

600 INCIDENTALS

ITEM 601 SLOPE AND CHANNEL PROTECTION

- 601.01 Description**
- 601.02 Materials**
- 601.03 General**
- 601.04 Riprap**
- 601.05 Crushed Aggregate Slope Protection**
- 601.06 Concrete Slope Protection**
- 601.07 Dumped Rock Fill**
- 601.08 Rock Channel Protection**
- 601.09 Paved Gutter**
- 601.10 Method of Measurement**
- 601.11 Basis of Payment**

601.01 Description. This work shall consist of protecting slopes, channels and gutters with riprap, concrete, crushed aggregate or rock. Types, locations, dimensions, lines, grades, and slopes shall be as specified, including all excavating, grading and compacting of the foundation and bed, sheeting and bracing, cofferdamming, pumping, bailing and draining, furnishing, placing and compacting of gravel or slag for foundation and bedding, the furnishing and placing of grout for joints, the furnishing and placing of joint filler, backfilling and disposing of surplus materials.

601.02 Materials. Limestone, rock, broken concrete, and broken stone shall be sound and durable, free from earth and foreign materials. Reinforced concrete and sandstone shall not be permitted. Other materials shall be as follows:

Brick and blocks	704
Cement for grout	701
Concrete - Class C	499, 511
Crushed gravel, stone or slag (Nos. 1, 3, and 4)	703.04
Joint sealer	705.01, 705.02
Preformed expansion joint	705.03
Reinforcing steel	509.02
Sand for grout	703.03

601.03 General. When specified, brick, stone or broken concrete used in riprap and gutters shall be grouted in place.

The grout filler shall be composed of a mixture of portland cement, sand and water, mixed in the proportion of one part cement and three parts sand.

Cement grout shall be prepared in a mixing machine of approved design equipped with an accurate graduated regulating device for controlling the amount of water for each batch. The quantities for each batch shall be exactly sufficient for one or more sacks of cement and shall be accurately measured and proportioned.

Brick, stone or broken concrete shall be thoroughly wet immediately before grout is applied. As soon as the grout is deposited on the surface, it shall be thoroughly worked into the joints with excess grout removed from the exposed surfaces of the brick, stone or concrete. The application of additional water to the grout after it has been deposited will not be permitted.

Grouted gutters and riprap shall be cured in accordance with 451, except that membrane cure shall be applied at the rate of not less than 1 gallon per 200 square feet of surface.

All concrete shall be Class C, mixed and placed in accordance with 511, and finished with a float. Concrete shall be cured as described in 451 except that material meeting the requirements of 705.07, Type 1 may be used. Membrane cure shall be applied at the rate of not less than 1 gallon per 200 square feet of surface.

601.04 Riprap. This type of protection shall be provided in accordance with one of the following three alternates:

(1) Limestone, rock, broken concrete, and broken stone, not less than one cubic foot in volume, nor less than 6 inches in width and 12 inches in depth may be used.

Prior to laying the riprap, the foundation shall be excavated to a depth 6 inches below the bottom of the riprap wall, and the bank excavated and sloped as shown on the plans. Then a foundation of 6 inches of gravel or slag shall be laid and thoroughly compacted and, if called for on the plans, a similar bed shall be prepared on the slope.

The stones shall be rough dressed, set to line and grade and firmly embedded in the gravel or slag. Stones shall be laid so as to break joints vertically. Joints, both horizontal and vertical, shall not exceed 1 inch in width. All joints in the riprap shall be filled with grout.

The height, length and thickness of the wall shall be not less than the dimensions shown on the plan. The sizes of the individual pieces of stones used for riprap shall be selected to conform to the minimum dimensions required, but they may exceed such dimensions by a reasonable amount if such over dimensions do not interfere with the general construction of the riprap.

(2) Concrete riprap in cloth or burlap bags may be used. Prior to laying the bags, the foundation shall be excavated to a depth 6 inches below the bottom of the bag wall and the bank excavated and sloped as shown on the plans. Then a foundation of 6

601.05

inches of gravel or slag shall be laid and thoroughly compacted and, if called for on the plans, a similar bed shall be prepared on the slope.

The bags shall be soaked with water and filled with approximately 2/3 cubic foot of Class C concrete, and the bags hand placed to the specified lines and grades. The nominal size of each bag of concrete shall be 6x12x16 inches. The open end of each bag shall be tied or folded under and each course of bags shall be placed to overlap the joints in the lower course. After being placed, each bag shall be pierced to permit some concrete to flow out and make bond with the overlying course. The volume of concrete used shall not be less than 1/3 cubic yard for each square yard of riprap in place. One-half inch reinforcing bars approximately 18 inches long and spaced approximately 12 inches apart shall be pushed or driven down through the top three courses. When the protected slope is 1-1/2:1 or steeper, a bed shall be placed consisting of two courses of bags placed with their long dimension parallel to the flow as stretchers and covered by a row of bags placed with their long dimension normal to the flow as headers. Succeeding courses of bags shall be placed as stretchers. On slopes flatter than 1-1/2:1, all courses after the bed course shall be placed as headers.

(3) A 6 inch reinforced class "C" concrete slab may be used.

The reinforcement shall consist of steel bars or fabricated reinforcement equivalent to 3/8 inch round bars spaced at 24 inch centers in two directions, or wire fabric conforming to 709.10 or 709.12, placed approximately midway between top and bottom of slab. Formed construction joints may be used, subject to the approval of the Engineer, but the reinforcement shall extend through the joint. Cutoff walls as shown on the plans shall be included for payment in the unit price bid for reinforced concrete slab.

601.05 Crushed Aggregate Slope Protection. No. 1 crushed gravel, stone or slag shall be placed so that the surface is flush with the embankment slopes. It shall be 12 inches thick where placed on slopes under bridges and shall extend from the face of the abutments down to the toe of the slopes or to normal water elevation, and a minimum of 3 feet beyond the outer edges of the superstructure.

601.06 Concrete Slope Protection. A concrete slab, 6 inches thick, shall extend over the area of the embankment under a bridge from the face of the abutment down to the toe of the slope and extending a minimum of 3 feet beyond the outer edges of the superstructure. The concrete slab shall be thickened along the bottom edge from 6 inches to 18 inches in a distance of 3 feet to provide resistance to sliding.

Where pier columns extend through the slab, 1 inch preformed expansion joint material shall be placed around the columns for the full thickness of the slab.

Depressed grooves, one inch deep with rounded edges, shall be uniformly spaced at 4 to 5 foot centers in two directions. The grooves shall be truly horizontal in one direction, and parallel to the center line of the superstructure in the other direction.

601.07 Dumped Rock Fill. Limestone, sound and durable rock, broken concrete or stone shall be placed as a rock fill material for the protection of the slope or other surfaces. Sandstone shall not be permitted. Thin slab-like pieces or pieces having any dimension larger than 36 inches or less than 8 inches shall not be used. The material shall be dumped in place with the larger pieces at the outer face and the smaller pieces and spalls near the inner surface of the protected area. The material shall be placed so as to insure a reasonably smooth and continuous surface conforming to the slope lines shown on the plans. The completed dumped rock fill material shall be sufficiently uniform to avoid concentration of fines and small pieces at any location.

This item shall be of three types defined below:

Type A shall consist of sizes such that at least 85 percent of the total material by weight shall be larger than an 18 but less than a 36 inch square opening. The material smaller than an 18 inch square opening shall consist predominantly of rock spalls and rock fines and shall be free of soil.

Type B shall consist of sizes such that at least 85 percent of the total material by weight shall be larger than a 12 but less than a 30 inch square opening. The material smaller than a 12 inch square opening shall consist predominantly of rock spalls and rock fines and shall be free of soil.

Type C shall consist of sizes such that at least 50 percent of the total material by weight shall be larger than a 9 but less than an 18 inch square opening, and shall be free of soil. The amount of material passing a 3 inch sieve shall be not more than 15 percent by weight of the total material.

601.08 Rock Channel Protection. Material for rock channel protection shall meet the requirements of Type A, Type B, or Type C dumped rock fill material as defined in 601.07, and shall be placed with a 6 inch bed of No. 3 or 4 crushed gravel, stone or slag as specified. Reasonable care shall be exercised in placing the rock to assure that the finished surface of the protected channel will conform with the channel cross sections as required by the plans. At no time shall individual stones project more than 25% of the largest allowable opening specified in 601.07.

601.09 Paved Channel. Paved channel shall be constructed to the dimensions and shape as shown on the plans or as directed by the Engineer by one of the following methods:

(a) Brick. A foundation of limestone or slag 6 inches thick shall be placed and compacted. The bricks shall be placed with their long dimension normal to the flow of the channel, and the joints filled with grout filler.

(b) Concrete. Concrete shall be mixed in accordance with 499.03 and placed in accordance with 499 and 511.08.

601.10

601.10 Method of Measurement. Riprap, crushed aggregate slope protection and concrete slope protection will be measured by the square yard of finished surface complete in place. Dumped rock fill and rock channel protection will be measured by the cubic yard completed in place and accepted, in accordance with the dimensions shown on the plans, or if it is not practicable to determine the amount by measurement, the yardage may be determined from tonnage of acceptable material delivered. Paved channel will be measured by the square yard complete in place.

601.11 Basis of Payment. The accepted quantities of specific items of slope and channel protection will be paid for at the contract price per unit of measurement designated for each of the pay items listed below that are included in the proposal. These prices shall be full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete the items as specified.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
601	Square Yard	Riprap
601	Square Yard	Crushed aggregate slope protection
601	Square Yard	Concrete slope protection
601	Cubic Yard	Dumped rock fill, Type_____
601	Cubic Yard	Rock channel protection, Type_____
601	Square Yard	Paved channel

ITEM 602 MASONRY

- 602.01 Description**
- 602.02 Materials**
- 602.03 General**
- 602.04 Method of Measurement**
- 602.05 Basis of Payment**

602.01 Description. This work shall consist of furnishing all materials and constructing headwalls, pipe cradles, collars, encasement, and other masonry of the types and sizes specified. This work shall include all sheeting, bracing, cofferdamming, pumping, bailing and draining, pointing and plastering, the furnishing, setting and removal of forms, the furnishing and placing of vitrified brick, or concrete, where required, as well as backfilling and the restoration of existing surface areas disturbed by the work.

602.02 Materials. Materials shall be as follows:

Brick	704.01
Cement for mortar	701.07

Concrete, (Class C).....	499 and 511
Reinforcing steel	509
Sand for mortar.....	703.03

602.03 General. The designated item shall be constructed at the locations and to the dimensions, lines and grades specified.

The excavation shall be of such dimensions in all cases as will give ample room for construction. The removal of any obstruction not included as a bid item under 202, which is necessary for the construction of the work, shall be done by the Contractor at no additional cost to the City.

The Contractor shall protect the sides of all excavations from caving by providing suitable sheeting, shoring, and bracing. Excavation shall be made by such methods that the original material below the bottom of footers will not be disturbed.

If the material found at grade is not suitable for foundation, a further depth shall be excavated, filled and compacted with suitable material as directed by the Engineer. If the depth excavated and backfilled exceeds 2 feet, and is not due to neglect or the fault of the Contractor, the excavation and backfill in excess of 2 feet shall be performed and paid for as specified in 203.13, c.

