a vertical position. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

Remove abandoned concrete foundations, including steel, to 2 ft. below finished grade unless otherwise shown on the plans. Cut off and remove steel protruding from the remaining concrete. Backfill with material equal in composition and density to the surrounding area, and replace surfacing with like material to an equivalent condition.

4. MEASUREMENT

This Item will be measured as each overhead sign support installed, relocated, or removed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Overhead Sign Supports" of the type and span lengths specified, "Relocate Existing Overhead Sign Supports," and "Remove Overhead Sign Supports." The span lengths will be the design span lengths shown on the plans rounded up to the next 5-ft. increment.

New drilled shaft foundations will be paid for under **Item 416, "Drilled Shaft Foundations."** New concrete columns and spans will be paid for under **Item 420, "Concrete Substructures."** New signs will be paid for under **Item 636, "Signs."** New sign walkways will be paid for under **Item 654, "Sign Walkways."**

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, assembling, and erecting the overhead sign supports; furnishing and placing anchor bolts, nuts, washers, and templates; furnishing and placing conduit, ground rods, and wiring; and materials, equipment, labor, tools, and incidentals.

- 5.2. **Relocation.** This price is full compensation for removing overhead sign supports; removing existing foundations; backfilling and surface placement; storing the components to be reused or salvaged; disposal of unsalvageable materials; furnishing, fabricating, and installing required new components including anchor bolts, nuts, washers, and templates; placing and securing sign supports on new foundations; furnishing and placing conduit, ground rods, and wiring; loading and hauling; and materials, equipment, labor, tools, and incidentals.
- 5.3. **Removal.** This price is full compensation for removing overhead sign support components; removing the foundations; storing the components to be reused or salvaged; disposal of unsalvageable materials; backfilling and surface placement; loading and hauling; and materials, equipment, labor, tools, and incidentals.

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Item 654

Sign Walkways



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect sign walkways.
- **Removal.** Remove sign walkways.

2. MATERIALS

Provide materials and construct sign walkways and handrails in accordance with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 441, "Steel Structures"
- Item 445, "Galvanizing"

3. CONSTRUCTION

- 3.1. **Standard Designs.** Provide sign walkways as shown on the plans. Electronically submit shop drawings in accordance with [Item 441, "Steel Structures."](#) Submit shop drawings for sign walkways with shop drawings for overhead sign supports. Electronically submit separate shop drawings for sign walkways when installing sign walkways on existing overhead sign supports. Walkways of identical design and dimensions require only a single shop drawing submission. Electronically submit shop drawings to the Bridge Division unless otherwise shown on the plans.
- 3.2. **Fabrication.** Fabricate and weld sign walkways in accordance with [Item 441, "Steel Structures,"](#) the requirements of this Item, and AWS D1.1, *Structural Welding Code—Steel*.
- Conformance to the plans and other approved drawings does not relieve the Contractor of the responsibility for proper fit of components.
- 3.3. **Galvanizing.** Hot-dip galvanize all fabricated parts in accordance with [Item 445, "Galvanizing."](#) Punch or drill permitted holes in steel parts or members prior to galvanizing. Repair galvanizing for any steel part or member damaged in assembly, transit, or erection or for any steel part or member welded when permitted after galvanizing. Make all galvanizing repairs in accordance with [Item 445, "Galvanizing."](#)
- 3.4. **Delivery and Installation.** Deliver each sign walkway as a complete unit or with sub-assemblies marked for field assembly. Install all fittings and hardware, or package all parts together with their associated major components during shipment. Erect the sign walkway in accordance with the details shown on the plans.
- 3.5. **Removal.** Remove sign walkways without damaging materials, and salvage them when indicated on the plans. Stockpile salvaged materials at the location shown on the plans and as directed. Accept ownership of unsalvageable materials, and dispose of them in accordance with federal, state, and local regulations.

4. MEASUREMENT

This Item will be measured by the foot installed or each sign walkway removed.

This is a plans quantity measurement Item. The quantity to be paid for is the quantity shown in the proposal, unless modified by [Article 9.2., "Plans Quantity Measurement."](#) Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Sign Walkways" of the types and widths specified or for "Remove Sign Walkways."

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, assembling, and erecting sign walkways; furnishing and placing required handrails, including connections, latches, plates, bolts, nuts, and washers; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Removal.** This price is full compensation for removing various components; stockpiling; disposal of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

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Item 656

Foundations for Traffic Control Devices



1. DESCRIPTION

Construct concrete foundations for small roadside signs, traffic signal controllers, pedestal poles, roadside flashing beacon assemblies, electrical services, and other small traffic control devices.

2. MATERIALS

Ensure materials and construction methods conform to the requirements of this Item and the pertinent requirements of the following Items:

- Item 400, "Excavation and Backfill for Structures"
- Item 416, "Drilled Shaft Foundations"
- Item 420, "Concrete Substructures"
- Item 421, "Hydraulic Cement Concrete"
- Item 432, "Riprap"
- Item 440, "Reinforcement for Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 447, "Structural Bolting"
- Item 449, "Anchor Bolts"
- Item 618, "Conduit"

Use Class A concrete for non-reinforced drilled shafts. Use Class C concrete for reinforced drilled shafts. Use Class B concrete or polymer concrete composed of borosilicate glass fiber, catalyzed polyester resin, and aggregate for traffic signal controller foundations. Use drilled shaft or galvanized steel screw-in type foundations for roadside flashing beacon assemblies.

Use reinforcing steel when required.

3. CONSTRUCTION

Stake and install foundations as shown on the plans. The Engineer may shift the foundation locations within design guidelines where necessary to secure a more desirable location or avoid conflict with utilities. Use established industry and utility safety practices when working near underground or overhead utilities. Consult the appropriate utility before beginning work.

Hold anchor bolts in place with templates during concrete placement. Hold embedded items such as conduit or other hardware in place during concrete placement with templates or other approved means. Cap conduits before placing concrete. Ream conduit to remove burrs and sharp edges. Install bell ends or bushings on the conduit.

Carefully align foundation, posts, and anchor bolts. Do not spring or rake posts or anchor bolts.

Remove the top template after concrete has achieved initial set. Keep forms and other bracing intact until the concrete has cured at least one curing day.

Allow concrete for pedestal poles and roadside flashing beacon assemblies to cure at least 7 days before placing bases and poles on the foundation unless otherwise permitted in writing.

Allow concrete for traffic signal controller foundations and small roadside signs to cure at least 4 days before placing cabinets and posts on the foundation unless otherwise permitted.

Provide an ordinary surface finish to the concrete foundation extending above ground in accordance with Section 420.4.13., "Ordinary Surface Finish."

Place concrete riprap around the foundation in accordance with the plans.

Backfill disturbed surface with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

4. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to pertinent items.

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Item 658

Delineator and Object Marker Assemblies



1. DESCRIPTION

- **Installation.** Install delineator or object maker assembly.
- **Removal.** Remove delineator or object marker assembly.

2. MATERIALS

Furnish only new materials in accordance with details shown on the plans unless otherwise directed. The Engineer will sample in accordance with Tex-725-I or Tex-737-I.

2.1. **Delineator and Object Marker Assemblies.** Fabricate in accordance with the following:

- DMS-8600, "Delineators, Object Markers, and Barrier Reflectors."
- DMS-4400, "Flexible Delineator and Object Marker Posts (Embedded and Surface-Mount Types)."

2.2. **Wing Channel Post.** Furnish material of the size shown on the plans. Supply a completed material identification form with supporting mill test report certifying that the base metal is in accordance with the following:

- ASTM A1011, SS Grade 50.
- ASTM A499.

Galvanize material in accordance with **Item 445, "Galvanizing."**

3. CONSTRUCTION

3.1. **Installation.** Locate delineators and object markers as shown on the plans or as directed.

Locate barrier reflectors as shown on the plans or as directed, and install in accordance with manufacturers recommendations.

Install winged channel post and flexible delineator posts to allow the reflector units and reflectorized panels to be installed at the specified height and orientation. Align post as shown or as directed.

Drive post plumb using a driving cap to prevent visible cross-section dimension distortion. Drill or drive a pilot hole when post cannot be driven without visibly distorting the cross-section dimension. Backfill pilot holes thoroughly by tamping in 6-in. lifts to grade.

Install surface-mount and other types of delineators and object markers in accordance with details shown on the plans.

Repair damaged galvanizing in accordance with **Section 445.3.5., "Repairs."** Install reflector units on wing channel posts after the posts have been erected.

3.2. **Removal.** Remove post assemblies without damaging materials and salvage when indicated on the plans. Remove post to a minimum of 6 in. below finish grade. Stockpile salvaged materials at the location shown on the plans or as directed. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local requirements.

4. MEASUREMENT

Installation will be measured by each delineator or object marker assembly installed. When removal is specified on the plans to be a pay item, it will be measured by each delineator or object marker assembly removed.

This is a plans quantity measurement item. The quantity to be paid for is shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Delineator Assemblies" or "Install Object Marker Assemblies" of the types and colors specified and for "Remove Delineator or Object Marker Assemblies."

5.1. **Installation.** This price is full compensation for furnishing and fabricating when required, and installing and mounting the delineator or object marker assemblies including posts, adhesive or pads for surface mount assemblies, back plates, reflector units, fastening plates, brackets, bolts, nuts, and washers; and materials, equipment, labor, tools, and incidentals.

5.2. **Removal.** Unless otherwise shown on the plans, removal will not be paid for directly, but is subsidiary to bid items of the Contract.

When removal is shown on the plans as a bid item, this price is full compensation for removal and disposal of delineator and object marker assemblies and for materials, equipment, labor, tools, and incidentals.

Item 662

Work Zone Pavement Markings



1. DESCRIPTION

Furnish, place, and maintain work zone pavement markings.

2. MATERIALS

Provide thermoplastic, paint and beads, raised pavement markers (RPMs), prefabricated pavement markings, temporary flexible reflective roadway marker tabs, or other approved materials for work zone pavement markings.

Supply materials meeting:

- DMS-4200, "Pavement Markers (Reflectorized),"
- DMS-4300, "Traffic Buttons,"
- DMS-8200, "Traffic Paint,"
- DMS-8220, "Hot Applied Thermoplastic,"
- DMS-8240, "Permanent Prefabricated Pavement Markings,"
- DMS-8241, "Temporary (Removable) Prefabricated Pavement Markings,"
- DMS-8242, "Temporary Flexible, Reflective Roadway Marker Tabs," and
- DMS-8290, "Glass Traffic Beads."

2.1. **Nonremovable Markings.** Use hot-applied thermoplastic or permanent prefabricated pavement markings for nonremovable markings. Paint and beads or other materials are not allowed for nonremovable markings unless shown on the plans.

2.2. **Removable and Short-Term Markings.** Use RPMs, removable prefabricated pavement markings, temporary flexible reflective roadway marker tabs, or other approved materials for removable and short-term markings. Do not use hot-applied thermoplastic or traffic paint for removable markings. Use removable prefabricated pavement markings on the final pavement surface when the plans specify removable markings.

3. CONSTRUCTION

Apply pavement markings in accordance with the following Items.

- Item 666, "Reflectorized Pavement Markings"
- Item 668, "Prefabricated Pavement Markings"
- Item 672, "Raised Pavement Markers"

3.1. **Placement.** Install longitudinal markings on pavement surfaces before opening to traffic. Maintain lane alignment traffic control devices and operations until markings are installed. Install markings in proper alignment in accordance with the TMUTCD and as shown on the plans. Short-term markings will be allowed when standard markings (removable or nonremovable) cannot be placed before opening to traffic, if shown on the plans or directed.

When short-term markings are allowed for opening to traffic, place standard longitudinal markings no later than 14 calendar days after the placement of the surface. When inclement weather prohibits placement of markings, the 14-day period may be extended until weather permits proper application.

Place standard longitudinal markings no sooner than 3 calendar days after the placement of a surface treatment, unless otherwise shown on the plans.

Apply thermoplastic markings to a minimum thickness of 0.060 in. (60 mils). When paint and beads are allowed, apply to a minimum dry thickness of 0.012 in. (12 mils).

Place short-term markings in proper alignment with the location of the final pavement markings. Remove and replace short-term markings not in alignment at the Contractor's expense.

