

SECTION 02586
TRAFFIC SIGNALS

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SECTION 02586

TRAFFIC SIGNALS

PART 1 - GENERAL

1.01 DESCRIPTION

This work shall consist of furnishing and installing all equipment necessary for the erection and operation of a traffic signal, flashing beacon, temporary traffic signal or modification of a traffic signal, all in reasonably close conformity with the plans. All traffic control signals shall be approved by the City of Saco Police Chief. Signals shall be synchronized when required by the Police Chief.

1.02 MATERIALS

All equipment shall be new unless otherwise specified. Substitutes for specified material will be accepted upon approval by the Engineer. Functionally, any substitute shall give equal or better service than the specified material and reconditioned as noted on the plans. All equipment installation of equipment and other incidental work shall conform to the latest applicable provisions of: NEC, MUTCD, NESC, NEMA and the ITE Standards for traffic control equipment. All work shall be done to the satisfaction of the Engineer. This meaning of specific terms shall be as defined in MUTCD, NESC and the ITE Standards for traffic control equipment.

Material shall meet the requirements specified in the following Subsections of Division 700 Materials of the current Maine Department of Transportation, Standard Specifications for Highways and Bridges (MDOT Specs):

Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired conduit	715.04
Metallic junction and Fuse Box	715.05
Secondary Wiring	715.07
Vehicular Signal Indications	718.01
Pedestrian Signal indications	718.02
Signal Mounting	718.03
Loop Vehicular Detectors	718.04
Microwave Detectors	718.05
Pedestrian Detectors	718.06
Controllers	718.07
Controller Cabinet	718.08
Flasher	718.09
Program Selection	718.10
Contacts and relays	718.11
Conductors	718.12
Aluminum Supports	720.01
Aluminum Mast Arm and bracket Arm	720.02
Steel Supports	720.03
Steel Mast Arm and bracket Arms	720.04
Wood Utility Pole	720.10
Anchor bolts	720.07

Paint. Aluminum paint shall conform to AASHTO M69, Type II. Black enamel paint, as indicated on the plans, shall meet or exceed the latest Federal Specification TT-E-489. The color shall match Federal Color Standard Number FED-STD-595B-27038.

Design and Fabrication. The design and fabrication of traffic signal support structures shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" and interims thereto, except as otherwise indicated within these specifications or on the contract plans. All poles and mast arms shall be designed to withstand the maximum forces generated on the design configuration by the loads specified in Section 2 of the "MDOT Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", using the 50-year mean recurrence interval for wind speeds.

All welding shall conform to the applicable provisions of the latest edition of the AWS Structural Welding Code, Steel, D1.1 for steel construction, or the latest edition of the AWS Structural Welding Code, Aluminum D1.2 for aluminum construction.

After execution of the contract and before any shop work is commenced, the Contractor shall submit two sets of the manufacturer's drawings of the poles he proposes to furnish and erect under this Contract. The drawings shall be of sufficient detail to indicate material and dimensional conformance with these specifications and the contract drawings. Each drawing shall contain a reference to the design criteria and a certification that the design criteria have been met by the poles, mast arms and associated hardware and fittings, as submitted. The certification shall be signed by a Registered professional Engineer under his official seal.

It is the intent of these specifications that the contractor shall be fully responsible for the adequacy of the sizes, wall thicknesses, materials and connections of the poles, mast arms and associated hardware and fittings. Approval of the drawing by the Engineer will signify only approval of the materials, mounting height(s) and mast arm length(s). Approval of deviations from the contract drawings and/or specifications shall be requested in writing and approved by the Engineer before being incorporated in the manufacturer's drawings.

The Contractor shall furnish and install all electrical fittings, pipe, switches, fuses and such other material necessary to install the equipment properly and securely. All equipment shall conform to the applicable code and be of first-class workmanship. All electrical fittings shall be complete with weatherproof gaskets.