Adequate precautions shall be taken to prevent concrete and mortar from freezing. Brick and masonry units shall not be set with mortar until heated for a period sufficient to insure a temperature of 50°F to 80°F throughout the entire mass of the material. Water is to be free of organic materials. All material and masonry shall be kept warm and otherwise protected in a manner acceptable to the Engineer. Under no condition will the use of frozen or ice covered brick be permitted. Unless otherwise specified, a mortar for brick masonry consisting of one part portland cement and two parts damp, loose sand measured by volume shall be used. This proportion requires not less than thirteen sacks of cement for each cubic yard of mortar.

Mortar shall be mixed dry to a uniform color in a clean, tight box or an acceptable mixer and tempered with water and thoroughly mixed. Mortar shall be mixed in batches of such size as are needed for prompt use. The use of retempered mortar, or that which has received an initial set, is prohibited.

Unless otherwise specified on the drawings, brick masonry shall consist of common brick. The brick shall be free from dirt and frost, and laid truly horizontal with close mortar-filled "push" joints. Care shall be taken to "break" joints and to thoroughly bond the work. In summer months the brick shall be wetted unless otherwise directed by the Engineer.

Brick masonry shall not be laid in water, nor shall water be permitted to come in contact with such work until the mortar shall have set. It shall be protected from the weather and all disturbance, and kept well moistened until set.

602.04

In bonding new masonry to old, the old brick work shall be toothed and surfaces cleaned of dirt, grease and surplus mortar. In leaving unfinished work for the day, the masonry shall be racked or toothed back and all surplus mortar removed.

Joints for exposed faces shall not exceed 1/4 inch in width and shall be carefully pointed except where the surfaces are to be plastered unless otherwise specified. Surfaces of brick masonry which are to be plastered shall be thoroughly cleaned and wetted. Plaster shall be applied before the masonry has set, and shall receive a smooth, dense trowel finish.

Concrete headwalls, cradles, encasement, and other concrete masonry shall be constructed of the materials and by the methods as described under 499 and 511 and shall be Class C. Reinforcing steel shall be placed as prescribed under 509.

Forms or centers shall be true to dimensions, clean, rigid, and braced to prevent deflection. The construction of the forms and bracing shall be such as to insure removal without jar or injury to the brick masonry and to offer to the workmen adequate space in which to lay up the brick work. Forms or centers shall be left in place until their removal is permitted by the Engineer.

Backfilling shall follow completion of the work as closely as the type of construction will permit. Earth shall be placed around the work in layers not exceeding 8 inches thick loose measurement, and thoroughly tamped in place with suitable tampers.

After the backfilling has been completed, the Contractor shall immediately remove all surplus material and all dirt and rubbish from the site. Surplus excavation and other materials shall be disposed of as prescribed in 203.

602.04 Method of Measurement. The quantity to be paid for under this item shall be the number of cubic yards of masonry completed and accepted. Quantities shall be determined by measurement of the work in place or from plan dimensions as determined by the Engineer. Deductions will be made from the gross quantity for all openings or structures contained in the masonry and payment shall be made only for the actual quantity of masonry.

602.05 Basis of Payment. The accepted quantities of masonry, including epoxy coated reinforcing steel where specified, measured as above provided shall be paid for at the contract unit price bid, which price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals, including epoxy coated reinforcing steel where specified, required to complete the items as specified.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
602	Cubic Yard	Brick Masonry

602	Cubic Yard	Concrete Masonry
602	Cubic Yard	Concrete Masonry with Epoxy Coated Reinforcing Steel

ITEM 603 SLAG AND LIMESTONE

- 603.01 Description**
- 603.02 Materials**
- 603.03 Construction**
- 603.04 Method of Measurement**
- 603.05 Basis of Payment**

603.01 Description. This item shall consist of excavation and the furnishing, hauling and placing of slag or limestone for bedding pipe sewers or excavation, and the furnishing, hauling and placing of slag or limestone for driveway reconstruction as specified in the plans or as directed by the Engineer.

603.02 Materials. Bedding materials shall conform to the following:

Air-cooled slag	703.02
Granulated slag.....	703.08
Limestone	703.02

Size shall be as directed by the Engineer. Granulated slag screenings shall be used as filler for the slag course of driveway reconstruction, as directed by the Engineer.

603.03 Construction. Material for embedding pipe shall be in accordance with the item requiring the material or as directed by the Engineer.

Slag or limestone for driveway reconstruction shall be spread and compacted by roller or vibrator to a 6 inch thickness or as directed by the Engineer. Filler material shall be spread and broomed over compacted slag or limestone and rolled or vibrated until a satisfactory roadway is obtained. In order to assure stability, the Contractor may add cement to the choking material if so desired.

603.04 Method of Measurement. The quantity to be paid for as bedding materials under this item shall be the number of cubic yards in place and accepted as specified in the item requiring material. The quantity to be paid for as driveway reconstruction shall be the number of square yards of slag or limestone in place and accepted. The yardage shall be determined from the Engineer's final measurements.

603.05 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
603	Cubic Yard	Slag
603	Cubic Yard	Limestone

604.01

603 Square Yard Slag or limestone for driveway reconstruction,
 _____ inches thick

ITEM 604 BANK RUN GRAVEL

604.01 Description

604.02 Materials

604.03 Construction

604.04 Method of Measurement

604.05 Basis of Payment

604.01 Description. This item shall consist of the furnishing and placing of bank run gravel for backfilling sewer and other trenches and for filling such other as may be shown on the plans.

604.02 Materials. Bank run gravel for this item shall be a natural or processed material composed of a mixture of hard, durable particles or fragments of stone or gravel and sand, and small amounts of silt, clay or other similar binding materials, and shall be free from excessive or detrimental amounts of clay, clay lumps, loam, roots, vegetable matter, rubbish, wood, muck or other non-stable materials.

Oversized pebbles, stones, rocks and boulders of acceptable quality, occurring in the pit may be crushed and become a part of the mixture provided the blend meets the following gradation:

Passing a 3 inch sieve:	100%
Passing a 2 inch sieve:	90 -100%
Passing a 1 inch sieve:	70 - 90%
Passing a No. 4 sieve:	25 - 70%
Passing a No. 40 sieve:	5 - 30%
Passing a No. 200 sieve:	0 - 10%

The Contractor shall give the Engineer sufficient advance notice of the source of the materials to enable tests to be made. No materials shall be delivered to the job until the Engineer has approved its use.

604.03 Construction. The bank run gravel shall be placed and compacted as specified in the item requiring the material or as directed by the Engineer.

604.04 Method of Measurement. The quantity to be paid for under this item shall be the number of cubic yards compacted in place and accepted and measured as specified in the item requiring the material.

604.05 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
604	Cubic Yard	Bank run gravel

ITEM 605 STABILIZED BACKFILL

605.01 Description

605.02 Materials

605.03 Construction

605.04 Method of Measurement

605.05 Basis of Payment

605.01 Description. This item of work shall consist of furnishing and placing dry stabilized backfill in areas designated on the plan or as directed by the Engineer.

605.02 Materials. Backfill shall be of materials meeting the requirements of 604.02. Portland cement shall be as specified in 499.02.

605.03 Construction. The granular backfill material and the portland cement shall be thoroughly mixed at the ratio of one cubic yard of granular material to one sack of portland cement. The stabilized backfill material shall be placed and compacted in accordance with 503.10.

605.04 Method of Measurement. The quantity to be paid for under this work shall be the number of cubic yards of stabilized backfill placed and compacted as specified. Payment shall be made for only the backfill placed within the specified pay limits. The number of cubic yards of stabilized backfill shall be determined from the Engineer's measurements.

605.05 Basis of Payment. Payment for accepted quantities complete in place shall be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
605	Cubic Yard	Stabilized Backfill

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete this work as specified.

ITEM 606 GUARDRAIL

606.01 Description

606.02 Materials

606.01

- 606.03 Setting Posts**
- 606.04 Erecting Rail Elements**
- 606.05 Guardrail Rebuilt**
- 606.06 Impact Attenuators**
- 606.07 Method of Measurement**
- 606.08 Basis of Payment**

606.01 Description. This work shall consist of the construction or reconstruction of guardrail, guardrail posts, bridge terminal assemblies, end terminals, and impact attenuators, including the furnishing, assembling, and erecting of all component parts and materials, in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the Engineer.

Guardrail shall be deep beam rail Type 5, 5A, or 8. Appurtenances shall include bridge terminal assemblies, end terminals, and impact attenuators. Construction of the various types of guardrail include the furnishing, assembling, and erecting of all component parts and materials, complete and in place, at the location shown on the plans or as directed by the Engineer, and according to the manufacturer’s recommendations where applicable.

606.02 Materials. Steel posts, rails, bolts, fittings and other accessories shall be galvanized. Specific materials shall be as follows:

Deep beam rail.....	710.06
Galvanizing, hardware.....	711.02
Pressure treated guardrail posts and spacer blocks	710.14
Steel guardrail posts.....	710.15
Concrete (Class C).....	499 and 511
Reinforcing steel.....	509.02
White paint	708.16
Paint thinner	708.03 or 708.04

Use galvanized steel posts, rails, bolts, fittings, and other accessories.

For guardrail, use deep beam rail Type 5, 5A, or 8.

606.03 Setting Posts. Posts shall be set plumb in holes, or driven. The manner of driving shall be such as to avoid battering or distorting of posts. Posts set or driven to within 1 inch of grade need not be trimmed. If post tops are trimmed, they shall be treated after trimming with a preservative material specified in 712.06. Post holes shall be backfilled with acceptable material placed in layers and thoroughly compacted.

Space Type 5 guardrail posts 6 feet 3 inches on center measured along the centerline of the rail and construct blockouts. Construct each end of the Type 5 guardrail barricades without blockouts and with a flared end section.

Space Type 5A guardrail posts 3 feet 1 1/2 inches on center measured along the centerline of the rail and construct blockouts. Construct each end of the Type 5A guardrail barricades without blockouts and with a flared end section.

Space Type 8 guardrail posts 6 feet 3 inches on center measured along the centerline of the rail and construct blockouts.

For flexibility, transition guardrail posts shall be spaced as detailed on the plans or as directed by the Engineer.

606.04 Erecting Rail Elements. Erect standard design (single faced) guardrail of the type shown on the plans. Erect barrier design (double faced Type 4 or Type 5) guardrail as shown on the plans.

Rail elements shall be erected in a manner resulting in a smooth, continuous installation. Shop-curved rail shall be used on curves with radii of 5 feet to 70 feet, inclusive.

All bolts, except where otherwise required, such as expansion joint bolts, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch beyond the nuts. Except where required for adjustment, bolts shall not extend more than 1/2 inch beyond the nuts. For single-faced guardrail, bolts through posts shall extend from 1/4 inch to 2 inches beyond the nuts and for double-faced rail 1/4 inch to 1 inch.

All metal shall be fabricated in the shop. No burning or welding shall be done in the field. Holes for special details in exceptional cases may be made in the field when approved by the Engineer. Field punching, cutting and drilling may be permitted if approved by the Engineer after it has been demonstrated that it will not result in damage to the surrounding metal.

Galvanized surfaces which have been abraded so that the base metal is exposed, threaded portions of all fittings and fasteners and cut ends of bolts shall be repaired as specified by ASTM A 780.