For removable placements, use of RPMs to simulate longitudinal markings is at the Contractor's option. Use side-by-side RPMs to simulate longitudinal lines wider than 4 in. Do not use RPMs for words, symbols, shapes, or diagonal or transverse lines.

- 3.2. **Marking Removal.** Remove markings that conflict with succeeding markings in accordance with **Item 677, "Eliminating Existing Pavement Markings and Markers."** Remove short-term markings that interfere or conflict with final marking placement immediately before placing final pavement markings, unless otherwise directed. Remove the remainder of the short-term markings before final acceptance.

Remove all temporary markings with minimal damage to the roadway to the satisfaction of the Engineer.

- 3.3. **Performance Requirements.** Ensure all markings are visible from a distance at least 300 ft. in daylight conditions and at least 160 ft. in nighttime conditions when illuminated by automobile low-beam headlights. Determine visibility distances using an automobile traveling on the roadway under dry conditions.

Maintain the markings for 30 calendar days after installation. The end of the 30-day maintenance period does not relieve the Contractor from the performance deficiencies requiring corrective action identified during the 30-day period. Remove and replace markings at the Contractor's expense if they fail to meet the requirements of this Item during the 30-day period. The 30-calendar day performance requirement will begin again after replacement of the markings.

Ensure daytime and nighttime reflected color of the markings are distinctly white or yellow. Ensure markings exhibit uniform retroreflective characteristics.

4. MEASUREMENT

This Item will be measured by the foot or each word, shape, symbol, or temporary flexible reflective roadway marker tab. Each stripe will be measured separately. RPMs used to simulate a marking will be measured by the foot of marking or each RPM.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by **Article 9.2., "Plans Quantity Measurement."** Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Work Zone Pavement Markings" of the type and color specified and the shape, width, and size specified as applicable. This price is full compensation for furnishing, placing, maintaining, and removing work zone pavement markings and for materials, equipment, labor, tools, and incidentals.

Elimination of nonremovable markings will be paid for under **Item 677, "Eliminating Existing Pavement Markings and Markers."** Removal of short-term and removable markings will not be paid for directly, but will be subsidiary to this Item.

Type II work zone pavement markings (paint and beads) used as a sealer for Type I pavement markings (thermoplastic) will be paid for under this Item.

DRAFT

Item 666

Retroreflectorized Pavement Markings



1. DESCRIPTION

Furnish and place retroreflectorized, non-retroreflectorized (shadow) and profile pavement markings.

2. MATERIALS

2.1. **Type I Marking Materials.** Furnish in accordance with DMS-8220, "Hot Applied Thermoplastic."

Furnish pavement marking material used for Type I profile markings and shadow markings that have been approved by the Construction Division, and in accordance with DMS-8220, "Hot Applied Thermoplastic."

2.2. **Type II Marking Materials.** Furnish in accordance with DMS-8200, "Traffic Paint."

2.3. **Glass Traffic Beads.** Furnish drop-on glass beads in accordance with DMS-8290, "Glass Traffic Beads" or as approved. Furnish a double-drop of Type II and Type III drop-on glass beads where each type bead is applied separately in equal portions (by weight), unless otherwise approved. Apply the Type III beads before applying the Type II beads.

2.4. **Labeling.** Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

3. EQUIPMENT

3.1. **General Requirements.** Use equipment that:

- is maintained in satisfactory condition,
- meets or exceeds the requirements of the National Board of Fire Underwriters and the Texas Railroad Commission for this application,
- applies beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser must have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment,
- has an automatic cut-off device with manual operating capabilities to provide clean, square marking ends,
- is capable of producing the types and shapes of profiles specified, and
- can provide continuous mixing and agitation of the pavement marking material. The use of pans, aprons, or similar appliances which the die overruns will not be permitted for longitudinal striping applications.

Provide a hand-held thermometer capable of measuring the temperature of the marking material when applying Type I material.

When pavement markings are required to meet minimum retroreflectivity requirements on the plans:

- Use a mobile retroreflectometer approved by the Construction Division and certified by the Texas Transportation Institute Mobile Retroreflectometer Certification Program.
- Use a portable retroreflectometer that:

- uses 30-meter geometry and meets the requirements described in ASTM E1710;
- has either an internal global positioning system (GPS) or the ability to be linked with an external GPS with a minimum accuracy rating of 16 ft. 5 in., in accordance with the circular error probability (CEP) method (CEP is the radius of the circle with its origin at a known position that encompasses 50% of the readings returned from the GPS instrument);
- can record and print the GPS location and retroreflectivity reading for each location where readings are taken.

3.2.

Material Placement Requirements. Use equipment that can place:

- at least 40,000 ft. of 4-in. solid or broken non-profile markings per working day at the specified thickness;
- at least 15,000 ft. of solid or broken profile pavement markings per working day at the specified thickness;
- linear non-profile markings up to 8 in. wide in a single pass;
- non-profile pavement markings other than solid or broken lines at an approved production rate;
- a centerline and no-passing barrier-line configuration consisting of 1 broken line and 2 solid lines at the same time to the alignment, spacing, and thickness for non-profile pavement markings shown on the plans;
- solid and broken lines simultaneously;
- white line from both sides;
- lines with clean edges, uniform cross-section with a tolerance of $\pm 1/8$ in. per 4 in. width, uniform thickness, and reasonably square ends;
- skip lines between 10 and 10-1/2 ft., a stripe-to-gap ratio of 10 to 30, and a stripe-gap cycle between 39-1/2 ft. and 40-1/2 ft., automatically;
- beads uniformly and almost instantly on the marking as the marking is being applied;
- beads uniformly during the application of all lines (each line must have an equivalent bead yield rate and embedment); and
- double-drop bead applications using both Type II and Type III beads from separate independent bead applicators, unless otherwise approved by the Engineer.

4.

CONSTRUCTION

Place markings before opening to traffic unless short-term or work zone markings are allowed.

4.1.

General. Obtain approval for the sequence of work and estimated daily production. Minimize interference to roadway operations when placing markings on roadways open to traffic. Use traffic control as shown on the plans or as approved. Protect all markings placed under open-traffic conditions from traffic damage and disfigurement.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway.

Apply markings on pavement that is completely dry and passes the following tests:

- **Type I Marking Application**—Place a sample of Type I marking material on a piece of tarpaper placed on the pavement. Allow the material to cool to ambient temperature, and then inspect the underside of the tarpaper in contact with the pavement. Pavement will be considered dry if there is no condensation on the tarpaper.
- **Type II Marking Application**—Place a 1-sq. ft. piece of clear plastic on the pavement, and weight down the edges. The pavement is considered dry if, when inspected after 15 min., no condensation has occurred on the underside of the plastic.

Apply markings:

- that meet the requirements of Tex-828-B,
- that meet minimum retroreflectivity requirements when specified on the plans (applies to Type I markings only),
- using widths and colors shown on the plans,
- at locations shown on the plans,
- in proper alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum,
- without abrupt deviations,
- free of blisters and with no more than 5% by area of holes or voids,
- with uniform cross-section, density and thickness,
- with clean and reasonably square ends,
- that are retroreflectorized with drop-on glass beads, and
- using personnel skilled and experienced with installation of pavement markings.

Remove all applied markings that are not in alignment or sequence as stated on the plans, or in the specifications, at the Contractor's expense in accordance with **Item 677, "Eliminating Existing Pavement Markings and Markers,"** except for measurement and payment.

- 4.2. **Surface Preparation.** Prepare surfaces in accordance with this Section unless otherwise shown on the plans.
- 4.2.1. **Cleaning for New Asphalt Surfaces and Retracing of All Surfaces.** Air blast or broom the pavement surface for new asphalt surfaces (less than 3 years old) and for retracing of all surfaces to remove loose material, unless otherwise shown on the plans. A sealer for Type I markings is not required unless otherwise shown on the plans.
- 4.2.2. **Cleaning for Old Asphalt and Concrete Surfaces (Excludes Retracing).** Clean old asphalt surfaces (more than 3 years old) and all concrete surfaces in accordance with **Item 678, "Pavement Surface Preparation for Markings,"** to remove curing membrane, dirt, grease, loose and flaking existing construction markings, and other forms of contamination.
- 4.2.3. **Sealer for Type I Markings.** Apply a pavement sealer to old asphalt surfaces (more than 3 years old) and to all concrete surfaces before placing Type I markings on locations that do not have existing markings, unless otherwise approved. The pavement sealer may be either a Type II marking or an acrylic or epoxy sealer as recommended by the Type I marking manufacturer unless otherwise shown on the plans. Follow the manufacturer's directions for application of acrylic or epoxy sealers. Clean sealer that becomes dirty after placement by washing or in accordance with **Section 666.4.2.1., "Cleaning for New Asphalt Surfaces and Retracing of All Surfaces,"** as directed. Place the sealer in the same configuration and color (unless clear) as the Type I markings unless otherwise shown on the plans.
- 4.3. **Application.** Apply markings during good weather unless otherwise directed. If markings are placed at Contractor option when inclement weather is impending and the markings are damaged by subsequent precipitation, the Contractor is responsible for all required replacement costs.
- 4.3.1. **Type I Markings.** Place the Type I marking after the sealer cures. Apply within the temperature limits recommended by the material manufacturer. Flush the spray head if spray application operations cease for 5 min or longer by spraying marking material into a pan or similar container until the material being applied is at the recommended temperature.

Apply on clean, dry pavements passing the moisture test described in **Section 666.4.1., "General,"** and with a surface temperature above 50°F when measured in accordance with Tex-829-B.

- 4.3.1.1. **Non-Profile Pavement Markings.** Apply Type I non-profile markings with a minimum thickness of:
- 0.100 in. (100 mils) for new markings and retracing water-based markings on surface treatments involving **Item 316, "Surface Treatments,"** or **Item 318, "Hot Asphalt-Rubber Surface Treatments,"**
 - 0.060 in. (60 mils) for retracing on thermoplastic pavement markings, or
 - 0.090 in. (90 mils) for all other Type I markings.

The maximum thickness for Type I non-profile markings is 0.180 in. (180 mils). Measure thickness for markings in accordance with Tex-854-B using the tape method.

- 4.3.1.2. **Profile Pavement Markings.** Apply Type I profile markings with a minimum thickness of:
- 0.060 in. (60 mil) for edgeline markings, or
 - 0.090 in. (90 mil) for gore and centerline/no-passing barrier line markings.

In addition, at a longitudinal spacing indicated on the plans, the markings must be profiled in a vertical manner such that the profile is transverse to the longitudinal marking direction. The profile must not be less than 0.30 in. (300 mil) nor greater than 0.50 in. (500 mil) in height when measured above the normal top surface plane of the roadway. The transverse width of the profile must not be less than 3.25 in., and the longitudinal width not less than 1 in., when measured at the top surface plane of the profile bar. The profile may be either a 1 or 2 transverse bar profile. When the 2 transverse bar profile is used, the spacing between the bases of the profile bars must not exceed 0.50 in. The above transverse bar width is for each 4 in. of line width.

- 4.3.2. **Type II Markings.** Apply on surfaces with a minimum surface temperature of 50°F. Apply at least 20 gal. per mile on concrete and asphalt surfaces and at least 22 gal. per mile on surface treatments for a solid 4-in. line. Adjust application rates proportionally for other widths. When Type II markings are used as a sealer for Type I markings, apply at least 15 gal. per mile using Type II drop-on beads.

- 4.3.3. **Bead Coverage.** Provide a uniform distribution of beads across the surface of the stripe for Type I and Type II markings, with 40% to 60% bead embedment.

- 4.4. **Retroreflectivity Requirements.** When specified on the plans, Type I markings must meet the following minimum retroreflectivity values for edgeline markings, centerline or no passing barrier-line, and lane lines when measured any time after 3 days, but not later than 10 days after application:

- White markings: 250 millicandelas per square meter per lux (mcd/m²/lx)
- Yellow markings: 175 mcd/m²/lx

- 4.5. **Retroreflectivity Measurements.** Use a mobile retroreflectometer for projects requiring minimum retroreflectivity requirements to measure retroreflectivity for Contracts totaling more than 200,000 ft. of pavement markings, unless otherwise shown on the plans. For Contracts with less than 200,000 ft. of pavement markings or call out work Contracts, mobile or portable retroreflectometers may be used at the Contractor's discretion.