Miscellaneous Materials. Span wire shall be minimum 7.9 mm (5/16 inch) diameter, minimum, 7 strand, extra-high strength, galvanized steel wire. Anchors shall be power installed and sized according to strain and soil conditions. All hardware, such as strandwise feed-thru dead ends, performing guy grip dead ends and angle thimble-eye bolts, shall be standard pole line hardware.

Guying of poles shall meet the requirements of Grade "B" construction as defined in the NESC. Guys shall be installed in line with the direction of pull. Anchors shall be power installed so that the centerline of the anchor rod will be within 10° of the line of the guy wire. The holding capacity of the anchor shall be 1.25 times the calculated load on the guy wire. Guy wires shall be utility grade and the maximum working stress shall not exceed half of the maximum ultimate tensile strength of utility grade guy strand. Where bedrock is encountered, rock anchors shall be used.

Pipe stand-offs for sidewalk anchors shall be galvanized steel pipe sized according to the offset distance from anchor to pole and shall be fitted with standard guying hardware.

Messenger wire shall be 6 mm (1/4 inch) diameter, 7 strand, extra-high strength, galvanized steel wire, unless otherwise specified.

1.03 CONSTRUCTION REQUIREMENTS

General. Installation details will be shown on the plans. The location shown for all equipment and vehicle detectors is approximate; final locations will be determined in the field.

During installation, all heads installed but not operating shall be covered or otherwise concealed from view.

The requirements of certain Subsections of this specification may be waived for temporary traffic signals and traffic signal modifications, if so noted on the plans.

Poles. Wood poles shall be placed in the ground to a depth of 20 percent of their overall length, with a maximum deviation from the vertical of 6 mm in 1500 mm (1/4 inch in 5 feet).

After each wood pole has been set in the ground and plumbed, the space around the pole shall be backfilled with selected earth or sand, free of rocks and other deleterious material, placed in layers approximately 100 mm (4 inches) thick. Each layer shall be moistened and thoroughly compacted.

Strain poles, pedestal poles and mast arm poles shall be erected in a vertical position, with a maximum deviation from the vertical of 6 mm in 1500 mm (1/4 inch in 5 feet) using the leveling nuts provided with the anchor bolts. Once the poles have been plumbed, the top nuts shall be tightened by bringing the nut to a snug tight condition using the full efforts of a worker using a spud wrench or compatible tool. After all nuts have been brought to a snug, tight condition, each nut shall be tightened an additional one-third turn, using an impact wrench, torque wrench or large crescent wrench. A minimum of two full threads shall project beyond the outside face of the nut. Nuts and bolts, other than anchor bolts, shall also be tightened by the above procedure.

When foundation and anchor bolts have been installed by others, the Contractor shall verify the anchor bolt dimensions at each location so that bases will be furnished with properly located and sized bolt holes.

Wires in poles shall be supported with a Kellum-type, braided, strain-relief grip attached to a "J" hook mounted inside the pole near the top.

Loop Detector and Loop Detector Wire Installation. The detector unit shall be located in the controller. No more than four loops shall be connected to a single detector amplifier.

Detectors shall be installed according to the manufacturer's recommendation, subject to approval. Each detector shall be supplied complete with comprehensive installation instructions.

The pavement slot for wire shall be 50 to 75 mm (2 to 3 inches) below the finished surface and not closer than 450 mm (18 inches) from the edge of pavement or the curb. The right-angle corners of the pavement slot shall be chamfered to eliminate sharp bends in the loop wires.

Loop detector wire shall be number 14 or number 12 AWG copper conductors drawn through vinyl plastic tubing approximately 6 mm (1/4 inch) in diameter. All pulse loop "approach" wiring shall be insulated red and shall be permanently marked "A", "B", "C", or "D", according to the "approach" guidelines in the controller cabinet. All pulse loop "presence" wiring shall be insulated black and shall be permanently marked according to the "presence" guidelines in the controller cabinet. All loop lead-ins shall be of the same conductor with no splicing. The lead-in from the amplifier to the beginning of the loop shall be shielded pairs, as shown on the plans.

All debris and moisture shall be removed from the loop pavement slot before installation of loop wires. The pavement slot shall be filled to the road surface with the approved sealing compound to form a waterproof bond with the pavement after installing the wire loop.