Guardrail shall be erected so that the bolts at expansion joints will be located at the centers of the slotted holes. The rail elements shall be spliced by lapping in the direction of traffic. The plates at each splice shall make contact throughout the area of the splice.

606.05 Guardrail Rebuilt. Where so required by the plans, existing guardrail salvaged under 202 shall be rebuilt at the locations specified. Unless otherwise required by the plans, rebuilt units shall be of the same type, spacing of members, etc., as the original guardrail.

606.06

Rail element for re-erecting shall be obtained from salvage sources. The Contractor shall furnish all new posts, spacer blocks and such additional bolts, washers or incidental hardware as may be necessary to complete the guardrail, except: (1) existing steel posts and spacer blocks that are undamaged and still have a good galvanized coating may be reused, and (2) guardrail splice bolts that are undamaged and were not removed during salvage may be reused.

All salvaged painted guardrail rebuilt shall be cleaned, spot primed and given two coats of white paint in accordance with 514.07, except that sandblasting will not be required.

606.06 Impact Attenuators. Before installing the attenuator, the Contractor shall make all corresponding shop drawings from the manufacturer available for the Engineer's inspection. The Contractor shall include installation drawings and instructions with the shop drawings that completely describe the attenuator system.

The top of each foundation shall be graded at the same elevation as the adjacent travel lane and/or paved shoulder.

606.07 Method of Measurement. Guardrail, new or rebuilt, as applicable, will be measured by the linear foot from center to center of end posts, excluding anchor assemblies and transitions, except where end connections are made to masonry or steel structures, in which case measurement will be to the center of the normal post bolt slot. If rail element is used across a bridge, the measurement of guardrail will be to the first post off the bridge.

Anchor assemblies of the type specified to be paid for will be the actual number furnished and erected complete.

Bridge terminal assemblies of the type specified to be paid for will be the actual number furnished and erected complete.

Impact attenuators of the type specified to be paid for will be the actual number furnished and erected complete.

Guard posts of the kind specified to be paid for will be the actual number of posts furnished and erected.

606.08 Basis of Payment. The accepted quantities of new or rebuilt guardrail will be paid for at the contract unit price per linear foot for the type specified, complete in place.

Anchor assemblies, bridge terminal assemblies, and impact attenuators be paid for at the contract unit price per each for the type specified, complete in place.

Guard posts will be paid for at the contract unit price per each, complete in place.

Payment will be made under:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
606	Linear Foot	Guardrail, Type
606	Linear Foot	Guardrail, barrier design, Type ____
606	Linear Foot	Guardrail rebuilt, Type ____
606	Each	Anchor assembly, Type ____
606	Each	Anchor assembly, Type ____, barrier design
606	Each	Bridge terminal assembly, Type ____
606	Each	Impact Attenuator, Type ____
606	Each	Guardrail post

ITEM 607 FENCE

607.01 Description

607.02 Materials

607.03 Clearing and Grading

607.04 Post Assemblies

607.05 Horizontal Deflection

607.06 Line Posts

607.07 Post Braces

607.08 Fabric

607.09 Barbed Wire

607.10 Method of Measurement

607.11 Basis of Payment

607.01 Description. This work shall consist of furnishing and erecting fence and gates of the types designated in reasonably close conformance with lines, grades and locations specified on the plans or established by the Engineer. Construction shall be accomplished in a manner that will provide a rigid, taut fence closely conforming to the surface of the ground.

Fence will be designated by the following types:

- (a) Type 47 (47 inch woven wire fence fabric with steel line posts)
- (b) Type 47RA (47 inch woven wire fence fabric with wood line posts)
- (c) Type CL (____ inch chain link fence fabric with top rail)
- (d) Type CLT (____ inch chain link fence fabric with tension wire)
- (e) Type CLTTR (____ inch chain link fence fabric with tension wire and top rail)
- (f) Type CLBRMRTR (____ inch chain link fabric fence with bottom rail, middle rail(s) and top rail)

607.02 Materials. Fence materials shall meet the following requirements:

607.03

Fence posts, braces and dimension lumber	710.11
Woven steel wire fence	710.02
Steel line posts and ties (Type 47 fence)	710.11
Barbed wire	710.01
Chain link fence	710.03
Reinforcing steel	509.02
Concrete (Class C).....	499 and 511
Expansion shield anchors, self-drilling	712.01

607.03 Clearing and Grading. The Contractor shall perform such clearing and grading as may be necessary to construct the fence to the required alignment and shall provide a reasonably smooth ground profile at the fence line. Removal of trees less than 12 inches shall be considered incidental to this item. Removal of trees 12 inches and up shall be paid for separately under Item 201.

607.04 Post Assemblies. End, corner, gate, and pull or intermediate anchor posts shall be placed at designated locations in holes of the sizes specified. The posts shall be securely braced and the holes filled with concrete. Forms will not be required for post encasement.

Wood posts fabricated with square cut ends and set or driven within one inch of grade will not require cutting or trimming. Concrete encasement of wood posts driven to grade shall be omitted.

For Type 47 and Type CLT and CLTTR fence, the maximum spacing between intermediate anchor post assemblies, or between end post assemblies and intermediate anchor post assemblies, shall be 660 feet.

607.05 Horizontal Deflection. At points of horizontal deflection, construction shall be as follows:

(a) For Type 47 fence, either steel line posts encased in concrete or wood posts without encasement shall be installed at all horizontal deflection points where the fence changes alignment by more than 1 degree, but not more than 4 degrees. Where the change in alignment is in excess of 4 degrees and less than 30 degrees, an intermediate anchor post assembly shall be built at the deflection point. If the change in alignment is 30 degrees or more, a corner post assembly shall be built at the deflection point.

(b) For Type CL fence, special treatment will not be required at deflection points where the fence changes alignment by 5 degrees or less. At points of deflection where the fence changes alignment by more than 5 degrees, a post brace and truss rod shall be provided in each fence panel adjacent to the post located at the angle point. The footings for all posts located at points where the change in alignment exceeds 5 degrees shall be constructed as specified for end posts.

607.06 Line Posts. The setting of line posts shall conform to the following:

(a) For Type 47 fence, line posts shall be driven to the depth called for on the plans, at intervals not to exceed 12 feet. Line posts at the bottom of digs or depressions in the ground surface shall be anchored in concrete as shown on the plans. Where channels or streams cross the fence line, crossings shall be as shown on the plans.

Posts at points of horizontal deflection shall be located so that the fence fabric will bear against the post.

(b) For Type CL, CLT and CLTTR fence, line posts shall be spaced at not more than 10 foot centers. Line posts shall be set 36 inches deep in concrete footings unless an alternate post anchor method is specified on the plan.

607.07 Post Braces. For all types of fences, post braces shall be in accordance with plan details.

For Type CL, CLT and CLTTR fence, a brace and truss assembly shall support each gate, corner, pull, or end post. The brace shall extend to each adjacent line post at mid-height of fabric. The truss shall extend from the line post back to the gate, corner, pull, or end post.

607.08 Fabric. The fence shall not be erected until after five days from the time of setting posts in concrete when regular cement is used, or until after three days when high-early-strength cement is used.

Type 47 fabric shall be stretched and securely fastened in accordance with plan details. Galvanized ties shall be used for fastening fabric to line posts. The minimum number of ties shall be one each for top and bottom horizontal wire and one for each alternate horizontal wire below the top horizontal wire.

Chain link fabric shall be fastened to the line posts with clips or bands spaced approximately 14 inches apart, and to the rails or top tension wire with bands or tie wires at approximately 24 inch internals or less.

607.09 Barbed Wire. Where barbed wire is specified, it shall be stretched and fastened in the same manner as woven wire fabric.

607.10 Method of Measurement. Fence will be measured by the linear foot, complete in place. Measurement will be along the top of the fence from outside to outside of end posts, exclusive of gates and other openings.

Gates will be measured as complete units of the size and type specified.

607.11 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
-------------	-------------	--------------------

608.01

607	Linear Foot	Fence, Type _____, _____ inch
607	Each	Gate, Type _____, _____ inch
607	Linear Foot	Fence, Type _____, _____ inch, vinyl coated

ITEM 608 FENCE RECONSTRUCTION

608.01 Description

608.02 Material

608.03 Construction Methods

608.04 Method of Measurement

608.05 Basis of Payment

608.01 Description. This item shall consist of the removal and relocation of an existing fence in conformity with the lines shown on the plans, and as directed by the Engineer.

608.02 Material. The Contractor shall use the material from the existing fence replacing all damaged, broken, lost or stolen parts, with new or comparable parts as designated by the Engineer at the Contractor's expense.

608.03 Construction Methods. The existing fence shall be carefully removed and relocated to the designated location. The fence posts shall be set plumb and the fence material shall be taut between posts. Fence posts shall be set in concrete base 36 inches deep and not less than 11 inches in diameter with Class "C" concrete.

608.04 Method of Measurement. The quantity to be paid for shall be the number of linear feet of fence reconstructed in compliance with these specifications and accepted. The number of linear feet will be determined from the Engineer's final measurements. Measurements shall be horizontal centerline measurements of the length of relocated fence in place.

608.05 Basis of Payment. Payment for accepted quantities of the fence shall be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
608	Linear Foot	Fence Removal and Reconstruction

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete the work as specified herein, including all excavation, backfilling, removal, reconstruction, erection, handling of the fence materials and pouring concrete.

ITEM 609 ENGINEERING GEOGRID**609.01 Description****609.02 Materials****609.03 Construction****609.04 Method of Measurement****609.05 Basis of Payment**

609.01 Description. This item of work shall consist of furnishing all labor, materials, equipment and tools required for the installation of an engineering geogrid in accordance with details shown on the plans and these specifications.

609.02 Materials. Geogrid: Biaxial polymer grids will be manufactured from 100% polypropylene; such as Tensar BX1200 and/or BX1300 as manufactured by the Tensar Corporation, 1210 Citizens Parkway, Morrow, Georgia 30260 (Phone 1-800-843-8417) or an approved equal.

609.03 Construction. Geogrid shall be laid at the proper elevation and alignment as shown on the plans and shall be oriented such that the roll length runs parallel to the trench.

Geogrid sections shall be overlapped as shown in the plans or as directed by the Engineer. Minimum overlap in horizontal plane shall be three (3) feet. In vertical plane the minimum overlap shall be nine (9) inches. Care shall be taken to insure that geogrid sections do not separate at overlaps during construction. Placement of geogrid around curves or corners will require cutting of geogrid product and diagonal overlapping of same to insure that excessive buckling of grid material does not occur.

Specified granular fill material shall be placed in lift thicknesses and compacted as indicated on the plans and in accordance with Item 203 Aggregate Refill for subbase application and Item 603 - Slag or Limestone for trenches. Care shall be taken to assure that the geogrid is held in desired position during and after placement of slag.

No construction equipment shall operate directly upon the geogrid. A minimum fill thickness of 6 inches is required prior to operation of any vehicles over the geogrid. Sudden braking or sharp turning shall be avoided while operating any equipment on reinforced fill.

609.04 Method of Measurement. Measurement of geogrid shall be based on the net surface area in Square Yards of the completed work. Overlapped areas shall be measured only once. The quantity of limestone or slag shall be the number of cubic yards of limestone or slag in place as per plan and accepted and shall be paid for under Item 203 - Aggregate Refill or Item 603 - Slag for Trench, including excavation.