- 4.5.1. **Mobile Retroreflectometer Measurements.** Provide mobile measurements averages for every 0.1 miles unless otherwise specified or approved. Take measurements on each section of roadway for each series of markings (i.e. edgeline, center skip line, each line of a double line, etc.) and for each direction of traffic flow. Measure each line in both directions for centerlines on two-way roadways (i.e. measure both double solid lines in both directions and measure all center skip lines in both directions). Furnish measurements in compliance with Special Specification, "Mobile Retroreflectivity Data Collection for Pavement Markings," unless otherwise approved. The Engineer may require an occasional field comparison check with a portable retroreflectometer meeting the requirements listed above to ensure accuracy. Use all equipment in accordance with the manufacturer's recommendations and directions. Inform the Engineer at least 24 hr. before taking any measurements.

A marking meets the retroreflectivity requirements if:

- the combined average retroreflectivity measurement for a one-mile segment meets the minimum retroreflectivity values specified, and
- no more than 30% of the retroreflectivity measurement values are below the minimum retroreflectivity requirements value within the one-mile segment.

The Engineer may accept failing one-mile segments if no more than 20% of the retroreflectivity measurements within that mile segment are below the minimum retroreflectivity requirement value.

The one-mile segment will start from the beginning of the data collection and end after a mile worth of measurements have been taken; each subsequent mile of measurements will be a new segment. Centerlines with two stripes (either solid or broken) will result in 2 miles of data for each mile segment. Each centerline stripe must be tested for compliance as a stand-alone stripe.

Restripe at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking if the marking fails retroreflectivity requirements. Take measurements every 0.1 miles a minimum of 10 days after this second application within that mile segment for that series of markings.

If the markings do not meet minimum retroreflectivity after 10 days of this second application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

- 4.5.2. **Portable Retroreflectometer Measurements.** Take a minimum of 20 measurements for each 1 mile section of roadway for each series of markings (i.e. edgeline, center skip line, each line of a double line, etc.) and direction of traffic flow when using a portable reflectometer. Measure each line in both directions for centerlines on two-way roadways (i.e. measure both double solid lines in both directions and measure all center skip lines in both directions). The spacing between each measurement must be at least 100 ft. The Engineer may decrease the mileage frequency for measurements if the previous measurements provide satisfactory results. The Engineer may require the original number of measurements if concerns arise.

Restripe once at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements fails. Take a minimum of 10 more measurements after 10 days of this second application within that mile segment for that series of markings. Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements fall below the minimum retroreflectivity requirements. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

- 4.5.3. **Traffic Control.** Provide traffic control, as required, when taking retroreflectivity measurements after marking application. On low volume roadways (as defined on the plans), refer to the figure, "Temporary Road Closure" in Part 6 of the *Texas Manual on Uniform Traffic Control Devices* for the minimum traffic control requirements. For all other roadways, the minimum traffic control requirements will be as shown on the Traffic Control Plan (TCP) standard sheets TCP (3-1) and TCP (3-2). The lead vehicle will not be required on divided highways. The TCP and traffic control devices must meet the requirements listed in Item 502, "Barricades, Signs, and Traffic Handling." Time restrictions that apply during striping application will also apply during the retroreflectivity inspections except when using the mobile retroreflectometer unless otherwise shown on the plans or approved.

- 4.6. **Performance Period.** All markings must meet the requirements of this specification for at least 30 calendar days after installation. Unless otherwise directed, remove pavement markings that fail to meet requirements, and replace at the Contractor's expense. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

5. MEASUREMENT

This Item will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans. Each stripe will be measured separately.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Acrylic or epoxy sealer, or Type II markings when used as a sealer for Type I markings, will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Sealer" of the size specified, "Retroreflectorized Pavement Markings" of the type and color specified and the shape, width, size, and thickness specified as applicable, Retroreflectorized Pavement Markings with Retroreflective Requirements" of the types, colors, sizes, widths, and thicknesses specified or "Retroreflectorized Profile Pavement Markings" of the various types, colors, shapes, sizes, and widths specified.

This price is full compensation for application of pavement markings, materials, equipment, labor, tools, and incidentals.

Surface preparation of new concrete and asphalt concrete pavements more than 3 years old, where no stripe exists, will be paid for under Item 678, "Pavement Surface Preparation for Markings." Surface preparation of all other asphalt and old concrete pavement, except for sealing, will not be paid for directly, but is subsidiary to this Item.

Work-zone pavement markings (Type II, paint and beads) used as a sealer for Type I markings (thermoplastic) will be paid for under Item 662, "Work Zone Pavement Markings."

If the Engineer requires that markings be placed in inclement weather, repair or replacement of markings damaged by the inclement weather will be paid for in addition to the original plans quantity.

Item 668

Prefabricated Pavement Markings



1. DESCRIPTION

Furnish and place retroreflectorized or non-reflectorized (contrast) prefabricated pavement markings.

2. MATERIALS

Furnish prefabricated pavement marking materials in accordance with DMS-8240, "Permanent Prefabricated Pavement Markings."

Furnish prefabricated pavement marking materials used for contrast markings in accordance with DMS-8240, "Permanent Prefabricated Pavement Markings," with the exception that the color requirement for the black contrast portion does not have to meet the color requirements specified for white or yellow markings. Store all materials in a weatherproof enclosure and prevent damage during storage.

3. CONSTRUCTION

3.1. **General.** Obtain approval for the sequence of work and estimated daily production. Remove all waste generated from the jobsite before the end of each working day.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use guide material that will not leave a permanent mark on the roadway.

Place pavement markings in alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum and with no abrupt deviations.

3.2. **Placement Limitations.** Do not place Type B pavement-marking materials between September 30 and March 1 unless otherwise directed.

3.2.1. **Moisture.** Apply material to pavement that is completely dry. Pavement will be considered dry if, on a sunny day after 15 min., no condensation occurs on the underside of a 1-sq. ft. piece of clear plastic that has been placed on the pavement and weighted on the edges.

3.2.2. **Temperature.** Follow pavement and ambient air temperature requirements recommended by the material manufacturer. Do not place material when the pavement temperature is below 60°F or above 120°F if the material manufacturer does not establish temperature requirements.

3.3. **Dimensions.** Place markings in accordance with the color, length, width, shape, and configuration shown on the plans. Locate alignment as shown on the plans or as directed.

3.4. **Methods.** Place all materials in accordance with the material manufacturer's instructions, as well as the surface condition, moisture and temperature requirements of this Item, unless otherwise directed.

3.5. **Surface Preparation.** Prepare surface by any approved cleaning method that effectively removes contaminants, loose materials, and conditions deleterious to proper adhesion. Abrasive or water-blast cleaning is not required unless shown on the plans. Blast clean, when required, in accordance with **Item 678, "Pavement Surface Preparation for Markings."** Prepare surfaces further after cleaning by sealing or priming as recommended by the pavement-marking material manufacturer or as directed. Use adhesive, when

required, of the type and quality recommended by the pavement-marking material manufacturer. Do not clean concrete pavement surfaces by grinding.

3.6. **Performance Requirements.**

3.6.1. **Adhesion.** Ensure markings do not lift, shift, smear, spread, flow, or tear by traffic action.

3.6.2. **Appearance.** Ensure markings present a neat, uniform appearance that is free of excessive adhesive, ragged edges, and irregular lines or contours.

3.6.3. **Visibility.** Ensure markings have uniform and distinctive retroreflectance when inspected in accordance with Tex-828-B.

3.7. **Performance Period.** All markings and replacement markings must meet the requirements of this Item for at least 30 calendar days after installation. Remove and replace all pavement markings that fail to meet requirements at the Contractor's expense unless otherwise directed. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

4. **MEASUREMENT**

This Item will be measured by the foot or by each word, shape, or symbol.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Prefabricated Pavement Markings" of the type and color specified and the shape, width, and size specified as applicable. This price is full compensation for cleaning the pavement by any means other than required abrasive or water-blast cleaning or milling; furnishing and placing materials; and equipment, labor, tools, and incidentals.

Abrasive or water-blast cleaning and milling, when shown on the plans, will be paid for under Item 678, "Pavement Surface Preparation for Markings."

Item 672

Raised Pavement Markers



1. DESCRIPTION

Furnish and install raised pavement markers (RPMs).

2. MATERIALS

2.1. **Markers.** Furnish RPMs in accordance with the following Department Material Specifications:

- **Reflectorized Pavement Markers.** DMS-4200, "Pavement Markers (Reflectorized)," types I-A, I-C, I-R, II-A-A, and II-C- R.
- **Traffic Buttons.** DMS-4300, "Traffic Buttons," types I-A, I-C, I-R, II-A-A, II-C- R, W, Y and B. Round or oval unless otherwise specified on the plans.
- **Plowable Reflectorized Pavement Markers.** DMS-4210, "Snowplowable Pavement Markers", types I-A, I-C, I-R, II-A-A, and II-C- R.

The following are descriptions for each type of RPM:

- **Type I-A.** The approach face must retro-reflect amber light. The body, other than the retro-reflective face, must be yellow.
- **Type I-C.** The approach face must retro-reflect white light. The body, other than the retro-reflective face, must be white or silver-white.
- **Type I-R.** The trailing face must retro-reflect red light. The body, other than the retro-reflective face, must be white or silver-white, except for I-R plowable markers which may be black.
- **Type II-A-A.** The two retro-reflective faces (approach and trailing) must retro-reflect amber light. The body, other than the retro-reflective faces, must be yellow.
- **Type II-C-R.** Contain two retro-reflective faces with an approach face that must retro-reflect white light and a trailing face that must retro-reflect red light. The body, other than the retro-reflective faces, must be white or silver-white.
- **Type W.** Must have a white body and no reflective faces.
- **Type Y.** Must have a yellow body and no reflective faces.
- **Type B.** Must have a black body and no reflective faces.

2.2. **Adhesives.** Furnish adhesives that conform to the following requirements:

- DMS-6100, "Epoxies and Adhesives," Type II—Traffic Marker Adhesives.
- DMS-6130, "Bituminous Adhesive for Pavement Markers."
- The Contractor may propose alternate adhesive materials for consideration and approval.

2.3. **Sampling.** The Engineer will sample in accordance with Tex-729-I.

3. CONSTRUCTION

Remove existing RPMs in accordance with [Item 677, "Eliminating Existing Pavement Markings and Markers"](#) (except for measurement and payment). Furnish RPMs for each class from the same manufacturer. Prepare all surfaces in accordance with [Item 678, "Pavement Surface Preparation for Markings,"](#) when shown on the plans. Ensure the bond surfaces are free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings, and any other material that would adversely affect the adhesive bond.

Establish pavement marking guides to mark the lateral location of RPMs as shown on the plans and as directed. Do not make permanent marks on the roadway for the guides.

Place RPMs in proper alignment with the guides. Acceptable placement deviations are shown on the plans.

Remove RPMs placed out of alignment or sequence, as shown on the plans or stated in this specification, at Contractor's expense, in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers" (except for measurement and payment).

Use the following adhesive materials for placement of reflectorized pavement markers, and traffic buttons unless otherwise shown on the plans:

- standard or flexible bituminous adhesive for applications on bituminous pavements, and
- epoxy adhesive or flexible bituminous adhesive for applications on hydraulic cement concrete pavements.

Use epoxy adhesive for plowable reflectorized pavement markers.

Apply enough adhesives to:

- ensure that 100% of the bonding area of RPMs is in contact with the adhesive, and
- ensure that RPMs, except for plowable markers, are seated on a continuous layer of adhesive and not in contact with the pavement surface.

Apply adhesives in accordance with manufacturer's recommendations unless otherwise required by this Article. Apply bituminous adhesive only when pavement temperature and RPM temperature are 40°F or higher. Do not heat bituminous adhesive above 400°F. Machine agitate bituminous adhesive continuously before application to ensure even heat distribution.

Machine-mix epoxy adhesive. Apply epoxy adhesive only when pavement temperature is 50°F or higher.

Furnish RPMs free of rust, scale, dirt, oil, grease, moisture, and contaminants that might adversely affect the adhesive bond.