Detector conductors shall not be housed in the same jacket as the signal conductors.

Microwave Detector Installation. The microwave detector shall be installed in accordance with the manufacturer's recommendations. A four conductor wire shall be installed from the microwave unit to the controller. All angles and adjustment of patterns shall be the responsibility of the Contractor. The detectors shall operate in either pulse or presence mode.

Span Wire, Messenger Wire and guy Wire. All span wire, messenger wire, and guy wire installations shall be in conformance with the requirements of the utility companies, when installed on utility poles.

All span wires, messenger wires, guy wires, terminal boxes, controller cabinets, or any other metallic surface that might be contacted by people, shall be bonded to ground.

All sidewalk guy wires and slant guy wires installed in a sidewalk area shall be equipped with full-round or half-round guy guards.

Conduit. All conductors under roadways from the controller to the mast arm poles shall be three inch schedule 80 PVC.

Service Connection. The Contractor shall furnish and install the necessary electrical service as directed by the utility company. The Contractor shall make all arrangements for the service connection and be responsible for all charges incurred thereby.

Under no condition shall any equipment, except that shown on the plans, be installed on any utility pole.

Whenever a service connection is to be made, the contractor shall contact the utility involved and inform them of the location, pole number and time proposed for the service connection.

The Contractor shall be responsible for all outstanding bills for preliminary work done by the utility company during the installation of the traffic signal system, to facilitate the service connection.

The Contractor shall be responsible for all outstanding bills for preliminary work done by the utility company during the installation of the traffic signal system, to facilitate the service connection.

A service ground rod shall be installed if the service meter trim is not grounded.

The contractor shall be responsible for grounding the system to 5 OHMS or less. The grounding shall be performed using a ground meter with reference grounds. All testing will be done in the presence of the Engineer.

Wiring. The Contractor shall furnish and install sufficient cable and wire to operate the system properly as shown on the plans and as directed.

The following color code shall be used where possible:

Red wire	Red, artery
Orange Wire	Yellow, artery
Green wire	Green, artery
Red with tracer	Red, side street
Orange with Tracer	Yellow, side street
Green with Tracer	Green, side street
White and white with tracer	Common for all signals and bond
Blue	All steady burning arrows
Blue with Tracer	Intermittent arrows
Remaining	Detectors and pedestrian signals

The white wire and white wire with tracer shall be used for all common connections and it shall be continuously connected to ground at the controller.

There shall be no wire splices. Connections shall be made on a terminal board inside a watertight galvanized steel or aluminum junction box or in an aerial terminal enclosure with protective cover rated for 600 volts.

Spade type copper terminal ends shall be used to attach all connectors to terminals. All exposed metal parts, including service conduit and the controller cabinet shall be bonded and grounded.

Not more than 3 conductors shall be brought to any one terminal. Terminals shall be mounted to face the cabinet door.

The number and size of conductors required in each cable will be indicated on the plans.

Vertical Clearance. Vertical clearances for vehicular and pedestrian heads shall be in conformity with the NUTCD. All clearances shall be uniform among each type of head or mounting scheme. Clearance for mast arm pole and span wire for pole mounted vehicular heads shall be 3 m (10 feet); clearance for pedestrian heads shall be 5.5 m (8 feet) unless otherwise specified. Clearance for span wire mounted flashing beacon heads shall be a minimum of 5.2 m (17 feet) and a maximum of 5.5 m (18 feet).

Painting. All exterior parts of the following equipment shall be delivered to the project finished with black enamel:

- Vehicular Signal Heads
- Pedestrian Signal Heads
- Pedestrian Push Button Detectors

The outsides of the steel controller cabinet shall be painted with aluminum paint.

The Contractor shall apply one coat of black enamel to all existing equipment designated on the plans to be painted. The Contractor shall touch up all scratches on exposed surfaces of new equipment with matching enamel after the equipment has been installed.

All exposed signal parts to be painted shall be cleaned and shall be dry when the paint is applied. No painting shall be done in damp weather nor when the air temperature is below 4°C (40°F), unless otherwise permitted.