609.05

609.05 Basis of Payment. Payment for the accepted quantities of geogrid measured as above will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment, and other items necessary and incidental to completion of work.

<u>Item</u>	<u>Unit</u>	<u>Description</u>
609	Square Yard	Engineering Geogrid for Roadways, Type_____
609	Square Yard	Engineering Geogrid for Trenches, Type_____

ITEM 610 CELLULAR RETAINING WALLS

610.01 Description

610.02 Approval by Engineer

610.03 Material

610.04 Manufacture of Units

610.05 Excavation

610.06 Backfill

610.07 Construction Methods

610.08 Method of Measurement

610.09 Basis of Payment

610.01 Description. This work shall consist of constructing retaining walls composed of a series of cells formed by assembling precast reinforced concrete or galvanized metal units to form walls of satisfactory stability in reasonably close conformity with the lines, grades and dimensions specified or ordered.

(a) Concrete cellular walls shall consist of a series of rectangular or triangular cells formed by building up tiers of precast reinforced concrete units. If cells are rectangular, the units shall be known as headers and stretchers; and if the cells are triangular, the stretcher and header shall be joined into one unit at the time of manufacture and adequately reinforced with steel at this point. The face of the wall shall be closed by inserting precast concrete filler slabs between the rows of stretchers, allowing sufficient clearance between ends of slabs and headers for drainage; or in the instance of triangular type cribbing the stretcher portion of the units shall be spaced approximately 1/2 inch apart by means of lugs formed on the underside of the stretcher portion. The lugs shall act as a continuous vertical bearing between the units and same shall be spaced at a distance not exceeding 3 feet from center to center.

For header and stretcher type cribbing the headers shall have lugs formed thereon which interlock with the stretchers at the front and rear of the wall, and shall not appreciably project beyond the face of the wall. Sufficient clearance or tolerance shall be made on the lugs of headers to permit proper flexibility of movement in the interlocking joints.

No metal pin or dowel connected cribbing will be permitted.

(b) Metal cellular retaining walls shall consist of a plurality of pairs of columns, one column of each pair being in the plane of the front of the wall and the other being in the plane of the rear of the wall, with the pairs of columns spaced longitudinally with overlapping S-shaped facing and rear members and transversely with overlapping U-shaped members.

All necessary bolts and appurtenances shall be furnished for complete assembly of the units into a closed-face wall of connecting bins.

The units in the wall shall conform to the dimensions and gages specified, and when assembled shall present a uniform and workmanlike appearance.

610.02 Approval by Engineer. The Contractor shall, within fifteen days after the award of the contract, submit drawings of the units to be furnished, together with a proposed erection plan and schedule of operations.

The drawing of the units, the erection plan and the schedule of operations shall all be approved before any material is delivered on the project.

Only walls produced by manufacturers whose type of wall and design of units have been in successful commercial use for a period of at least three years will be considered for approval. The units shall be manufactured in a plant suitable for making these units efficiently and uniformly. Plant and method of manufacture shall be approved before the units are made.

Materials shall be sampled and tested as directed by the Laboratory.

610.03 Material. Manufactured units shall be as follows:

(a) Concrete Cellular Wall. The units shall consist of concrete into which steel has been embedded in such a manner that the steel and concrete act together in resisting force.

Concrete shall conform to 499, Class C, except for aggregate gradation.

Reinforcing steel shall conform to 509.02.

(b) Galvanized Metal Wall. The units shall be made from galvanized metal sheets. The base metal shall conform to AASHTO M 218. The sheets shall be galvanized on both sides by the hot-dip process. The average spelter coating shall be not less than 2 ounces per square foot, nor shall the measurement of any 2-1/4 x 2-1/4 inch area indicate less than 1.8 ounces per square foot of double exposed surface. The finished sheets shall be of first-class commercial quality, free from injurious defects, such as blisters, flux, and uncoated spots.

610.04

All metal sheets used in making the various units shall have a minimum thickness of 0.057 inch, unless otherwise shown on the plans.

The manufacturer shall furnish three copies of an "Analysis and Coating Test Certificate" containing the following information covering each project or order on which galvanized metal walls are furnished.

- (a) Heat or heats used for units.
- (b) Analysis of each heat.
- (c) Amount of spelter coating for each heat.
- (d) Total units of each size and gage.
- (e) Name of Contractor.
- (f) Project name.

This certificate shall be sworn to by a person having legal authority to bind the company. Two copies shall be sent to the Engineer.

Galvanized bolts shall be 5/8 inches in diameter and shall have a minimum length of 1-1/4 inches measured from the underside of the bolt head. They shall be galvanized in accordance with 711.02.

610.04 Manufacture of Units.

(a) Concrete cellular wall units shall be cast in substantial, unyielding steel forms. The forms shall be properly assembled, cleaned and oiled before any concrete is placed therein. During the placing and setting of the concrete, the forms shall be rigidly held in place on a smooth and level platform. The reinforcement must be securely held in the required position in the forms so that it will not be displaced during pouring of the concrete.

Sufficient vibration shall be given the fresh concrete to insure filling all space in the form, to densify the concrete, and to completely and intimately contact the reinforcement.

Over-vibration or over-spading causing segregation of the concrete materials will not be permitted, and such units with segregated areas shall be rejected.

The units shall be covered with burlap, cotton mat or jute felt cotton mats and be kept wet at least 7 days, or steam cured for a period of not less than 24 hours.

Reinforced concrete units will be subject to rejection for any of the following reasons: (1) Displacement or lack of minimum cover of the reinforcing steel. (2)

Defects which indicate imperfect mixing, placing or curing. (3) Fractures and cracks, except that small spalls or broken edges may not be considered cause for rejection.

(b) Galvanized metal cellular wall units shall be so fabricated that units of the same nominal size shall be fully interchangeable. No drilling, punching or drifting to correct defects in manufacture will be permitted. Any units having holes improperly punched shall be promptly replaced by the manufacturer free of charge.

Whenever possible in the manufacture of the units, a minimum forming radius of 1 inch shall be maintained. All units formed with less than 1 inch radius shall be hot-dipped galvanized after forming.

610.05 Excavation. Excavation, including accurate grading for foundation, will be measured and paid for as 203. Bearing for the foundation of the walls shall be firm and to grade and shall be approved by the Engineer before erection of the wall.

610.06 Backfill. Below the elevation of the proposed ground line at the face of the wall, the interior of the cell spaces formed by the units shall be filled with soil as defined in 203.02. Above the elevation of the proposed ground line at the face of the wall, the interior of the cell spaces formed by the units shall be filled with subbase material conforming to 310.02 Grading A except that the material shall contain not more than 5 percent passing the No. 200 sieve.

The material shall be placed in layers not to exceed 6 inches uncompacted depth and compacted to the density established by the Engineer. Compaction shall be obtained by means of approved tampers or compactors.

Water may be required as directed by the Engineer to assist in obtaining the desired compaction.

The space behind the wall shall be filled in accordance with 503.10, except as noted below.

Backfill, including the interior filling, shall be made simultaneously with the erection of the wall, following the progress of erection as closely as the type of construction will permit.

Rolling equipment shall not be used directly over a portion of the wall until at least a 12 inch thickness of compacted fill has been placed to prevent damage to the units of the wall.

The compacted backfill, including the interior filling, and water will be included for payment in the unit price bid per square foot of facial area of cellular retaining wall.

610.07 Construction Methods. The individual types of walls shall be constructed as follows:

610.08

(a) Concrete Cellular Wall. Sills shall be placed with exactness to the required grade and alignment, and be supported on firm foundation material for their entire length. Shimming with loose earth, stones, etc., will not be permitted.

The headers shall be placed perpendicular to the sills and stretchers and interlocked. Templates shall be used to insure that the members are placed in proper position.

Before placing units, two layers of asphalt impregnated paper shall be spread on all points of contact of the units to insure a uniform bedding.

When the wall has been constructed two tiers high, alignment, grade and batter shall be checked, adjusted if necessary, and backfill completed to this height before subsequent units are added. The remainder of the wall may then be completed. Templates shall be used to insure proper face batter.

(b) Corrugated Metal Wall. Foundations for the bearing plates at the corners of the bins shall be firm and to grade.

When the columns have been placed and the wall constructed two tiers high, alignment, grade and batter shall be checked, adjusted if necessary, and backfill completed to this height before subsequent units are added. The remainder of the wall may then be completed. Templates shall be used to insure that members are placed in proper position and to secure proper batter.

Members shall be handled carefully, and any which are damaged shall be removed and replaced at the Contractor's expense.

610.08 Method of Measurement. The quantity measured will be the actual number of square feet of facial area of approved cellular retaining wall measured complete in place. Excavation will be measured by the cubic yard as provided in 203.

610.09 Basis of Payment. Payment for accepted quantities of cellular retaining wall will be made at the contract price per square foot. These prices shall include compensation for all materials, backfill and disposal of surplus materials.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
610	Square Foot	Cellular retaining wall

ITEM 611 RETAINING WALL

- 611.01 Description**
- 611.02 Material**
- 611.03 Approvals**
- 611.04 Construction Methods**
- 611.05 Method of Measurement**
- 611.06 Basis of Payment**

611.01 Description. This item shall consist of the construction of modular block and landscape timber walls in conformity with the lines, grades and dimensions shown on the plans or as directed by the Engineer.

611.02 Material. Landscape timbers shall only be used when specifically called for on the plans or when approved by the Engineer. The landscape timbers shall be made from pressure treated wood. The timbers shall be pressure treated using Ammoniacal Copper Quaternary (ACQ), per ASTM D 5654. No CCA (Chromated Copper Arsenate) treated wood shall be permitted. The timbers shall be new, free of splits, and straight, with bows not exceeding 1/2 inch in an 8 foot length. The minimum size of timbers shall be 6" x 8" x 8'-0".

For modular block walls, the Contractor shall construct the walls per the current City of Akron Standard Construction Drawing. Materials incidental to the wall shall be in accordance with the manufacturer's guidelines or as directed by the Engineer.

611.03 Approvals. Walls higher than 3 feet require a building permit from the City's Building Department. The Contractor shall be required to pay all plan review and permit fees.

The contractor shall submit, to the Engineer, for review and approval, six (6) copies of the installation procedures, as recommended by the manufacturer of the particular wall system chosen for the project, unless additional copies are required. Installation shall not begin until the submitted information has been approved by the Engineer.

611.04 Construction Methods. Construction of landscape timber walls shall conform to the applicable City standard drawing. Heights of walls shown on the plans are approximate, and may be changed at the direction of the Engineer.

For landscape timber walls, the front face shall be battered at the direction of the Engineer. The vertical joints shall be staggered. The horizontal joint alignment shall be uniform throughout the wall. Any cut timbers shall be dressed as directed by the Engineer. No timbers shall be any shorter than three feet.

For modular block walls, installation shall be in accordance with the current applicable City standard drawing and the manufacturer's guidelines. The color of the retaining wall shall be determined by the Engineer.

611.05

Any tree roots that are encountered during excavation shall be cleanly cut, leaving no jagged edges. To reduce stress on trees, this work shall be completed within five (5) working days.

611.05 Method of Measurement. The quantity to be paid shall be the number of square feet of wall constructed. The number of square feet will be determined from the Engineer's final measurements of the actual area of front face of wall constructed and accepted.