Place RPMs immediately after the adhesive is applied and ensure proper bonding. Do not use adhesives or any other material that impairs the functional retro-reflectivity of the RPMs.

Provide a 30-day performance period that begins the day following written acceptance for each separate location. The date of written acceptance will be the last calendar day of each month for the RPMs installed that month for the completed separate project locations. This written acceptance does not constitute final acceptance.

Replace all missing, broken or non-reflective RPMs. Visual evaluations will be used for these determinations. Upon request, the Engineer will allow a Contractor representative to accompany the Engineer on these evaluations.

The Engineer may exclude RPMs from the replacement provisions of the performance, provided the Engineer determines the failure is a result of causes other than defective material or inadequate installation procedures. Examples of outside causes are extreme wear at intersections, damage by snow or ice removal, and pavement failure.

Replace all missing or non-reflective RPMs identified during the performance period within 30 days after notification. The end of the performance period does not relieve the Contractor from the performance deficiencies requiring corrective action identified during the performance period.

4. MEASUREMENT

This Item will be measured by each RPM.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reflectorized Pavement Marker," "Traffic Button," or "Plowable Reflectorized Pavement Marker" of the types specified. This price is full compensation for removing existing markers; furnishing and installing RPMs; and materials, equipment, labor, tools, and incidentals.

No additional payment will be made for replacement of RPMs failing to meet the performance requirements.

DRAFT

Item 677

Eliminating Existing Pavement Markings and Markers



1. DESCRIPTION

Eliminate existing pavement markings and raised pavement markers (RPMs).

2. MATERIALS

Furnish surface treatment materials in accordance with the following Items:

- Item 300, "Asphalts, Oils, and Emulsions"
- Item 302, "Aggregates for Surface Treatments"
- Item 316, "Surface Treatments"

Use approved patching materials for repairing damaged surfaces.

Use a commercial abrasive blasting medium capable of producing the specified surface cleanliness. Use potable water when water is required.

3. EQUIPMENT

Furnish and maintain equipment in good working condition. Use moisture and oil traps in air compression equipment to remove all contaminants from the blasting air and prevent the deposition of moisture, oil, or other contaminants on the roadway surface.

4. CONSTRUCTION

Eliminate existing pavement markings and markers on both concrete and asphaltic surfaces in such a manner that color and texture contrast of the pavement surface will be held to a minimum. Remove all markings and markers with minimal damage to the roadway to the satisfaction of the Engineer. Repair damage to asphaltic surfaces, such as spalling, shelling, etc., greater than 1/4 in. deep resulting from the removal of pavement markings and markers. Dispose of markers in accordance with federal, state, and local regulations. Use any of the following methods unless otherwise shown on the plans:

- 4.1. **Surface Treatment Method.** Apply surface treatment material at rates shown on the plans, or as directed. Place a surface treatment a minimum of 2 ft. wide to cover the existing marking. Place a surface treatment, thin overlay, or microsurfacing a minimum of one lane in width in areas where directional changes of traffic are involved or other areas as directed.
- 4.2. **Burn Method.** Use an approved burning method. For thermoplastic pavement markings or prefabricated pavement markings, heat may be applied to remove the bulk of the marking material before blast cleaning. When using heat, avoid spalling pavement surfaces. Sweeping or light blast cleaning may be used to remove minor residue.
- 4.3. **Blasting Method.** Use a blasting method such as water blasting, abrasive blasting, water abrasive blasting, shot blasting, slurry blasting, water-injected abrasive blasting, or brush blasting as approved. Remove pavement markings on concrete surfaces by a blasting method only.
- 4.4. **Mechanical Method.** Use any mechanical method except grinding. Flail milling is acceptable in the removal of markings on asphalt and concrete surfaces.

5. MEASUREMENT

This Item will be measured by each word, symbol, or shape eliminated; by the foot of marking eliminated; or by any other unit shown on the plans.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Eliminating Existing Pavement Markings and Markers" of the type and width as applicable. This price is full compensation for the elimination method used and materials, equipment, tools, labor, and incidentals. Removal of RPMs will not be paid for directly, but will be subsidiary to the pertinent bid Items.

DRAFT

Item 678

Pavement Surface Preparation for Markings



1. DESCRIPTION

Prepare pavement surface areas before placement of pavement markings and raised pavement markers (RPMs). **Item 677, "Eliminating Existing Pavement Markings and Markers,"** governs removal of existing markings.

2. MATERIALS

Use a commercial abrasive blasting medium capable of producing the specified surface cleanliness. Use potable water, when water is required.

3. EQUIPMENT

Furnish and maintain equipment in good working condition. Use moisture and oil traps in air compression equipment to remove all contaminants from the blasting air and prevent the deposition of moisture, oil, or other contaminants on the roadway surface.

4. CONSTRUCTION

Prepare enough pavement surface for the pavement markings or RPMs shown on the plans. Remove all contamination and loose material. Avoid damaging the pavement surface. Remove loose and flaking material when existing pavement markings are present. Approved pavement surface preparation methods are sweeping, air blasting, flail milling, and blast cleaning unless otherwise specified on the plans.

Air blast concrete pavement surfaces, in addition to the above, after the removal of contamination or existing material and just before placing the stripe. Perform air blasting with a compressor capable of generating compressed air at a minimum of 150 cu. ft. per min. and 100 psi using 5/16 in. or larger hosing.

Contaminants up to 0.5 sq. in. may remain if they are not removed by the following test, performed just before application of markings:

- **Step 1.** Air blast the surface to be tested, to simulate blasting during application of markings.
- **Step 2.** Firmly press a 10-in. long, 2-in. wide strip of monofilament tape onto the surface, leaving approximately 2 in. free.
- **Step 3.** Grasp the free end and remove the tape with a sharp pull.

5. MEASUREMENT

This Item will be measured by the foot for each width specified; by each word, shape, or symbol; or by any other unit except lump sum.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by **Article 9.2., "Plans Quantity Measurement."** Additional measurements or calculations will be made if adjustments of quantities are required.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Surface Preparation for Markings" of the type and width as applicable. This price is full compensation for the cleaning method used, materials, equipment, labor, tools, and incidentals.

DRAFT

Item 680

Highway Traffic Signals



1. DESCRIPTION

- **Installation.** Install highway traffic signals.
- **Removal.** Remove, store, and salvage traffic signals.

2. MATERIALS

Ensure electrical materials and construction methods conform to the current NEC and additional local utility requirements.

Furnish new materials. Ensure all materials and construction methods conform to the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 610, "Roadway Illumination Assemblies"
- Item 625, "Zinc-Coated Steel Wire Strand"
- Item 627, "Treated Timber Poles"
- Item 636, "Signs"
- Item 656, "Foundations for Traffic Control Devices"

Provide controller assemblies that meet the requirements of DMS-11170, "Fully Actuated, Solid-State Traffic Signal Controller Assembly," and the details shown on the plans.

Provide prequalified controller assemblies from the Department's MPL.

Provide flasher assemblies that meet the requirements of DMS-11160, "Flasher Controller Assembly," and the details shown on the plans.

Provide prequalified flasher assemblies from the Department's MPL.

Sampling and testing of traffic signal controller assemblies will be done in accordance with Tex-1170-T.

3. CONSTRUCTION

3.1. **Installation.** Install traffic signal controller foundations in accordance with **Item 656, "Foundations for Traffic Control Devices."**

3.1.1. **Electrical Requirements.**

3.1.1.1. **Electrical Services.** Make arrangements for electrical services and install and supply materials not provided by the utility company as shown on the plans. Install 120-volt, single-phase, 60-Hz AC electrical service unless otherwise shown on the plans.

3.1.1.2. **Conduit.** Install conduit and fittings of the sizes and types shown on the plans. Conduit of larger diameter size than that shown on the plans may be used with no additional compensation, providing the same diameter size is used for the entire length of the conduit run. Extend conduit in concrete foundations 2 to 3 in. above the concrete. Seal the ends of each conduit with silicone caulking, or other approved sealant, after all cables and conductors are installed.

- 3.1.1.3. **Wiring.** Furnish stranded No. 12 AWG XHHW conductors. Install above-ground cables and conductors in rigid metal conduit, except for span wire suspended cables and conductors, drip loops, and electrical wiring inside signal poles unless otherwise shown on the plans. Make power entrances to ground-mounted controllers through underground conduit. Wire each signal installation to operate as shown on the plans.
- Attach ends of wires to properly sized self-insulated solderless terminals. Attach terminals to the wires with a ratchet-type compression crimping tool properly sized to the wire. Place pre-numbered identification tags of plastic or tape around each wire adjacent to wire ends in the controller and signal pole terminal blocks.
- Splices will not be permitted except as shown on the plans, unless each individual splice is approved in writing. Make all allowed splices watertight.
- 3.1.1.4. **Grounding and Bonding.** Ground and bond conductors in accordance with the NEC. Ensure the resistance from the grounded point of any equipment to the nearest ground rod is less than 1 ohm.
- Install a continuous bare or green insulated copper wire (equipment ground) throughout the electrical system that is the same size as the neutral conductor, but a minimum No. 8 AWG. Connect the equipment ground to all metal conduit, signal poles, controller housing, electrical service ground, ground rods, and all other metal enclosures and raceways.
- Provide copper wire bonding jumpers that are a minimum No. 8 AWG.
- 3.1.2. **Controller Assemblies.** Construct controller foundations in accordance with **Item 656, "Foundations for Traffic Control Devices."** Immediately before mounting the controller assembly on the foundation, apply a bead of silicone caulk to seal the cabinet base. Seal any space between conduit entering the controller and the foundation with silicone caulk.
- Deliver the keys for the controller cabinets to the Engineer when the Contract is complete.
- Place the instruction manual and wiring diagrams for all equipment in the controller cabinet, inside the controller cabinet.
- 3.1.3. **Timber Poles.** Furnish ANSI Class 2 timber poles other than for electrical services in accordance with details shown on the plans.
- 3.1.4. **Preservation of Sod, Shrubbery, and Trees.** Replace sod, shrubbery, and trees damaged during the Contract.
- 3.1.5. **Removal and Replacement of Curbs and Walks.** Obtain approval before cutting into or removing walks or curbs not shown on the plans to be removed or replaced. Restore any curbs or walks removed equivalent to original condition after work is completed, to the satisfaction of the Engineer.
- 3.1.6. **Intersection Illumination.** Install luminaires on signal poles as shown on the plans.
- 3.1.7. **Signal Timing Plan.** The traffic signal timing plan will be provided by the Department.
- 3.1.8. **Test Period.** Operate completed traffic signal installations continuously for at least 30 days in a satisfactory manner. If any Contractor-furnished equipment fails during the 30-day test period, repair or replace that equipment. This repair or replacement, except lamp replacement, will start a new 30-day test period.
- Replace materials that are damaged or have failed before acceptance. Replace failed or damaged existing signal system components when caused by the Contractor. The Department will relieve the Contractor of maintenance responsibilities upon passing a 30-day performance test of the signal system and acceptance of the Contract.

- 3.2. **Removal.** Remove existing electrical services, pedestal poles, strain poles, mast arm pole assemblies, luminaires, signal heads, vehicle detector equipment, controllers, cables, and other accessories. Remove materials so damage does not occur. Remove and store items designated for reuse or salvage at locations shown on the plans or as directed.

Remove abandoned concrete foundations, including steel, to a point 2 ft. below final grade. Backfill holes with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

Accept ownership and dispose of unsalvageable materials in accordance with federal, state, and local regulations.

4. MEASUREMENT

This Item will be measured as each traffic signal installed or removed. A traffic signal is a signalized intersection controlled by a single traffic signal controller.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Installation of Highway Traffic Signals" of the type (isolated, system, or flashing beacon) specified, or "Removing Traffic Signals."

- 5.1. **Installation.** This price is full compensation for furnishing, installing, and testing the completed installation, controller and associated equipment, controller foundations, luminaires, signs mounted on signal equipment, damping plates, timber poles, mounting hardware and steel wire strand; preservation and replacement of damaged sod, shrubbery and trees; removal and replacement of curbs and walks; and materials, equipment, labor, tools, and incidentals. The Department will pay for electrical energy consumed by the traffic signal.