The contractor shall identify recently painted equipment with "Wet Paint" signs, and shall be responsible for all claims for damages resulting from contact with wet paint surfaces.

Power Factor. In the event that the equipment is of such design that the power factor is reduced below the requirement of the utility company, the Contractor shall furnish and install, without further charge, all equipment necessary to restore the power factor to a satisfactory percentage. Such equipment shall be accessible and shall not be mounted on the utility company poles.

Field Tests. Prior to acceptance of the work, and in the presence of the Engineer, the contractor shall conduct the following tests on all traffic signal equipment and circuits.

- (a) Continuity. Each circuit shall be tested for continuity.
- (b) Ground. Each circuit shall be tested for grounds.
- (c) Megger. Megger tests at 500 volts DC shall be made on each circuit between the circuit and a ground. The insulation resistance shall not be less than 1000 s (10 megohms) on all circuits, except or inductive loop detector circuits which shall have an insulation resistance value of not less than 10,000 s (100 megohms).
- (d) Loop Inductance. A loop test meter shall be used to determine that the inductance of the installed loop and lead-in are within the tuning range recommended by the loop detector manufacturer.
- (e) Functional. A functional test shall be made in which it is demonstrated that each part of the system functions as specified.

The functional test for each new or modified traffic signal and flashing beacon shall consist of not less than 10 days of continuous satisfactory operation. If unsatisfactory performance of the system develops, the condition shall be corrected and the test shall be repeated until the 10 days of continuous satisfactory operation is obtained.

The initial operation shall be made between 9:00 A.M. and 2:00 P.M. unless specified otherwise. Prior to initial operation, all equipment shown on the plans shall be installed and operable.

Initial operation of new or modified traffic signal systems shall be made only after all traffic signal circuits have been thoroughly tested as specified above.

During the test period all costs except electrical energy shall be the contractor's responsibility.

Functional tests shall start on any working day except Friday or the day preceding a legal holiday.

Shutdown caused by a power interruption shall not constitute discontinuity of the functional test, however, the test shall continue after power is restored.

Timing. The controller shall be timed as noted on the plans. The contractor shall notify the Engineer, at least 1 week in advance, of his intention to initially operate the signals.

At the time of initial operation of the new signals, the contractor shall provide police protection from the local police department at the contractor's expense until the contractor demonstrates to the Engineer that the signal operates in conformance with the specification.

Final Cleaning Up. After all work has been completed, the contractor shall remove all barriers, "Wet Paint" signs, equipment and all debris which has accumulated during the work.

Unless otherwise specified in the plans, the Contractor shall remove and deliver all unused signal equipment and wiring to the State of Maine, Department of transportation, as directed by the City of Saco Engineer. The Contractor shall notify the State Traffic Engineer (207-289-3775) as to time and date of such delivery. (Deliveries will be accepted Monday through Friday between the hours of 7:00 A.M. and 4:00 P.M. only.) Notification shall precede delivery by a minimum of 24 hours.

Documents. The Contractor shall furnish two operation and maintenance manuals for all controller units, auxiliary equipment, vehicle detector sensor units, control units and amplifier. Documents shall be delivered with the controller at the time of testing. Each manual must include, but need not be limited to the following:

- (a) An explanation of the theory of operation, including a functional description and a detailed circuit description.
- (b) A schematic diagram of each unit. A cabinet wiring diagram including all field wiring and pin locations and designations for all plug type connectors.
- (c) A trouble shooting and preventive maintenance procedure including both field and bench trouble shooting analysis.
- (d) A parts list including a pictorial diagram showing the location and identification of each component on the chassis or circuit board.
- (e) A drawing of the controller cabinet interior showing the location of all shelves, terminal blocks, relays, timers, loop amplifier.

In addition, manufacturer's warranties and guarantees for materials shall be delivered to the Engineer prior to acceptance of the project.

1.04 MEASUREMENT AND PAYMENT

Please refer to Measurement and Payment Section 01025 of these specifications.

---END OF SECTION 02586---