611.06 Basis of Payment. Payment for accepted quantities shall be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
611	Square Foot	Landscape Timber Wall
611	Square Foot	Modular Block Wall

The above price shall constitute full compensation for furnishing all labor, material, equipment, tools and incidentals required to construct the wall as specified herein, including all excavation, backfilling, anchors and tiebacks, geogrid, filter fabric, drainage aggregate, granular base, sealer, surface restoration, handling of the required materials, and the required permits.

ITEM 612 LANDSCAPE TIMBER EDGING

612.01 Description

612.02 Material

612.03 Construction Methods

612.04 Method of Measurement

612.05 Basis of Payment

612.01 Description. This item shall consist of furnishing and placing new landscape timbers to form an edging for driveways or other purposes in areas designated by the plans or as directed by the Engineer. This work shall include all excavating, furnishing and placing timbers, as directed, cutting, staking and dressing timbers, backfilling and restoring surface.

612.02 Material. Materials shall be in accordance with 611.02.

612.03 Construction Methods. The landscape timbers shall be laid with ends abutting and true to line and grade in accordance with the plan or as directed by the Engineer. Any cut timbers shall be dressed as directed by the Engineer. Timbers shall be staked with 1/2" deformed reinforcing rods, 2' into existing ground at 4' intervals with a minimum of two stakes per timber.

612.04 Method of Measurement. The quantity to be paid for shall be the number of linear feet of new landscape timbers in place. The number of linear feet will be determined from the Engineer's final measurements. Measurements shall be taken end to end of landscape timber edging in place.

612.05 Basis of Payment. Payment for accepted quantities complete in place will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
612	Linear Foot	Landscape Timber Edging

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the item as specified.

ITEM 613 UNIFORMED LAW ENFORCEMENT OFFICER

613.01 Description

613.02 Traffic Control

613.03 Method of Measurement

613.04 Basis of Payment

613.01 Description. This item shall consist of providing a uniformed law enforcement officer to maintain traffic in a safe and orderly manner.

613.02 Traffic Control. The Contractor shall provide the services of uniformed law enforcement officers for the exclusive purpose of controlling traffic. The officer shall be utilized for the lane restrictions, or during hours of peak traffic or as authorized by the Engineer. The officer shall constantly move with the backup of traffic so that he is always in a position near the end of the line of stopped traffic to assist in controlling traffic and informing drivers as to the nature of the delay. The Contractor's traffic safety coordinator, with the Engineer's approval, shall determine when and how many officers shall be required.

The officer will be invited to attend such meetings pertaining to traffic maintenance, to recommend and to help coordinate the safe and efficient movement of traffic during construction periods or during lane restrictions. Necessary provisions shall be made to provide the Engineer and law enforcement officer with direct radio contact whereby assistance can be furnished immediately in case of an accident or unusual condition that would tend to be conducive to a potential accident.

613.03 Method of Measurement. The method of measurement will be the actual hours of uniformed law enforcement officer with or without patrol car worked at the project site when directed by the Engineer.

613.04

613.04 Basis of Payment. Payment for providing uniformed law enforcement officer with or without a patrol car shall be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
613	Hr.	Uniformed Law Enforcement Officer
613	Hr.	Uniformed Law Enforcement Officer with Patrol Car

This price shall include compensation for all labor, materials, equipment, tools and incidentals required to complete the work as specified herein.

ITEM 614 MAINTAINING TRAFFIC

- 614.01 Description**
- 614.02 Traffic Facilities**
- 614.03 Traffic Control**
- 614.04 Performance**
- 614.05 Basis of Payment**

614.01 Description. This work shall consist of maintaining and protecting vehicular and pedestrian traffic and the work while the contract is in force in accordance with these provisions and 104.04.

614.02 Traffic Facilities. General. Facilities for vehicular and pedestrian traffic as are in the street or highway, including all temporary walks, roads, bridges, culverts and traffic control devices, shall be constructed and maintained by the Contractor.

(a) Local Traffic. For local traffic, the Contractor shall provide and maintain in safe condition, including snow and ice removal, such drives, temporary roadways, bypasses, walks, temporary structures and other facilities as may be necessary to provide safe vehicular and pedestrian ingress and egress for all property adjacent to the improvements. Temporary approaches and crossings of intersecting highways shall also be provided and maintained in a safe condition.

(b) Through Traffic. When the highway under construction is being used by through traffic, including periods of suspension of the work, the Contractor shall so maintain by the use of labor, equipment and materials that portion of the highway being used, in such a manner that it is smooth, free from holes, ruts, ridges, bumps and dust. The highway being used shall be provided with the necessary outlets to drain freely. Pipe trenches or other openings left in hard surface pavements shall be maintained with material of comparable quality.

The City may enter upon that portion of a project where the Contractor is responsible for maintaining traffic through part or the entire project, to remove snow and ice and place abrasives at its own expense, as may be considered advisable. The

Contractor shall be responsible for the removal of abrasives placed, for which no claim for additional compensation shall be allowed nor shall the Contractor be relieved in any way of his obligation for maintenance of traffic.

(c) The City will provide for the necessary maintenance of public highways which are used as detour beyond the work limits of the contract.

614.03 Traffic Control. (a) General. The installation, maintenance and operation of all traffic controls and traffic control devices shall conform to the requirements of the "Ohio Manual of Uniform Traffic Control Devices for Streets and Highways," hereinafter called The Ohio Manual, and the City of Akron Barricade and Signing Manual for Construction and Maintenance. Traffic control devices shall be provided with suitable supports of sufficient strength and stability.

Faces of construction signs, barricades, vertical panels and drum bands shall be reflectorized with Type G sheeting complying with the requirements of 730.19.

Traffic cones shall be a highly visible orange color. Pavement markings for traffic maintenance shall conform to 621 unless otherwise specified.

Channelizing devices such as barricades, vertical panels and cones shall be protected by adequate advance warning construction signs.

If equipment, vehicles and material are stored or parked on highway rights-of-way, the Contractor shall provide any lights, barricades, etc., that may be needed for the protection of pedestrian or vehicular traffic.

(b) Road Closed. When the highway is closed to traffic the Contractor shall provide, erect, maintain and subsequently remove approved traffic control devices, barricades and suitable and sufficient red or yellow lights at the following locations: (1) Work limits of the project. (2) Work limits on all intersecting roads. (3) Any other points designated in the contract.

Throughout construction, the Contractor shall furnish, erect, maintain and subsequently remove all signs, lights, barricades, watchmen, etc., for the maintenance of local traffic.

The Contractor shall furnish, erect, maintain and subsequently remove such additional traffic control devices as are required on public highways beyond the project limits which are used as detours.

(c) Traffic Maintained. Where the highway under construction is being used by through traffic, including periods of suspension of the work, the Contractor shall furnish and maintain pavement markings, lights, warning signs, road construction traffic maintained signs, end construction signs, barricades, temporary guardrail and such other traffic control devices, and watchmen and flagmen as may be necessary to maintain safe traffic conditions within the work limits.

614.03

The City will furnish and erect regulatory signs and guide signs, unless otherwise provided in the plans, within the work limits on all traffic maintained projects. The responsibility for maintenance of these signs shall rest with the Contractor. The erection and removal of all regulatory signs shall be approved by the Engineer.

Existing signs and traffic control devices within the work limits shall remain in use during the construction period unless otherwise specified on the plans. If the Contractor needs to relocate or modify existing signs and other traffic control devices as a consequence of his work, he shall provide suitable supports and may modify the devices with prior approval of the Engineer and the concurrence of the Traffic Engineer. Routine maintenance of existing traffic control devices will remain the responsibility of the City. The function of existing Stop or Yield signs shall be retained at all times although their position may be adjusted. Existing signs that must be relocated laterally shall be placed in accordance with the Ohio Manual. The Contractor shall restore relocated or modified signs to the position and condition which existed prior to construction as directed by the Engineer.

When an existing signal operation must be interrupted for a period, the Contractor shall provide a temporary traffic control method approved by the Engineer and the Traffic Engineer.

Whenever it is necessary for the Contractor to divert the flow of traffic from its normal channel into another channel, the channel for such diverted traffic shall be clearly marked by the Contractor with cones, drums, barricades, vertical panels, pavement markings, or flashing arrow barricades. This method of marking shall also be used where work is being done adjacent to the part of the highway in use by the public, or where work is being done on the shoulder where the roadway is being used by the public. During darkness hours, barricades and drums shall be supplemented with yellow flashing or steady electric warning lights in accordance with Section 7G of the Ohio Manual.

The Contractor shall obtain the approval of the Engineer and the City Traffic Engineer before closing a traffic lane, diverting traffic or establishing a one-way traffic operation.

(d) Flagmen. Whenever alternating one-way traffic is established, at least two flagmen shall be used, unless otherwise authorized by the Engineer, and signs, cones, barricades and other traffic control devices shall be erected by the Contractor in accordance with the Ohio Manual. Traffic control devices shall be reflectorized as previously noted herein. The Contractor shall maintain positive and quick means of communication between the flagmen at the opposite ends of the restricted area.

Flagmen shall be equipped according to the standards for flagging traffic contained in the Ohio Manual. The red flag or the Stop/Slow sign paddle shall be used. At night, flagmen stations shall be adequately illuminated, and flagmen shall use the reflectorized Stop/Slow sign paddle or a red light approved by the Engineer.

The Contractor may, in lieu of flagmen or supplementing them, furnish, install and operate a temporary traffic signal or signals for the purpose of regulating traffic in accordance with the written approval of the Engineer and the Traffic Engineer.

(e) Temporary traffic signals. When specified on the plans, the Contractor shall furnish, erect, maintain and subsequently remove signal and signal controller equipment of a proper type and capacity to provide the required operation. Subject to the Engineer's approval, the Contractor may use new equipment which is to be installed later on the project, or may use equipment in used but good condition. Used equipment shall be reconditioned as necessary to assure a proper operation. Temporary traffic signal operation shall be subject to the approval of the Engineer and the Traffic Engineer, and also shall meet the general requirements of the Ohio Manual.

The Contractor shall be responsible for the procurement of and payment for electric power for temporary traffic signals. The operation of an approved temporary traffic signal shall not be altered by the Contractor without the approval of the Engineer in concurrence with the City Traffic Engineer. Any malfunctions or failures shall be corrected without delay. Temporary traffic signals not in use shall be covered or removed.

(f) Pavement marking operations. Moving marking operations shall be performed by a truck equipped with necessary flashers and warning signs and shall be protected by a similarly equipped trailing vehicle or vehicles separated a sufficient distance to provide adequate warning to overtaking traffic. The marking operation should use the extreme left or right lane when possible. Where three or more lanes exist, the operation shall allow traffic to pass on one side only.

Stationary marking operations in intersections, school zones, gores and other areas shall be protected with traffic control devices such as advance warning signs and cones.

When a United States Postal Service (USPS) mailbox is located within the work limits,, the Contractor shall arrange with the USPS to relocate the mailbox to a safe location during construction. Access for delivery and collection of mail shall be maintained at all times. Disturbed mailboxes shall be reset within the right-of-way upon completion of the construction activities.

614.04 Performance. If, in the opinion of the Engineer, proper maintenance of traffic facilities and proper provisions for traffic control are not being provided by the Contractor, the City may take the necessary steps to place them in proper condition, and the cost of such services will be deducted from any money which may be due or become due the Contractor.