New drilled shaft foundations for traffic signal poles will be paid for under **Item 416, "Drilled Shaft Foundations."** New conduit will be paid for under **Item 618, "Conduit."** New electrical conductors will be paid for under **Item 620, "Electrical Conductors."** New ground boxes will be paid for under **Item 624, "Ground Boxes."** New electrical services will be paid for under **Item 628, "Electrical Services."** New vehicle and pedestrian signal heads will be paid for under **Item 682, "Vehicle and Pedestrian Signal Heads."** New traffic signal cables will be paid for under **Item 684, "Traffic Signal Cables."** New traffic signal pole assemblies will be paid for under **Item 686, "Traffic Signal Pole Assemblies (Steel)."** New traffic signal detectors will be paid for under **Item 688, "Pedestrian Detectors and Vehicle Loop Detectors."**

- 5.2. **Removal.** This price is full compensation for removing the various traffic signal components; removing the foundations; disposal of unsalvageable materials; hauling; and materials, equipment, labor, tools, and incidentals.

Item 681

Temporary Traffic Signals



1. DESCRIPTION

Furnish, install, operate, maintain, reconfigure, and remove temporary traffic signals.

2. MATERIALS

Furnish new or used materials in accordance with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items, except for measurement and payment:

- Item 416, "Drilled Shaft Foundations"
- Item 610, "Roadway Illumination Assemblies"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 621, "Tray Cable"
- Item 622, "Duct Cable"
- Item 624, "Ground Boxes"
- Item 625, "Zinc-Coated Steel Wire Strand"
- Item 627, "Treated Timber Poles"
- Item 628, "Electrical Services"
- Item 636, "Signs"
- Item 656, "Foundations for Traffic Signals"
- Item 680, "Installation of Highway Traffic Signals"
- Item 682, "Vehicle and Pedestrian Signal Heads"
- Item 684, "Traffic Signal Cables"
- Item 686, "Traffic Signal Pole Assemblies Steel"
- Item 687, "Pedestal Pole Assemblies"
- Item 688, "Pedestrian Detectors and Vehicle Loop Detectors"

Obtain signal equipment at locations shown on the plans if the equipment is furnished by the Department. All materials determined to be in good working condition by the Engineer can be reused on temporary traffic signals. Do not use previously installed materials for permanent traffic signal installations.

3. CONSTRUCTION

Install traffic signal assemblies in accordance with **Item 680, "Highway Traffic Signals"** (except for measurement and payment) as shown on the plans. Install electrical services in accordance with **Item 628, "Electrical Services"** (except for measurement and payment) as shown on the plans.

- 3.1. **Operation and Maintenance.** Maintain and operate the temporary traffic signals for the duration of the Contract. The traffic signal timing plan will be provided by the Department. Set signal timing as shown on the plans or as directed.

Designate in writing a sufficiently skilled individual responsible for maintenance and operation of the temporary traffic signals who is available to respond within a reasonable time, 24 hr. each day, unless otherwise shown on the plans.

Provide backup power for each location at all times, when shown on the plans.

- 3.2. **Reconfiguration.** Reconfigure temporary traffic signals in accordance with the plans, and within the requirements of this Item, as directed. Reconfiguration is any change made to an installed intersection, including relocation of poles, controller, signal heads, or luminaires.
- 3.3. **Removal.** Remove all equipment installed for temporary traffic signals as shown on the plans or as directed in writing.

Completely remove poles or other supports used for temporary traffic signals. When approved, concrete foundations may remain 2 ft. or more below finished grade. Backfill the remaining hole with material equal in composition and density to the surrounding area. Replace any surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition.

Retain all removed temporary signal components, except for those furnished by the Department, unless otherwise shown on the plans.

4. MEASUREMENT

This Item will be measured by each temporary signalized intersection. A signalized intersection is a group of signals operated by a single controller.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Traffic Signals." This price is full compensation for picking up and returning materials furnished by the Department; installation, operation, maintenance, reconfiguration, and removal of the temporary traffic signal consisting of traffic signal pole assemblies, vehicle and pedestrian signal heads, vehicle loop detectors, pedestrian detectors, traffic signals, flasher controllers, and associated equipment, signs, luminaires, ground boxes, conduit, traffic signal cables, conductors, wire strand, and electrical services; installation and removal of foundations; and materials, equipment, labor, tools, and incidentals.

Electrical energy consumed by the Contractor on an existing Department electrical service will be paid for by the Department.

Costs for utility-owned power line extensions, connection charges, meter charges, consumption charges, and other charges will be paid for by the Department. The Department will reimburse the Contractor the amount billed by the utility plus an additional 5% of the invoice cost will be paid for labor, equipment, administrative costs, superintendence, and profit.

Item 682

Vehicle and Pedestrian Signal Heads



1. DESCRIPTION

Furnish and install vehicle and pedestrian signal heads.

2. MATERIALS

Furnish only new materials.

2.1. Definitions.

- **Back Plate.** A thin strip of material extending outward from all sides of a signal head.
- **LED Optical Unit.** The LED lens and associated supporting parts in a signal section.
- **Louver.** A device mounted to the visor restricting signal face visibility.
- **Signal Section.** One housing case, housing door, visor, and optical unit.
- **Signal Face.** One section or an assembly of 2 or more sections facing one direction.
- **Signal Head.** A unidirectional face or a multidirectional assembly of faces, including back plates and louvers when required, attached at a common location on a support.

2.2. General.

Provide vehicle signal heads in accordance with DMS-11121, "Twelve-Inch LED Traffic Signal Lamp Unit." Provide prequalified vehicle signal heads from the Department's MPL.

Provide pedestrian signal heads in accordance with DMS-11131, "Pedestrian LED Countdown Signal Modules." Provide prequalified pedestrian signal heads from the Department's MPL.

Supply either aluminum or polycarbonate signal head components of the same material and manufacturer for any one project.

Use galvanized steel, stainless steel, or dichromate sealed aluminum bolts, nuts, washers, lock washers, screws, and other assembly hardware. When dissimilar metals are used, ensure the metals are selected or insulated to prevent corrosion.

Use closed-cell silicone or closed-cell neoprene gaskets.

3. CONSTRUCTION

3.1. Assembly.

Assemble individual signal sections in multi-section faces in accordance with the manufacturer's recommendations to form a rigid signal face. Assemble and mount signal heads as shown on the plans. Install louvers and back plates in accordance with the manufacturer's recommendations. Close any openings in an assembled signal head with a plug of the same material and color as the head.

Remove only the existing lens, reflector, and incandescent lamp when installing a retrofit replacement LED traffic signal or pedestrian signal lamp unit into an existing signal housing; fit the new unit securely in the housing door; and connect the new housing unit to the existing electrical wiring or terminal block by means of simple connectors.

3.2. Wiring.

Wire each optical unit to the terminal block located in that signal section by means of solderless wire connectors or binding screws and spade lugs. Wire all sections of a multi-section signal face to the section terminal blocks in which the traffic signal cable is terminated. Maintain the color coding on leads from the

individual optical units throughout the signal head, except for the traffic signal cable. Use solderless wire connectors or binding screws and spade lugs for connections to terminal blocks. Use binding screws and spade lugs for field wiring.

4. MEASUREMENT

This Item will be measured by each vehicle signal section, pedestrian signal section, back plate, or louver.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pedestrian Signal Section," "Vehicle Signal Section," "Back Plate," or "Louver," of the types and sizes specified. This price is full compensation for furnishing, assembling, and installing the signal sections, back plates and louvers, and lenses and optics; mounting attachments; and materials, equipment, labor, tools, and incidentals.

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Item 684

Traffic Signal Cables



1. DESCRIPTION

Furnish and install traffic signal cables.

2. MATERIALS

Provide polyethylene-jacketed multi-conductor cables in accordance with details shown on the plans. Individual conductors must be copper with polyethylene insulation rated for 600 volts. Furnish new materials. Provide traffic signal cables in accordance with DMS-11110, "Traffic Signal Cable."

- 2.1. **Type A Cables.** Use Type A cables meeting the requirements of IMSA 20-1 for underground conduit installation or aerial cable supported by a messenger.
- 2.2. **Type B Cables.** Use Type B cables meeting the requirements of IMSA 20-3 as the integral messenger cable for aerial installations.
- 2.3. **Type C Cables.** Use Type C cables meeting the requirements of IMSA 50-2 for loop detector lead-in installations consisting of 2 conductor shielded cable.
- 2.4. **Types A and B Cable Materials.** Provide the following materials for Type A and B cables:
- Use the size and number of conductors shown on the plans. Unless otherwise shown on the plans, use conductors consisting of 7 copper strands.
 - Ensure color coding of conductors and sequence for cables are in compliance with Table 1. Base color is the insulation color. Tracer color is the colored stripe that is part of or firmly adhered to the insulation surface for the full length of the conductor.
 - Ensure 2-conductor cable is of the round twisted type with fillers used where necessary to form a round cable.
 - For cables with more than 2 conductors, ensure individual conductors are laid up symmetrically in layers with fillers used when necessary, to produce a uniform assembly of conductors with a firm, compact cylindrical core.
 - Ensure fillers are a non-metallic, moisture-resistant, non-wicking material.
 - Supply conductor assemblies covered with a wrapping of a moisture-resistant tape applied to overlap at least 10% of the tape width.
 - Ensure the taped conductor assembly is covered with a tightly fitting black polyethylene jacket that is smooth and free from holes, splits, blisters, and any other imperfections.
 - Supply cables that clearly show the name of the manufacturer and the IMSA specification number applied at approximate 2-ft. intervals to the outer surface of the jacket by indent printing.

Table 1
Conductor Color and Sequence for Cables

Conductor No.	Base Color	Tracer Color
1	Black	
2	White	
3	Red	
4	Green	
5	Orange	
6	Blue	
7	White	Black
8	Red	Black
9	Green	Black
10	Orange	Black
11	Blue	Black
12	Black	White
13	Red	White
14	Green	White
15	Blue	White
16	Black	Red
17	White	Red
18	Orange	Red
19	Blue	Red
20	Red	Green
21	Orange	Green

- 2.5. **Additional Requirements for Type B Cable Materials.** Additional material requirements particular to Type B cable are as follows:
- Ensure cables consisting of 5 or more conductors have a 0.25-in. nominal diameter messenger. For the messenger, use Class A galvanized Extra High Strength Steel Strand with 3 or 7 wires.
 - A solid strand messenger with 0.134-in. diameter may be used for cables with less than 5 conductors.
 - To provide corrosion protection, ensure the messenger strand is coated and the interstices are flooded with a rubber asphalt compound or equivalent.
 - Ensure the integral messenger and conductors are enclosed in the jacket forming a cross-section similar to a figure 8.
- 2.6. **Type C Cable Materials.** Use the following materials for Type C cables:
- Unless otherwise shown on the plans, use No. 14 AWG insulated conductors with concentric stranding with black insulation on 1 of the 2 conductors and clear insulation on the other conductor. Ensure conductors have a minimum of 2 twists per foot within the cable.
 - Use cables that have 100% shield coverage using aluminum bonded to a Mylar film. Ensure the drain wire is stranded tinned copper, 2 AWG sizes less than the conductor, and in continuous contact with the aluminum side of the shield material.
 - Ensure the jacket is black polyethylene.
 - Use cables that legibly show the name of the manufacturer and the IMSA specification number applied at approximate 2-ft. intervals on a tape under the outer jacket.
- 2.7. **Sampling.** The Engineer may take samples from each roll of each size of cable for establishing conformity to IMSA. The samples will be at least 3 ft. long. Replace any cable failing to meet IMSA requirements.

3. CONSTRUCTION

For each cable run in underground conduit, coil an extra 5 ft. of cable in each ground box.

Splices are not permitted in Type A and B cables unless shown on the plans, or approved in writing. Ensure splices are watertight.

Make splices between Type C cable and loop detector wires only in the ground box near the loop the cable is servicing. Use non-corrosive solder for splices. Ground the drain wire of Type C cable to earth ground only at the controller or detector cabinet. Ensure the resistance from the drain wire to the ground rod is less than 1 ohm.

Test the cables after installation and before any connection to the cables. Cables testing less than 50 megohms insulation resistance at 500 volts will be rejected.

4. MEASUREMENT

This Item will be measured by the foot of traffic signal cables.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Traffic Signal Cables" of the types and sizes specified. This price is full compensation for furnishing and installing materials, and for equipment, labor, tools, and incidentals, except as shown below.

Cables inside traffic signal pole assemblies will be paid for under this Item.

Cables used for inside signal heads and controllers or coils in ground boxes, pole bases, and on span wires will not be paid for directly, but will be subsidiary to pertinent Items.

Item 685

Roadside Flashing Beacon Assemblies



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect roadside flashing beacon assemblies.
- **Relocation.** Remove and relocate existing roadside flashing beacon assemblies.
- **Removal.** Remove existing roadside flashing beacon assemblies.

2. MATERIALS

Furnish new materials in accordance with the following Items and details shown on the plans:

- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 656, "Foundations for Traffic Control Devices"

Provide prequalified flasher controller assemblies from the Department's MPL in accordance with DMS-11160, "Flasher Controller Assembly."

Provide prequalified pedestal pole bases from the Department's MPL in accordance with DMS-11140, "Pedestal Pole Base."

When shown on the plans, provide prequalified solar powered flasher controller assemblies from the Department's MPL in accordance with DMS-11150, "Solar Power Flasher Controller Assembly."

3. CONSTRUCTION

Install foundations for installation and relocation in accordance with Item 656, "Foundations for Traffic Control Devices."

- 3.1. **Fabrication.** Provide poles and bases in accordance with Item 687, "Pedestal Pole Assemblies." Provide mild steel anchor bolts in accordance with Item 449, "Anchor Bolts." Use galvanized bolts, nuts, and washers.
- 3.2. **Galvanizing.** Galvanize all fabricated parts in accordance with Item 445, "Galvanizing." Repair galvanizing for any steel part or member damaged in assembly, transit, or erection, or any steel part or member welded after galvanizing, in accordance with Section 445.3.5, "Repairs."
- 3.3. **Installation.** Install roadside flashing beacon assemblies at the locations shown on the plans or as directed. Stake the assembly locations for verification by the Engineer unless otherwise shown on the plans.

Install pole, breakaway base, connectors, wiring, signal beacons, sign, and foundation as shown on the plans, or as directed. Install the flasher controller assembly on the electrical service pole. Install watertight breakaway electrical fuse holders in all line and neutral conductors at the breakaway base.

Use established industry and utility safety practices to erect assemblies near overhead or underground utilities. Consult with the appropriate utility company before beginning such work.

Install solar panels, batteries, and battery box (when required) as shown on the plans or as directed.

- 3.4. **Relocation.** Disconnect and isolate the electrical power supply before removal of the assembly. Remove existing assembly as directed. Salvage existing components such as sign, beacons, pole, and base unless otherwise directed. Repair or replace lost or damaged components as directed.

Relocate existing assembly to the location shown on the plans or as directed. Install existing assembly at new foundations in accordance with Section 685.3.3., "Installation." Remove existing foundations in accordance with Section 685.3.5., "Removal." Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

- 3.5. **Removal.** Disconnect and isolate existing electrical power supplies prior to removal of the assembly. Remove existing sign panel, beacons, pole, and base from existing assembly. Store items to be reused or salvaged without damaging. Store sign panels above the ground in a vertical position at locations shown on the plans or as directed. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

Remove abandoned foundations, including steel, to 2 ft. below the finished grade unless otherwise shown on the plans. Backfill with material equal in composition and density to the surrounding area, and replace any surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition.

4. MEASUREMENT

This Item will be measured by each installed, relocated, or removed roadside flashing beacon assembly.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Roadside Flashing Beacon Assemblies," "Install Roadside Flashing Beacon Assemblies (Solar Powered)," "Relocate Roadside Flashing Beacon Assemblies," "Relocate Roadside Flashing Beacon Assemblies (Solar Powered)," "Remove Roadside Flashing Beacon Assemblies," or "Remove Roadside Flashing Beacon Assemblies (Solar Powered)." The Department will pay for electrical energy consumed by the roadside flashing beacon.

New conduit will be paid for under Item 618, "Conduit," except for conduit in the foundation and within 6 in. of the foundation. New electrical conductors will be paid for under Item 620, "Electrical Conductors." New tray cable will be paid for under Item 621, "Tray Cable." New duct cable will be paid for under Item 622, "Duct Cable." New ground boxes will be paid for under Item 624, "Ground Boxes." New electrical services will be paid for under Item 628, "Electrical Services." New signs will be paid for under Item 636, "Signs." New signal heads will be paid for under Item 682, "Vehicle and Pedestrian Signal Heads." New traffic signal cable will be paid for under Item 684, "Traffic Signal Cable."

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, assembling, and erecting the roadside flashing beacon assemblies including poles and bases; solar power flashing controller assemblies including battery box (when required); foundations; conduit in the foundation and within 6 in. of the foundation; furnishing and placing anchor bolts, nuts, washers, and templates; controller; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Relocation.** This price is full compensation for removing the roadside flashing beacon assemblies; removing battery box (when required); removing existing foundations; installing new foundations; installing new conduit in the foundation and within 6 in. of the foundation; furnishing, fabricating, and installing any new components as required and replacing the assembly on its new foundations with all manipulations and electrical work; controller; salvaging; disposal of unsalvageable materials; loading and hauling; and materials, equipment, labor, tools, and incidentals.

- 5.3. **Removal.** This price is full compensation for removing the various roadside flashing beacon assemblies components; removing the foundations; storing the components to be reused or salvaged; disposal of unsalvageable materials; backfilling and surface placement; loading and hauling; and materials, equipment, tools, labor, and incidentals.

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Item 686

Traffic Signal Pole Assemblies (Steel)



1. DESCRIPTION

- **Installation.** Fabricate, furnish, and install steel traffic signal pole assemblies.
- **Relocation.** Remove and relocate existing steel traffic signal pole assemblies.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"

Furnish alloy steel or medium-strength mild steel anchor bolts in accordance with Section 449.2.1., "Bolts and Nuts," unless otherwise shown on the plans.

3. CONSTRUCTION

- 3.1. **Standard Design.** Fabricate poles assemblies in accordance with this Item to the designs shown on the plans. Alternate designs are not acceptable. Deviations that affect the basic structural behavior of the pole are considered to be alternate designs. For deviations that do not affect the basic structural behavior of the pole, electronically submit shop drawings in accordance with Item 441, "Steel Structures" to the Bridge Division for approval.
- 3.2. **Fabrication.** Fabricate and weld in accordance with Item 441, "Steel Structures," AWS D1.1, *Structural Welding Code—Steel*; and the requirements of this Item. Fabrication tolerances are given in Table 1.

Table 1
Fabrication Tolerances

Part	Dimension	Tolerance (in.)
Pole and mast arm shaft	Length	±1
	Thickness	+0.12, -0.02
	Difference between flats or diameter	±3/16
	Straightness	1/8 in 10 ft.
	Attachment locations	±1
Base and mast arm mounting plates	Overall	±3/16
	Thickness	+1/4, -0
	Deviations from flat	3/16 in 24 in.
	Spacing between holes	±1/8
	Bolt hole size	±1/16
Anchor bolts	Length	±1/2
	Threaded Length	±1/2
	Galvanized Length	-1/4
Assembled shafts	Angular Orientation	1/16 in 12 in. ¹
	Centering	±3/16
	Twist	3° in 50 ft.

1. 1/8 in 12 in. between mounting plates and between mounting plates and base plates.

Fabrication plants that produce steel traffic signal pole assemblies must be approved in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication and Plant Qualification." The Department maintains an MPL of approved traffic signal pole assembly fabrication plants.

Provide properly fitting components. Provide round or octagonal shafts for poles and mast arms tapered as shown on the plans. Fabricate mast arms straight in the unloaded condition unless otherwise shown on the plans. The Department will accept bolted slip joints overlapping by at least 1.5 diameters in mast arms 40 ft. and longer.

Provide circumferential welds only at the ends of the shafts. Provide no more than 2 longitudinal seam welds in shaft sections. Grind or smooth the exterior of longitudinal seam welds to the same appearance as other shaft surfaces. Ensure 100% penetration within 6 in. of circumferential base welds and 60% minimum penetration at other locations along the longitudinal seam welds. Use a welding technique that minimizes acid entrapment during later galvanizing. Hot-dip galvanize all fabricated parts in accordance with **Item 445, "Galvanizing."**

Treat welds with Ultrasonic Impact Treatment when shown on the plans after galvanization and with the dead load (actual or simulated) applied. Repair damaged galvanizing in accordance with **Section 445.3.5, "Repairs."**

Connect the luminaire arm to the pole with simplex fittings. Ensure the fittings have no defects affecting strength or appearance.

Permanently mark, at a visible location when erected, pole base plates and mast arm mounting plates with the design wind speed.

Permanently mark, at a visible location when erected, pole base plates and fixed mast arm mounting plates with the fabrication plant's insignia or trademark. Place the mark on the pole base plate adjacent to the hand-hole access compartment.

Deliver each traffic signal pole assembly with fittings and hardware either installed or packaged with its associated components. Ship all components with a weatherproof tag identifying the manufacturer, Contract number, date, and destination of shipment.

3.3. **Installation.** Locate traffic signal pole assemblies as shown on the plans unless otherwise directed to secure a more desirable location or avoid conflict with utilities. Stake the traffic signal pole assembly locations for verification by the Engineer.

Use established industry and utility safety practices when working near overhead or underground utilities. Consult with the appropriate utility before beginning work.

Construct foundations for new traffic signal pole assemblies in accordance with **Item 416, "Drilled Shaft Foundations,"** and the details shown on the plans. Orient anchor bolts as shown on the plans.

Erect structures after foundation concrete has attained its design strength as required on the plans and **Item 421, "Hydraulic Cement Concrete."** Coat anchor bolt threads and tighten anchor bolts in accordance with **Item 449, "Anchor Bolts."**

After the traffic signal pole assembly is plumb and all nuts are tight, tack weld each anchor bolt nut in 2 places to its washer. Tack weld each washer to the base plate in 2 places. Never weld components to the bolt. Tack weld in accordance with **Item 441, "Steel Structures."** After tack welding, repair galvanizing damage on bolts, nuts, and washers in accordance with **Section 445.3.5, "Repairs."**

Do not grout between the base plate and the foundation.

- 3.4. **Relocation.** Disconnect and isolate traffic signal cables before removing the pole. Remove existing traffic signal pole assemblies as directed. Ensure the poles or attached components suffer no undue stress or damage. Signs, signal heads, mounting brackets, luminaires, etc., may be left on the poles. Repair or replace damaged components as directed.

Remove abandoned concrete foundations, including steel, to a point 2 ft. below final grade unless otherwise shown on the plans. Cut off and remove steel protruding from the remaining concrete. Backfill the hole with materials equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

Move existing pole assemblies to locations shown on the plans, or as directed. Construct foundations for relocated traffic signal pole assemblies in accordance with **Item 416, "Drilled Shaft Foundations,"** and the details shown on the plans. Install existing pole assemblies on new foundations in accordance with **Section 686.3.3., "Installation."**

Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

4. MEASUREMENT

This Item will be measured by each traffic signal pole assembly installed or relocated.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Traffic Signal Pole Assemblies (Steel)" of the types and sizes specified or "Relocate Traffic Signal Pole Assemblies (Steel)" of the types specified.

New drilled shaft foundations will be paid for under **Item 416, "Drilled Shaft Foundations."**

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, assembling, and erecting the pole upon a foundation; furnishing and erecting required mast arms and luminaire arms; furnishing and placing anchor bolts, nuts, washers, and templates; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Relocation.** This price is full compensation for removing traffic signal pole assemblies; removing existing foundations; backfilling and surface placement; storing the components to be reused or salvaged; furnishing, fabricating, and installing required new components including anchor bolts, nuts, washers, and templates; placing and securing traffic signal pole assemblies on new foundations; furnishing and placing conduit, ground rods, and wiring; disposal of unsalvageable materials; loading and hauling; and materials, equipment, labor, tools, and incidentals.

Item 687

Pedestal Pole Assemblies



1. DESCRIPTION

Furnish and install pedestal pole assemblies for vehicle and pedestrian signals.