614.05

614.05 Basis of Payment. Payment for maintaining traffic shall include: lights, temporary traffic control devices, temporary guardrail, maintenance of portions of existing highway being used, and constructing, maintaining and removing temporary roads and structures required for this purpose, except temporary roads, pavements and bridges specifically designated under 502 and 615. Calcium chloride and asphalt concrete authorized by the Engineer and used for maintaining traffic will be paid for under 616, and 448.

Payment for accepted performance of this item will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
614	Lump Sum	Maintaining traffic
614	Sign Month	Portable Changeable Message Sign

ITEM 615 TEMPORARY WALKS AND PAVEMENTS

- 615.01 Description**
- 615.02 Earthwork**
- 615.03 Guardrail**
- 615.04 Pavement**
- 615.05 Sidewalks**
- 615.06 Maintenance**
- 615.07 Removal**
- 615.08 Method of Measurement**
- 615.09 Basis of Payment**

615.01 Description. This work shall consist of providing, maintaining and subsequently removing temporary walks and pavements at locations and to lines and grades specified. When the proposal does not include a pay item for temporary roads or walks as set forth in this item, such work shall be performed under 614.

615.02 Earthwork. Excavation and embankment construction necessary for providing and maintaining temporary walks, roads and drainage facilities attendant thereto, as well as subsequent removal of same and restoration of the areas to their original condition, shall be as prescribed in 203. Adequate side ditches shall be constructed in cut sections, and drainage pipe and culverts shall be provided where necessary. The width of the road from out to out of shoulders, unless otherwise called for on the plans, shall be not less than 30 feet and the side slopes shall be not steeper than 1-1/2:1. If sidewalks are required, the width of embankment shall be increased accordingly.

615.03 Guardrail. Where the height of the embankment is 5 feet or more measured at the outside edge of the berm, and the side slope is steeper than 4:1, guardrail shall be provided at a distance of at least 1-1/2 feet from the edge of the required width of surface course. The guardrail shall be in accordance with one of

the types specified in 606 except that reused material in good condition will be permitted. The guardrail shall be kept plainly visible at night by cleaning and/or painting whenever directed by the Engineer.

615.04 Pavement. Pavement type, width, and thickness shall be as shown on plans or noted in the proposal.

Calcium chloride shall be furnished, applied and paid for under 616. The amount of original and subsequent applications of chloride shall be as directed by the Engineer.

The temporary pavement shall conform to the specification requirements for the pertinent items except that method of measurement and basis of payment will not apply, and except as otherwise noted hereinafter.

For 403 and 448, the materials may be spread and finished by acceptable hand methods and the requirements for smoothness will be waived.

Rigid pavement shall be constructed in accordance with 452, except that tiebars or hookbolts will not be required for longitudinal joints. Materials shall conform to the quality requirements set forth in 499.02. A minimum of 400 lbs. of cement shall be used per cubic yard, otherwise materials shall be proportioned and mixed so as to provide concrete having a projected 28 day compressive strength of 3,500 psi.

615.05 Sidewalks. When temporary walks are required, they shall be 4 inches thick and conform to the requirements as set forth in 456 or as specified.

615.06 Maintenance. The Contractor shall maintain all portions of the temporary facilities in good condition with respect to both safety and smoothness for travel as long as it is needed for maintenance of traffic. If, in the opinion of the Engineer, the temporary facilities are not being properly maintained, they may be put into proper condition by the City and the cost of such services will be deducted from any money which may be due or become due the Contractor.

615.07 Removal. When the temporary facilities are no longer needed, the Contractor shall remove them, except such portions of the embankment as are indicated on the plans to be a part of the new roadway embankment, and shall leave the area in a neat condition. All material removed, unless otherwise indicated on the plans, shall be considered the Contractor's property and shall be removed from the site.

615.08 Method of Measurement. The quantity of temporary walks or pavement will be the surface area placed, maintained, and removed as directed, measured complete in place.

Calcium chloride will be measured and paid for under 616.

615.09

615.09 Basis of Payment. The accepted quantities of specific items of temporary walks and pavement will be paid for at the contract prices per unit of measurement designated for each of the pay items listed. These prices shall be full compensation for all materials, excavation, backfill and disposal of surplus materials for completion of the specified items.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
615	Square Yard	Temporary pavement
615	Square Foot	Temporary walks

ITEM 616 DUST CONTROL

616.01 Description

616.02 Procedure

616.03 Method of Measurement

616.04 Basis of Payment

616.01 Description. This work shall consist of applying when ordered, water or dust palliative for the alleviation or prevention of dust nuisance originating within the project right-of-way.

616.02 Procedure. Dust control operations shall be performed by the Contractor at the time, location and in the amount ordered by the Engineer. The application of water or dust palliative shall be under control of the Engineer at all times. The Engineer will determine if water or dust palliative is to be used to alleviate or prevent dust nuisance, and the amounts of each material to be used. Calcium chloride shall not be applied to areas that will be subsequently seeded.

Water used for dust control shall be furnished and applied by means of tanks equipped with suitable sprinkling devices and in the quantities as directed by the Engineer.

Dust palliative shall consist of calcium chloride, 712.02, or a brine solution containing a minimum of 30 percent by weight of calcium chloride. The calcium chloride shall be spread uniformly over the surface, at the rate of 1.5/S.Y. or as directed by the Engineer.

616.03 Method of Measurement. The quantity of water shall be the amount in thousands of gallons applied in accordance with the requirements of this item and measured in tanks, tank wagons or trucks of predetermined capacity, or by means of meters of a type satisfactory to the Engineer and furnished and installed by the Contractor at his own expense, or determined by weight conversion.

The quantity of calcium chloride shall be the number of tons by weight measurement, furnished and applied in accordance with the requirements of this item. When brine is used, the tons of calcium chloride shall be determined by multiplying the number of gallons by the factor 0.0024.

616.04 Basis of Payment. The quantities of water and calcium chloride measured shall be paid for at the contract unit price.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
616	M Gallons	Water
616	Tons	Calcium chloride

ITEM 617 LOW STRENGTH MORTAR BACKFILL

- 617.01 Description**
- 617.02 Materials**
- 617.03 Mix Proportioning**
- 617.04 Mix Adjustment**
- 617.05 Alternate Mixes**
- 617.06 Mixing Equipment**
- 617.07 Mixing the Materials**
- 617.08 Placing Mortar**
- 617.09 Method of Measurement**
- 617.10 Basis of Payment**

617.01 Description. This work shall consist of the placement of a flowable material consisting of portland cement, fly ash and/or sand with an expected 28 day unconfined compressive strength less than 100 pounds per square inch. This item shall be used for backfilling conduits or at other locations as shown on the plans or as specified. The work shall be in accordance with 551 and 499 unless otherwise specified herein.

617.02 Materials. Materials shall be:

Cement	701.01 or 701.04
Fly Ash	705.13
(Except where provided for under 617.05)	

Fine aggregate shall be natural sand or sand manufactured from stone, gravel or air-cooled blast furnace slag. The gradation of the sand shall meet the requirements of 703.05. The sand shall be fine enough to stay in suspension in the mixture to ensure proper flow.

617.03

617.03 Mix Proportioning. The low strength mortar mixture may consist of the following quantities of materials per cubic yard.

	Type 1 *	Type 2	Type 3
	lbs./yd. ³	lbs./yd. ³	lbs./yd. ³
Cement	50	100	0
Fly Ash, Class F	250	**	1500
Fly Ash, Class C ****	0	0	500
Sand ***	2910	2420	0
Water (Target)	500	210-300	850

* An air entraining agent specifically designed for the use in the low strength mortar mixture may be added to this mix.

** Entrained air is substituted for fly ash in this mix.

*** Saturated Surface Dry

**** Class C Fly Ash may be substituted for Class F Fly Ash in Type 1 mixes with an approved mix design meeting the alternate mix design criteria of this specification.

These mixtures of materials are expected to yield approximately one cubic yard of material of a flowable consistency. Small adjustments in the amounts of the materials in a mix may be required to achieve the final project. No additional compensation for a change in the material blends shall be allowed.

617.04 Mix Adjustment. The Contractor shall make one or more than one cubic yard trial batches at different water contents to ensure a flowable material. The mixture is too dry when cracks develop in the mixture as it flows into place.

Adjustments of the proportions shall be based on maintaining the total absolute volume. For large adjustments, see 613.05 Alternate Mixes.

In order to expedite the settlement of a Type 1 mixture without entrained air, it may be necessary for bleed water to appear on the surface immediately after the material is struck off. A delay in bleeding indicates there are too many fines in the mixture. The fly ash quantity may be reduced in increments of 50 pounds until the mixture is bleeding freely. Approximately 60 pounds of sand shall be added to replace each 50 pounds increment of fly ash to maintain the original yield.

617.05 Alternate Mixes. Other mixes may be submitted to the Engineer for approval. The Contractor shall submit the mix design and test data from an independent test lab 30 days prior to the intended usage for approval.

This requirement is for all mixes that:

1. Vary more than 300 pounds in sand, 100 pounds in water, 20 pounds in cement, or 200 pounds in fly ash from the above mixes. These are considered large adjustments.

2. Have less than 50 pounds of cement in the Type 1 mixes or less than 100 pounds of cement in the Type 2 mixes.

3. Utilizes alternate materials.

All alternate mixes shall have an unconfined compressive strength between 50 and 100 pounds per square inch at 28 days when tested in accordance with ASTM D 4832. The long term (12 month) unconfined compressive strength shall be less than 100 pounds per square inch.

The final mix shall have the required strength, fill the voids of the intended usage and set up within 12 hours (4 hours for Type 3 or Type 3 alternate mixes). The proportioning, yield, consistency, workability, compressive strength and all other requirements are the sole responsibility of the Contractor.

617.06 Mixing Equipment. Sufficient mixing capacity and delivery equipment shall be provided for the material to be placed without interruption as much as practical. The Type 1 and 2 mixes or Type 1 and 2 alternate mixes shall be delivered and placed from ready mixed concrete trucks or delivered from a batch plant.

Type 3 mix shall be delivered and placed using volumetric mobile mixers. Volumetric mixers shall be properly calibrated and shall sufficiently mix the materials to produce a uniform material.

617.07 Mixing the Materials. The mixture shall be discharged within 2.5 hours after the water is added.

617.08 Placing Mortar. The flowable material shall be discharged from the mixer by any reasonable means into the space of the plan intended usage. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed by the Engineer. Placing of the other fill material over low strength mortar backfill material may commence as soon as the surface water is gone or as directed by the Engineer. The Engineer reserves the right to reject the mix if a flowable mixture is not produced.

Before placing the low strength mortar backfill as backfill for conduit, the Contractor shall secure the conduit to prevent it from floating during placement of the flowable material.

617.09 Method of Measurement. Low strength mortar backfill will be measured by the number of cubic yards computed from the plan lines and placed. No additional compensation shall be allowed for over excavated areas.

617.10

617.10 Basis of Payment. For the volume of material furnished and placed as computed from the plan lines, the Contractor will be paid at the contract unit price per cubic yard. This payment shall be full compensation for placing the low strength mortar backfill meeting all of the above requirements and for furnishing all materials, equipment and incidentals necessary to complete this item, unless included under other items on the plans.