2. MATERIALS

Furnish new materials in accordance with the following Items and with details shown on the plans:

- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 656, "Foundations for Traffic Control Devices"

- 2.1. **Pedestal Pole Base.** Provide prequalified pedestal pole bases from the Department's MPL in accordance with DMS-11140, "Pedestal Pole Base."
- 2.2. **Pedestal Pole.** Provide 4-in. diameter schedule 40 steel pipe or tubing, aluminum pipe (alloy 6061 T6), or rigid metal conduit. Do not use aluminum conduit. Galvanize pedestal pole assemblies in accordance with Item 445, "Galvanizing," unless otherwise shown on the plans.
- 2.3. **Pedestrian Push Button Pole Assembly.** Provide diameter as shown on the plans, schedule 40 steel pipe or tubing, aluminum pipe (alloy 6061-T6), or rigid metal conduit. Do not use aluminum conduit. Galvanize pedestrian push button post in accordance with Item 445, "Galvanizing," unless otherwise shown on the plans.

3. CONSTRUCTION

Install foundations in accordance with Item 656, "Foundations for Traffic Control Devices."

- 3.1. **Pedestal Pole Base.** Ground the base with connectors to the 1/2-13 NC female threaded hole. Fabricate the base for 4 L bend anchor bolts arranged in a square pattern with a 12-3/4 in. bolt circle. Provide mild steel anchor bolts in accordance with Item 449, "Anchor Bolts," for each base. Provide three 1/16-in. thick and three 1/8-in. thick U-shaped galvanizing steel shims for each base. Size shims to fit around the anchor bolts.
- 3.2. **Installation.** Install pedestal pole assemblies and pedestrian push button post assemblies as shown on the plans, or as directed. Pedestal pole assemblies include foundation, pole shaft, base, anchor bolts, anchor bolt nuts, anchor bolt template, shims, and miscellaneous components. Watertight breakaway electrical disconnects are required for pedestal pole assemblies used in conjunction with vehicle and pedestrian heads and components. Pedestrian push button post assemblies include foundation, pole, and post cap.

Use established industry and utility safety practices to erect assemblies near overhead or underground utilities. Consult with the appropriate utility company before beginning such work.

Repair damaged galvanizing in accordance with Section 445.3.5., "Repairs."

- 3.3. **Painted Finish.** When required, paint pedestal pole and pedestrian push button post assemblies in accordance with details shown on the plans.

4. MEASUREMENT

This Item will be measured by each pedestal pole assembly or each pedestrian push button post assembly.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pedestal Pole Assembly" or by the unit bid price for "Pedestrian Push Button Post Assembly. This price is full compensation for furnishing and installing the shaft; base, shims, anchor bolts, and foundation; and materials, equipment, labor, tools, and incidentals.

New signal heads will be paid for under **Item 682, "Vehicle and Pedestrian Signal Heads."**

DRAFT

Item 688

Pedestrian Detectors and Vehicle Loop Detectors



1. DESCRIPTION

Furnish and install traffic signal detectors.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 618, "Conduit"
- Item 624, "Ground Boxes"
- Item 682, "Vehicle and Pedestrian Signal Heads"
- Item 684, "Traffic Signal Cables"

2.1. **Pedestrian Detectors.** Supply housing or an adapter (saddle) that conforms to the pole shape, fitting flush to ensure a rigid installation. Supply adapters of the same material and construction as the housing. Supply push-button switches that have single-pole, single-throw contacts and screw-type terminals and have a design life of at least 1 million operations.

Ensure the internal components provide a push-button with normal open contacts, and include all electrical and mechanical parts required for operation. Ensure the push-button assembly is weather-tight and tamperproof, is designed to prevent an electrical shock under any weather condition, and has provisions for grounding in accordance with the NEC.

2.1.1. **Standard Pedestrian Detectors.** Provide a 2-piece cast aluminum housing unit consisting of a base housing and a removable cover. Provide threaded holes for 0.5-in conduit in the housing for any necessary conduit attachment.

Ensure the manufacturer's name or trademark is located on the housing.

2.1.2. **Accessible Pedestrian Signals (APS).** Provide accessible pedestrian detectors in accordance with DMS-11132, "Accessible Pedestrian Signals (APS)."

2.2. **Vehicle Loop Detectors.** Use stranded copper No. 14 AWG XHHW cross-linked-thermosetting-polyethylene-insulated conductor rated for 600 volts AC for vehicle detector loop wire unless otherwise shown on the plans. Ensure each length of wire shows the name or trademark of the manufacturer, insulation voltage rating, wire gauge, and insulation type at approximate 2-ft. intervals on the insulation surface.

When shown on the plans, use flexible vinyl or polyethylene tubing with 0.184 in. minimum inside diameter, 0.031 in. minimum wall thickness, 0.26 in. maximum outside diameter, and a smooth bore. Use tubing that does not adhere to the loop wire in any way and is capable of resisting deterioration from oils, solvents, and temperatures up to 212°F. Use tubing that is abrasion-resistant and remains flexible from -22°F to 212°F. Use orange or red tubing unless otherwise shown on the plans.

Use sealant for the vehicle detector loops in accordance with DMS-6340, "Vehicle Loop Wire Sealant."

3. CONSTRUCTION

3.1. Pedestrian Detectors.

- 3.1.1. **Push-button Unit.** Meet the requirements of the TMUTCD when installing push-buttons. Wire the push-button according to manufacturer's installation instructions. Close unused housing openings with a weather-tight closure painted to match the housing. Verify that each button is communicating and fully functional.

Do not use terminal connections or splice wire leads except at approved locations. All allowed splices must be watertight.

Attach wires to terminal posts with solderless terminals unless otherwise advised by manufacturer's recommendations. Attach terminals to the wires with a ratchet-type compression crimping tool properly sized to the wire.

Mount a pedestrian push button sign near each push button as shown on the plans.

For installations where APS buttons are placed less than 10 feet apart from one another, program the appropriate speech walk message (include the name of the appropriate street in the message) for these buttons. When two APS buttons are installed on the same pole ensure that the APS buttons are insulated to eliminate vibrations from traveling to the other button.

- 3.2. **Controller Unit.** If a controller unit is required by the plans, integrate the pedestrian controller unit into the traffic signal controller cabinet assembly.

- 3.3. **Vehicle Loop Detectors.** Provide the loop location, configuration, wire color, and number of turns shown on the plans. Loops may be adjusted by the Engineer to fit field conditions.

- 3.3.1. **Saw-Cuts.** Cut the pavement with a concrete saw to form neat lines. Do not exceed 1 in. depth on concrete bridge slab saw-cuts. Cut all other saw-cuts deep enough to provide a minimum of 1 in. depth of sealant over the wire. Make a separate saw-cut from each loop to the edge of the pavement unless otherwise shown on the plans. Ensure the cut is clean and dry when the wire and sealant are placed.

- 3.3.2. **Conduit.** Place conduit between the pavement and ground box as shown on the plans.

- 3.3.3. **Loop Wire Color.** Use the following color code unless otherwise shown on the plans. Use white for the first loop on the right followed by black, orange, green, brown, and blue. Use the same color for all loops in the same lane. Loops installed in multi-lanes will have the same color code in the order the loops are installed. When facing the same direction that traffic flows, the color code will read from right to left for all lanes carrying traffic in that direction. If traffic moves in 2 directions, the color code will be repeated for the other direction of traffic.

- 3.3.4. **Loop Wire Installation.** When shown on the plans, place the loop wire in a flexible vinyl or polyethylene tubing in accordance with [Article 688.2., "Materials."](#) The loop wire color requirements do not apply to wires in tubing.

Twist the wire from the loop to the ground box a minimum of 5 turns per foot. When only 1 pair of wires is in a saw-cut, it need not be twisted while in the saw-cut. Do not splice loop wire in the loop or in the run to the ground box.

Hold the loop wire in place every 2 ft. with strips of rubber, neoprene flexible tubing, or polyethylene foam sealant approximately 1 in. long. Leave these strips in place and fill the slot with loop sealant.

Splice the loop lead-in cable and loop detector wires only in the ground box near the loop it is serving. Use non-corrosive solder for splices and ensure the splice is watertight. Ground the drain wire of the loop lead-in

cable to earth ground only at the controller or detector cabinet. Ensure the resistance from the drain wire to the ground rod is less than 1 ohm.

4. MEASUREMENT

This Item will be measured by the foot of saw-cut containing loop wire and each pedestrian push-button and controller unit.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Vehicle Loop Detectors" of the type specified, "Pedestrian Detector Push-button Units" of the type specified or "Pedestrian Detector Controller Unit." This price is full compensation for furnishing, installing, and testing the detectors, detector controller units, including detector configuration devices or software (when applicable); saw-cutting, excavation, backfill, sealant, and sealant placement; pavement repair associated with saw-cutting; and materials, equipment, labor, tools, and incidentals, except as follows.

The conduit and loop wire from the edge of pavement to the ground box used for the vehicle loop detectors will not be measured or paid for directly, but will be subsidiary to this Item.

New ground boxes will be paid for under Item 624, "Ground Boxes." New loop lead-in cable will be paid for under Item 684, "Traffic Signal Cables."

Item 690

Maintenance of Traffic Signals



1. DESCRIPTION

Furnish, install, modify, repair, replace, or remove components of a traffic signal:

2. MATERIALS

The Department will only furnish traffic signal poles, mast arms, and controllers that become part of the final installation, unless otherwise noted on the plans. Submit a materials list to the Engineer for all poles, mast arms, and controllers needed. Pick up materials at the locations and times shown on the plans. Designate in writing the persons authorized to pick up the materials.

Assume responsibility for all materials furnished by the Department. Use materials furnished by the Department for this Contract only. Return unused or removed materials deemed salvageable by the Engineer to the Department upon completion of the work and before final payment at location shown on the plans or as directed. Dispose of materials deemed unsalvageable by the Engineer, in accordance with federal, state, and local regulations. When materials are required to be furnished by the Contractor, meet the Materials Article requirements of the pertinent Item.

3. EQUIPMENT

Use equipment that includes, but is not limited to:

- an aerial device capable of reaching overhead work,
- trenching machine,
- boring machine,
- concrete saw, and
- digger-boom truck.

Use only equipment, tools, and machinery in good repair and operating condition. Repair or replace any equipment that, in the opinion of the Engineer, may affect the quality of work or safety.

4. WORK METHODS

Conform to the NEC, local utility requirements, requirements of this Item, and pertinent requirements of the following Items:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 476, "Jacking, Boring, or Tunneling Pipe or Box"
- Item 610, "Roadway Illumination Assemblies"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 622, "Duct Cable"
- Item 624, "Ground Boxes"
- Item 625, "Zinc-Coated Steel Wire Strand"
- Item 627, "Treated Timber Poles"
- Item 628, "Electrical Services"

- Item 636, "Signs"
- Item 656, "Foundations for Traffic Control Devices"
- Item 680, "Highway Traffic Signals"
- Item 682, "Vehicle and Pedestrian Signal Heads"
- Item 684, "Traffic Signal Cables"
- Item 685, "Roadside Flashing Beacon Assemblies"
- Item 686, "Traffic Signal Pole Assemblies (Steel)"
- Item 687, "Pedestrian Pole Assemblies"
- Item 688, "Pedestrian Detectors and Vehicle Loop Detectors"

Perform the following work as directed:

- 4.1. **Conduit.** Install, replace, remove, or modify conduits in accordance with Item 618, "Conduit"; as shown on the plans; or as directed. Use 90° "sweep" type elbow on conduits entering a ground box.
- 4.2. **Foundations.** Install, replace, or remove foundations for traffic signal pole, pedestal pole, and ground mount controller cabinets in accordance with Item 416, "Drilled Shaft Foundations"; and in accordance with Item 656, "Foundations for Traffic Control Devices"; as shown on the plans; or as directed.
- 4.3. **Concrete.** Install concrete in accordance with Item 421, "Hydraulic Cement Concrete."
- 4.4. **Ground Boxes.** Install, repair, replace, remove, or modify ground boxes in accordance with Item 624, "Ground Boxes"; as shown on the plans; or as directed.
- 4.5. **Vehicle and Pedestrian Detectors.** Install, repair, replace, remove, or modify pedestrian push buttons and vehicle loop detectors in accordance with Item 688, "Pedestrian Detectors and Vehicle Loop Detectors"; as shown on the plans; or as directed.
- 4.6. **Electrical Service.** Install, repair, replace, remove, or modify an electrical service assembly in accordance with Item 628, "Electrical Services"; as shown on the plans; or as directed. Mount any or all of the following on an electrical service support assembly: conduit, weather head, load center, meter base, lightning protection, wiring, and associated hardware.
- 4.7. **Signal Pole.** Install, repair, replace, remove, or modify signal poles in accordance with pertinent Items, as shown on the plans, or as directed. Comply with Item 627, "Treated Timber Poles," for timber signal poles with guy wires and anchors and Item 686, "Traffic Signal Pole Assemblies (Steel)," for steel poles with concrete foundations. Remove timber poles and anchors completely, to 24 in. below ground level, or as directed. Remove concrete foundations to 24 in. below ground level, or as directed.

Install, repair, replace, remove, or modify pedestrian signal pole assemblies in accordance with Item 687, "Pedestrian Pole Assemblies"; as shown on the plans; or as directed. Install, repair, replace, remove, or modify roadside flashing beacons in accordance with Item 685, "Roadside Flashing Beacon Assemblies"; as shown on the plans; or as directed.
- 4.8. **Down Guy.** Install, replace, remove, or modify down guy with guard or down guy with anchor and guard.
- 4.9. **Steel Wire Strand.** Install, replace, or remove steel wire strand in accordance with Item 625, "Zinc-Coated Steel Wire Strand"; as shown on the plans; or as directed. Attach span wire on timber poles using a 5/8-in. straight thimble-eye bolt. Attach span wire on metal poles using at least 2 turns of wire around the pole. Place and properly tighten the 3-bolt clamp as near as possible to the pole.
- 4.10. **Luminaire Head and Mast Arm.** Install, replace, remove, or modify luminaire heads, arms, bulbs, photocells, and hardware on timber or steel signal poles. Install material using manufacturer's specifications. Fuse luminaires individually in the signal pole hand-hole. Install a separate cable from the breaker load panel to each luminaire.

- 4.11. **Signal Head Assembly.** Install, repair, replace, remove, or modify pedestrian signal heads or vehicle signal head assemblies in accordance with **Item 682, "Vehicle and Pedestrian Signal Heads"**; as shown on the plans; or as directed. Mount signal heads by a span wire hanger clamp, bracket arm assembly, or mast arm bracket assembly. Signal head assemblies consist of 1 to 12 signal sections. Install signal heads as shown on the plans, or as directed.
- Assemble the signal heads with backplates, louvers, and brackets as needed. Mount all signal heads at the same elevation. Install signal head perpendicular to the travel lane it controls. Plumb all signal heads vertically and horizontally.
- 4.12. **Traffic Signal Controller Cabinet, Ground Mount.** Install, repair, replace, remove, or modify ground-mounted cabinet. Plumb and tighten the cabinet. Apply silicone sealant around the base of the cabinet. Coil all cabling that enters the cabinet neatly on the cabinet floor. Mark and terminate each cable as shown on the plans, or as directed.
- 4.13. **Traffic Signal Controller Cabinet, Pole Mount.** Install, repair, replace, remove, or modify pole-mounted cabinet. Plumb and tighten the cabinet. Coil all cabling that enters the cabinet neatly on the cabinet floor. Mark and terminate each cable as shown on the plans, or as directed.
- 4.14. **Flashing Beacon Controller Cabinet.** Install, repair, replace, remove, or modify flasher cabinet. Plumb and tighten the cabinet. Coil all cabling that enters the cabinet neatly on the cabinet floor. Mark and terminate each cable as shown on the plans, or as directed.
- 4.15. **Cables.** Install, repair, replace, remove, or modify signal, loop lead-in, electrical, communication, or illumination cables in conduits or along messenger cables in accordance with **Item 620, "Electrical Conductors"**; in accordance with **Item 684, "Traffic Signal Cables"**; as shown on the plans; or as directed.
- Attach aerial cable at 1-ft. intervals using approved cable ties along a messenger span cable. Install a drip loop with at least 2 turns at each pole, signal head, and weather head.
- Label each cable brought into the controller cabinet. Coil 5 ft. of cable neatly on the traffic signal controller cabinet floor for each cable.
- Install solderless pressure connectors that meet the requirements of the NEC for all wires attached to terminal posts. Use a ratchet-type full-circle crimper for insulated terminals to provide a solderless pressure connector.
- 4.16. **Sealing.** Install, repair, replace, remove, or modify sealant in detector saw slots, at the open end of all conduits terminated at the roadway edge, and in ground boxes. Apply sealant as shown on the plans or as directed.
- 4.17. **Salvage Operations.** Remove traffic signal when no replacement is required. Return unused or removed material deemed salvageable by the Engineer to the Department. Dispose of all other material.
- 4.18. **Signal-Related Signs.** Install, repair, replace, remove, or modify small post-mounted or overhead signs.
- 4.19. **Curbs, Ramps, and Sidewalks.** Install, repair, replace, remove, or modify curbs, ramps, and sidewalks. Secure permission to install traffic signal items before cutting into or removing curbs, ramps, and sidewalks. Replace all curbs, ramps, and sidewalks as shown on the plans. Install pedestrian access ramps as shown on the plans.
- 4.20. **Protection of Utilities.** Locate and protect all public lines and utility customer service lines in the work area. Notify the utility company and locate and mark, uncover, or otherwise protect all such lines in the construction area. Obtain information on the location and grade of water, sewer, gas, telephone, electric lines, and other utilities in the work area from the utility company. This information does not relieve the Contractor of responsibility for protecting utilities.

Reimburse the utility line owner for expenses or costs (including fines that may be levied against the utility company) that may result from unauthorized or accidental damage to any utility lines in work area.

- 4.21. **Preservation of Sod, Shrubbery, and Trees.** Preserve all sod, shrubbery, and trees at the site during the Contract. Obtain permission to remove any sod, shrubbery, or tree branches. Preserve and restore sod and shrubbery into their original position. Replace damaged sod or shrubbery at the Contractor's expense.
- 4.22. **PVC Weatherproof Enclosures.** Install, remove, or replace 12 × 12 × 6-in. PVC weatherproof enclosure at locations shown on the plans or as directed. Only use enclosure for reconnecting or terminating traffic signal cables at the top of a timber or steel strain pole which has been replaced or reinstalled due to accidental knock down.
- 4.23. **LED Lamp Unit.** Install, replace, or remove LED optical unit in accordance with **Item 682, "Vehicle and Pedestrian Signal Heads"**; as shown on the plans, or as directed.
- 4.24. **Spread Spectrum Radio Antennas.** Replace, repair, or install spread spectrum radio antenna in accordance with Special Specification, "Spread Spectrum Radios for Traffic Signals"; as shown on the plan; or as directed.
- 4.25. **Video Imaging Vehicle Detection System (VIVDS).** Install, repair, replace, remove, or modify VIVDS in accordance with Special Specification, "Video Imaging Vehicle Detection System" as shown on the plans, or as directed.

5. MEASUREMENT

Measurement will be as follows:

- 5.1. **Removal of Conduit.** By the foot of conduit.
- 5.2. **Installation of Conduit by Trenching.** By the foot of the trench containing conduit, regardless of the size of conduit.
- 5.3. **Installation of Conduit by Jacking or Boring.** By the foot of road bore made. Pits for jacking or boring are subsidiary to this Item.
- 5.4. **Installation of Vehicle Detectors.** By the foot of saw-cut containing detector wire.
- 5.5. **Removal, Replacement, or Installation of Ground Boxes.** By each box removed, replaced, or installed, regardless of the type of box. A concrete apron around the box will be considered subsidiary to this Item.
- 5.6. **Removal, Replacement, or Installation of Cables.** By the foot of traffic signal cables removed, replaced, or installed, except measurement will not be made for cable inside signal heads and controllers or cable coiled in ground boxes, in pole bases, and on span wires.
- 5.7. **Installation of Duct Cables.** By the foot of trench containing duct cable.
- 5.8. **Removal, Replacement, or Installation of Cables by Messenger Cable.** By the foot removed, replaced, or installed.
- 5.9. **Removal, Replacement, or Installation of Span Cable Assembly.** By the foot of span removed, replaced, or installed. A span is defined as the distance from one pole to the next pole.
- 5.10. **Replacement or Installation of Electrical Service.** By each electrical service replaced or installed. The removal of the existing assembly will be considered subsidiary to this Item.

- 5.11. **Removal, Replacement, or Installation of Timber Poles.** By each timber pole removed, replaced, or installed. Attachment of required hardware is subsidiary to this Item.
- 5.12. **Removal, Replacement, or Installation of Signal Head Assemblies.** By each head removed, replaced, or installed. Assembly and wiring are subsidiary to this Item.
- 5.13. **Removal, Replacement, or Installation of Signal Related Signs.** By each sign assembly removed, replaced, or installed.
- 5.14. **Removal, Replacement, or Installation of Pedestrian Push Buttons.** By each push button removed, replaced, or installed.
- 5.15. **Removal, Replacement, or Installation of Traffic Signal Pole Foundations.** By the foot, of the type of foundation removed, replaced, or installed.
- 5.16. **Installation of Foundations for Ground Mount or Pole Mount Cabinets.** By each foundation installed.
- 5.17. **Removal, Replacement, or Installation of Controller Cabinet, Ground Mount.** By each cabinet removed, replaced, or installed.
- 5.18. **Removal, Replacement, or Installation of Controller Cabinet, Pole Mount.** By each cabinet removed, replaced, or installed.
- 5.19. **Removal, Replacement, or Installation of Flasher Cabinet.** By each cabinet removed, replaced, or installed.
- 5.20. **Installation of Foundations for Roadside Flashing Beacon Assemblies.** By each foundation installed.
- 5.21. **Removal, Replacement, or Installation of Roadside Flashing Beacon Assemblies.** By each assembly removed, replaced, or installed.
- 5.22. **Removal, Replacement, or Installation of Signal Pole Assemblies.** By each assembly, according to the type of pole assembly removed, replaced, or installed. Wiring in the pole and hardware is subsidiary to this Item.
- 5.23. **Removal, Replacement, or Installation of Curbs.** By the foot removed, replaced, or installed.
- 5.24. **Removal, Replacement, or Installation of Pedestrian Ramps.** By each ramp removed, replaced, or installed.
- 5.25. **Removal, Replacement, or Installation of Sidewalks.** By the square foot removed, replaced, or installed.
- 5.26. **Removal of Concrete Foundations.** By each foundation removed.
- 5.27. **Removal, Replacement, or Installation of Luminaire Heads.** By each luminaire head removed, replaced, or installed.
- 5.28. **Removal, Replacement, or Installation of Luminaire Mast Arms.** By each mast arm removed, replaced, or installed.
- 5.29. **Removal, Replacement, or Installation of Down Guy with Guard.** By each down guy with guard removed, replaced, or installed.
- 5.30. **Removal, Replacement, or Installation of Down Guy with Guard and Anchor.** By each down guy with guard and anchor removed, replaced, or installed.

- 5.31. **Remove and Salvage Traffic Signals.** By each signalized intersection salvaged. A signalized intersection is a group of traffic signals operated by a single controller.
- 5.32. **Removal, Replacement, or Installation of 12 × 12 × 6-in. PVC Weatherproof Enclosure.** By each PVC weatherproof enclosure removed, replaced, or installed.
- 5.33. **Removal, Replacement, or Installation of LED Lamp Unit.** By each LED lamp unit removed, replaced, or installed.
- 5.34. **Removal, Replacement, or Installation of Spread Spectrum Radio Antennas.** By each radio antenna removed, replaced, or installed.
- 5.35. **Removal, Replacement, or Installation of Video Imaging Vehicle Detection System (VIVDS).** By each camera assembly removed, replaced, or installed.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices for the various designations. This price is full compensation for furnishing all materials, equipment, labor, fines, tools, and incidentals. The Department will pay for electrical energy consumed by the traffic signal.

Wiring in the pole; splices; backfill (soil or concrete); sealing of conduit ends and loop detector saw slots; installation of loop wire and PVC for encased loops; protection of utilities; and preservation of sod, shrubbery, and trees will not be measured or paid for directly, but will be subsidiary to pertinent Items.