<u>Item</u>	<u>Unit</u>	<u>Description</u>
617	Cubic Yard	Low strength mortar backfill
617	Cubic Yard	Low strength mortar backfill (Type ____)

ITEM 618 COMPUTER EQUIPMENT

618.01 Description

618.02 Basis of Payment

618.01 Description. This item shall consist of providing equipment as specified by the City in the pre-construction meeting for the exclusive use of the City for the duration of the contract. All warranties, services, and support options for the computer equipment shall be registered under the City of Akron, Akron Engineering Bureau. The Contractor shall be responsible for obtaining tax exempt certificates for the City purchases. The Contractor shall deliver the equipment in unopened boxes to the City of Akron, 166 S. High Street, Room 702. The equipment will remain the property of the City at the completion of the contract.

618.02 Basis of Payment. An allowance has been included in the bid schedule for the purchase of computer equipment as specified by the City. Payment shall be the actual cost of the equipment delivered plus five percent (5%) to cover administration costs for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
618	Allowance	Computer Equipment

ITEM 619 FIELD OFFICE

619.01 Description

619.02 General

619.03 Basis of Payment

619.01 Description. This item shall consist of providing, maintaining and subsequently removing a suitable field office for the exclusive use of the City of Akron for the duration of the contract.

619.02 General. The field office shall be available at the start of the work and shall remain until subfinal acceptance of the complete project. It shall have a floor area not less than that shown on the plans, but in no case less than 150 square feet, with an inside height of at least 7 feet. The field office shall have provisions for maintaining a temperature between 68° and 80°F, with lighting and electric outlets. The Contractor shall provide and maintain one line of telephone service in the field office, and the office shall be arranged and equipped with adequate working and storage facilities. If required, the Contractor shall provide and maintain a cell phone with a local phone number.

The Contractor shall provide bottled water and also maintain convenient sanitary facilities for the use of the occupants of the field office.

619.03 Basis of Payment. The field office will be paid for at the contract lump sum price bid, which price shall be full compensation for furnishing, maintaining and subsequently removing the field office and all incidentals necessary to complete this item.

Payment for accepted performance of this item will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
619	Lump Sum	Field office

ITEM 620 FURNISHING A VEHICLE

620.01 Description

620.02 Basis of Payment

620.01 Description. The Contractor shall furnish the City a truck or sport utility vehicle, not more than three years old, in good operating condition with air conditioning for use by the City inspection personnel for the duration of the project. This item shall include taxes, insurance and all necessary maintenance and/or repairs including fuel for satisfactory operation of the vehicle. The Contractor shall provide a replacement vehicle during downtime.

620.02 Basis of Payment. Payment shall be made at the lump sum price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
-------------	-------------	--------------------

621.01

620 Lump Sum Furnishing a Vehicle

ITEM 621 PAVEMENT MARKING

- 621.01 Description
- 621.02 Materials
- 621.03 General
- 621.04 Pavement Preparation
- 621.05 Application
- 621.06 Layout and Premarking
- 621.07 Line Placement Tolerance
- 621.08 Edge Lines
- 621.09 Lane Lines
- 621.10 Center Lines
- 621.11 Channelizing Lines
- 621.12 Stop and Crosswalk Lines
- 621.13 Transverse Lines
- 621.14 Curb and Island Marking
- 621.15 Parking Lot Stall Marking
- 621.16 Lane Arrows
- 621.17 Word on Pavement
- 621.18 Dotted Lines
- 621.19 Plastic Parking Stops
- 621.20 Removal of Pavement Markings
- 621.21 Deduction for Deficiency
- 621.22 Method of Measurement
- 621.23 Basis of Payment

621.01 Description. This work shall consist of furnishing and applying alkyd or water based traffic paint in accordance with the lines and dimensions shown on the plans or as described herein. All pavement markings shall conform with the requirements of the Ohio Manual of Uniform Traffic Control Devices for Streets and Highways.

621.02 Materials. The traffic paint shall be of a formulation identified by a manufacturer's code number and approved by the Engineer.

The paint shall comply with 708.14, Fast Dry. Glass beads shall comply with 712.05.

Plastic parking stops shall be 72" long, Model #PMP1006 as manufactured by the Plastic Lumber Co., Inc., or approved equal. Standard parking spaces shall be fitted with Yellow, C080, and handicap spaces shall be fitted with Blue, C020.

621.03 General. Pavement markings shall be free of uneven edges, overspray, or other readily visible defects which, in the opinion of the Engineer, detract from the appearance or function of the pavement markings. Methods and equipment used for pavement preparation, marking, and marking removal shall be subject to the approval of the Engineer.

621.04 Pavement Preparation. The Contractor shall clean all visible loose or foreign material from the surface to be marked. The Contractor shall power broom clean all surfaces where gore markings or edge lines are to be applied and, when required by the Engineer, other surfaces to be marked. Portland cement concrete painting shall not be done until the concrete in the areas to be painted is clean of membrane curing material and in a dry condition suitable for painting.

621.05 Application. The Contractor shall transfer the entire contents of each paint container to the striping tank. Pavement marking materials, as received from the manufacturer, shall be applied uniformly to the surface to be marked. The paint shall be thoroughly mixed at all times during application. Thinning shall not be permitted. Pavement markings shall be applied only when the surface is clean and dry, and when the temperature of the surface is above 40°F. Construction work such as sidewalks, driveways, topsoil, seeding and mulching shall be scheduled and performed in a manner to avoid damage to applied pavement markings.

Lines shall be applied as solid, dashed or dotted stripes, either singly or in combination, as shown on the plans. Dashed lines shall be applied in a 40 foot cycle consisting of a 10 foot dash and a 30 foot gap between dashes, unless otherwise shown on the plans. Dashed lines which are to be applied over plainly visible existing dashed lines shall begin within 6 inches of the beginning of the existing dash, unless otherwise directed by the Engineer. Dotted lines shall be applied in a 6 foot cycle consisting of a 2 foot dot and a 4 foot gap between dots.

Paint shall be applied at the following rates:

Gallons per Mile of Line					
Width of line, in.	4	6	8	12	24
Solid line	16	24	32	48	96
Dashed line	4	6	8	12	24
Dotted line	5-1/3	8	10-2/3	16	32
Areas Word Symbols	1 Gallon per 100 square feet				

When paint is applied to new bituminous pavement surfaces, the specified application rate shall be increased 25 percent. The width of line applied shall be the width specified plus or minus 1/4 inch.

Glass beads shall be applied to the wet paint so that the beads are embedded and retained in the paint and uniformly cover the paint surface. The rate of application shall be not less than 6 pounds of glass beads per gallon of paint applied.

621.06

The temperature of fast dry paint at the discharge point shall be in the range of 140-170°F for alkyd paint and 130-150°F for water-based paint.

Lines shall be sharp, well defined, and retroreflective. Fuzzy lines, excessive overspray, or nonuniform application are unacceptable. Lines will be inspected at night by the Engineer to verify proper retroreflectivity. Pavement markings which are improperly applied, improperly located, or non-retroreflective shall be corrected. Lines applied with insufficient material quantities shall be properly reapplied, or shall be subject to acceptance with deduction as provided in 621.21. Improperly located lines shall be removed by a method approved by the Engineer, and lines shall be applied in the correct locations at the Contractor's expense, including the furnishing of approved materials.

621.06 Layout and Premarking. The Contractor shall lay out the locations of all lines, words and other symbols to assure their proper placement. When applying longitudinal or transverse lines, the Contractor shall use existing lines, construction joints or premarking to guide his marking equipment.

On projects where resurfacing or other operations will result in obliteration of the existing pavement markings, the Contractor shall establish reference points to assure proper placement of restored markings.

"T" marking of no-passing zones shall be established by the Contractor in accordance with the contract plans or a no-passing zone log provided by the Engineer.

Premarking shall be located from survey data or reference points and offset so as to parallel the theoretical edge of the marking lines at a maximum distance of one inch. Templates are required for the layout of arrows, words and other symbols.

Premarking for longitudinal lines shall be placed at 40 foot intervals and shall not exceed 2 inches in width or 12 inches in length.

The layout and premarking lines shall be approved by the Engineer and the Traffic Engineer before marking operations are started.

621.07 Line Placement Tolerance. Pavement marking lines shall be straight or smoothly curved, true to the alignment of the pavement, and shall not deviate laterally from the proper location at a rate of more than 2 inches in 100 feet. No deviation greater than 3 inches will be permitted.

621.08 Edge Lines. Edge lines shall be continuous retroreflective stripes, 4 inches in width. Center of stripe shall be located 6 inches from the edge of the pavement.

621.09 Lane Lines. Lane lines shall be dashed white retroreflective stripes between contiguous lanes of pavement carrying traffic in the same direction. They shall be offset to the left of the longitudinal joint, if present, or the theoretical line

lying between contiguous lanes, if a joint is not present. The nearer edge of the stripe shall be 2 inches to the left of the joint or line.

621.10 Center Lines. Center lines shall be single or double yellow retroreflective stripes between contiguous lanes of pavement carrying traffic in opposite directions. Center line marking shall also include two-way left-turn lane striping and the outline of painted left-turn islands. Each stripe shall be 4 inches wide, solid or dashed.

621.11 Channelizing Lines. Channelizing lines shall be continuous white retroreflective stripes 8 inches wide.

621.12 Stop and Crosswalk Lines. Stop lines shall be solid white retroreflective stripes 24 inches wide. Crosswalk lines shall be solid white retroreflective stripes 12 inches wide.

621.13 Transverse Lines. Transverse lines shall be solid retroreflective stripes 24 inches wide, normally placed at an angle to the direction of travel to form all or a portion of a painted standard obstruction or road delineation marking.

621.14 Curb and Island Marking. Exposed surfaces of curbs and paved islands shall be prepared in accordance with 621.04. In addition to the requirements of 621.04, the Contractor shall remove all visible loose or foreign material, including vegetation, immediately contiguous to vertical surfaces to be marked. Paint shall be applied at the rate of 1 gallon to each 100 square feet.

621.15 Parking Lot Stall Marking. Standard parking stall marking lines shall be continuous white stripes, 4 inches in width. Handicapped parking stall marking lines shall be blue stripes, 4 inches in width.

621.16 Lane Arrows. Lane arrows shall be retroreflective white markings. Paint shall be applied at the rate of 1 gallon to each 100 square feet.

621.17 Word on Pavement. Words on pavement shall be retroreflective white markings. Paint shall be applied at the rate of 1 gallon to each 100 square feet.

621.18 Dotted Lines. Dotted lines shall be retroreflective white markings of the width specified.

621.19 Plastic Parking Stops. All new parking stops shall be installed in accordance with the manufacturer's recommendations, and as designated on the plans. Parking stops shall be installed at the locations shown on the plans.

The Contractor shall submit to the Engineer, for review and approval, six (6) copies of shop drawings and installation procedures, unless additional copies are requested. Installation shall not begin until the submitted shop drawings have been approved by the Engineer.

621.20

621.20 Removal of Pavement Markings. When indicated on the plans, pavement markings shall be removed. The markings shall be removed by high pressure water blast, sand blast, high temperature burning with excess oxygen, chemical treatment, or other methods, with the approval of the Engineer. Upon removal, any residual pavement stains shall be eradicated by the use of an approved solvent. Care shall be exercised during marking removal not to scar, discolor or otherwise damage the pavement surface. Overpainting or other methods of covering markings in lieu of removal shall not be permitted.

621.21 Deduction for Deficiency. The amount of paint or glass beads, applied per unit of measurement will be computed each day by the Engineer. A tolerance of 6 percent for deficiency of paint or glass beads shall be permissible without deductions. If computations reveal that the 6 percent tolerance has been exceeded and an insufficient quantity of either paint or glass beads has been applied, the contract unit price shall be reduced in direct proportion to the percent of deficiency of paint or beads as called for in 621.05, up to 20 percent for each material deficient; only the greater deficiency shall be used to compute the deduction.

If the deficiency of any material is 20 percent or more, the work shall be considered unsatisfactory and shall be repainted at full expense of the Contractor, including all labor, equipment, and material requirements.

621.22 Method of Measurement. Pavement marking will be measured complete in place in the units designated. Dashed or dotted line quantities will be the length of completed stripe, including the gaps, but excluding intersections, and other sections of pavement not normally marked.

621.23 Basis of Payment. Payment for accepted quantities will be made at the contract price, or price adjusted in accordance with 621.21, for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
621	Miles or Linear Foot	Edge lines, Type
621	Miles or Linear Foot	Lane lines, ____ inch, Type
621	Miles or Linear Foot	Center lines, Type
621	Miles or Linear Foot	Channelizing lines, Type
621	Linear Foot	Stop lines, Type
621	Linear Foot	Crosswalk lines, Type
621	Linear Foot	Broad transverse lines, Type
621	Linear Foot	Curb marking, Type
621	Square Foot	Island marking
621	Linear Foot	Parking lot stall marking, Type
621	Each	Lane arrows
621	Each	Word on pavement, ____ inch
621	Linear Foot	Dotted lines, ____ inch
621	Linear Ft., Sq. Ft., or Each	Removal of pavement mark
621	Each	Handicapped symbol marking
621	Each	Plastic Parking Stops, Safety Yellow

621 Each

Plastic Parking Stops, Handicap Blue

ITEM 622 MONUMENT BOXES**622.01 Description****622.02 Material****622.03 Construction Methods****622.04 Method of Measurement****622.05 Basis of Payment**

622.01 Description. This item shall consist of setting, adjusting, and relocating monument boxes in cut-outs or box-outs provided by the Contractor in asphalt or concrete pavements, and shall include the cut-out or box-out, cast iron frames, cover (current date cast there-on), monument, asphalt and/or concrete and dry P.C. - sand mix within the box-out or cut-out, as shown on Standard Drawings BP-8 and BP-9, and appurtenances thereto.

622.02 Material. Frames and covers shall conform to Standard Drawing BP-8, equal or similar to Neenah Catalog No. R-1973-A or East Jordan Catalog No. 1574. The cast iron shall conform to ASTM Standard Specification for gray iron castings serial designation A-48. Note requirement of 1% nickel alloy cast iron on Standard Drawing BP-8. Monument rod shall be #6 rebar, 48" long, one end cut or ground square, and the other end pointed at center.

622.03 Construction Methods. Concrete Pavements. Construction shall conform to Standard Drawing BP-9, monument box shall be set on a bed of dry P.C. - sand mix (1:3 proportions), and the box-out filled with concrete, Class "C", using due care to prevent movement of the box. The excess dry mix shall be removed from within the barrel of the monument box. Monument (#6 rebar) furnished by the Contractor shall be set by others.

Asphalt Pavements. Construction shall conform to Standard Drawing BP-9. Contractor shall remove the portion of the completed base, Item 301, within the limits as shown on standard drawing. Monument box shall be set on a bed of dry P.C. - sand mix (1:3 proportions) within the cut-out portion of the base. Concrete, Class "C", shall be carefully poured around the monument box, using due care to prevent movement of the box, level with the surface of the completed base course. Excess dry mix shall be removed from within the barrel of the monument box. Monument (#6 Rebar) furnished by the Contractor shall be set by others.

Adjusting monument box shall consist of resetting of the existing monument box casting at its existing location due to changes in grade of the surrounding roadway. Monument boxes shall be salvaged and replaced in the new or reconstructed pavement as described above in 622.03.

622.04

Relocating monument box shall consist of resetting an existing monument box casting at a new location as shown on the plans. Monument box shall be salvaged and relocated to a new location as described above in 622.03.

622.04 Method of Measurement. The quantity to be paid for shall be the number of monument boxes in place complete as specified, and shall be determined by the Engineer's count of acceptable boxes in place.

622.05 Basis of Payment. The quantity measured shall be paid for at the contract unit price bid for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
622	Each	Monument Boxes
622	Each	Monument Box, Adjusted
622	Each	Monument Box, Relocated

The above price shall constitute full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to install monument boxes as specified, ready for monument to be set by others.

ITEM 623 CONSTRUCTION LAYOUT STAKES

623.01 Description

623.02 General

623.03 Basis of Payment

623.01 Description. When this item is included in the proposal, it shall consist of furnishing, placing and maintaining construction layout stakes necessary for the proper prosecution of the work under the contract, all in accordance with these specifications. This item shall also include as-built survey of pertinent items.

When the proposal does not include a pay item for construction layout stakes, the Engineer will set construction stakes as described in 105.09.

623.02 General. The City will locate and reference the centerline of the project and all intersecting roads and streets and will establish benchmarks along the line of the improvement outside construction limits. One benchmark will be established by the City for use at each structure over 20 foot span. Locating and referencing the centerline shall consist of locating and referencing control points such as point of curve, point of tangent, and sufficient points on tangent to provide a line of sight. Reference points shall be set outside the construction limits in such a manner that they will be available to re-establish the control points at any time during the course of the work. Control points set by the City will be identified in the field to the Contractor and the field notes will be kept in the office of the Engineer.

The Contractor shall provide field forces and set all additional stakes for the project which are needed to establish offset stakes, reference points, slope stakes, pavement and curb line and grade, stakes for bridges, culverts, sewers and drainage structures, paved gutters, walls, monuments, fence, right-of-way lines, easements, and any other horizontal or vertical controls, including supplementary benchmarks, necessary to secure a correct layout of the work. The location of slope stakes for grading work shall be determined by a calculation method, and a copy of these calculations shall be made available to the Engineer for project records. The Contractor will not be required to set additional stakes to locate a utility line which is not included as a pay item in the contract, or to determine the property line between the properties.

Stakes shall be 2" x 2" hubs driven flush in lawn areas, or drill holes, spikes or nails in pavement. All stakes shall be marked with the station, offset, cut or fill and a cut sheet shall be supplied to the inspector.

Stakes for line and grade of pavement and/or curb shall be set at an offset of no more than 5 feet and at sufficient intervals to assure conformance to plan line and grade. Intervals shall not exceed 25 feet on grades less than 0.5%, 35 feet on grades less than 0.8% and 50 feet on all other grades. Vertical curves shall be staked at the P.V.C., P.V.I., P.V.T. and the quarter points as a minimum. Curb returns shall be staked at the quarter points. Stakes for sewers when using a laser shall include a line and grade stake behind the initial point, at the midpoint and ahead of the terminal point. Lasers shall not be used in the pipe without approval of the Engineer.

The Contractor shall be responsible for having the finished work conform to the lines, grades, elevations, and dimensions called for in the plans. Any inspection or checking of the Contractor's layout by the Engineer and the acceptance of all or any part of it shall not relieve the Contractor of the responsibility to secure the proper dimensions, grades, and elevations of the several parts of the work. The Contractor shall exercise care in the preservation of stakes and benchmarks and shall have them reset at no additional cost to the City when any are damaged, lost, displaced, or removed. The Contractor shall use competent personnel and suitable equipment for the layout work required, and shall provide that it be done under the direct supervision of a Registered Professional Engineer or Professional Surveyor. The Contractor shall not engage the services of any person or persons in the employ of the City for the performance of any of the work covered by this item.

It shall be the Contractor's responsibility to verify any survey information appearing in the plans, except for the centerline of the project, which he may use to lay out the work.

After construction is substantially complete, the Contractor shall submit, to the Engineer, an as-built survey of the following new, reconstructed or relocated items of contract-installed utility and drainage structures. The survey shall provide northing / easting coordinate locations and/or elevations (as shown below). The submitted information shall be stamped by a Registered Professional Surveyor.

623.03

1. Rim locations and elevations of all new or reconstructed inlets, catch basins and manholes.
2. Invert elevations of all pipes in the new or reconstructed manholes or new pipes in existing manholes.
3. Locations of all new or reconstructed water main valves, fittings, hydrants, bends, etc..
4. Locations of all new or relocated poles, pullboxes, junction boxes, conduit bends, etc. of any contract-installed utility, such as street lighting, traffic signals, communications, etc.

623.03 Basis of Payment. Construction layout stakes will be paid for at the contract lump sum bid, which price shall be full compensation for all services, materials, labor, equipment, tools and incidentals necessary to complete this item.

Payment can be made up to a maximum of 80 percent of the lump sum bid price without the submittal of the as-built information. Once the as-built information is submitted and approved by the Engineer, the remainder of the lump sum payment will be made up to 100 percent of the lump sum bid price.

Subfinal payment for the contract shall not be made until the as-built survey is submitted and approved by the Engineer.

Payment for accepted performance of this item will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
623	Lump Sum	Construction layout stakes

ITEM 624 MOBILIZATION

- 624.01 Description**
- 624.02 Materials**
- 624.03 Construction Requirements**
- 624.04 Limitation**
- 624.05 Method of Measurement**
- 624.06 Basis of Payment**

624.01 Description. This work shall consist of the preparatory work and operations for the assembling and setting up necessary facilities for the project, such as shops, plants, storage areas, sanitary facilities, moving in of personnel, equipment and incidentals to the project site, and any other facilities as required by the specifications and special requirements of the contract, as well as by local or state law and regulation.

When the proposal does not include a pay item for mobilization, the work described in this section shall be performed but will not be paid for directly, but shall be considered as a subsidiary obligation of the Contractor, payment for which is included in the various items of work in the contract.

624.02 Materials. The Contractor shall furnish all materials and furnishings required for this item. These materials and furnishings will not be considered as a part of the various items of the completed contract.

624.03 Construction Requirements. The Contractor shall provide all tools, equipment, materials, labor and work for the construction and furnishing of the required facilities and services. All work under this item shall be performed in a safe and workmanlike manner.

624.04 Limitation. The sum total of the two payments described in Item 1 and Item 2 under 624.06 will be limited to the amounts shown in the following table under "Maximum total of partial payments." The balance of the amount bid, if any, will be paid as described in Item 3 under 624.06.

Total Contract Amount		The Maximum Total of Partial Payments Shall Be
More than	Up to, inclusive	
\$ 0	\$ 50,000	\$ 1,000
50,000	100,000	2,000
100,000	200,000	4,000
200,000	500,000	7,400
500,000	1,000,000	16,500
1,000,000	2,000,000	30,000
2,000,000	5,000,000	54,000
5,000,000	10,000,000	115,000
10,000,000	----	200,000

If the contract lump sum amount bid for mobilization exceeds the total shown in the table above for partial payments, the excess will be paid on completion of the project.

624.05 Method of Measurement. Work performed under this item will be measured as a unit, acceptably performed.

624.06

624.06 Basis of Payment. Mobilization will be paid for at the contract lump sum price, which price will include the cost of all items herein described.

The contract lump sum price for this item shall be payable to the Contractor as specified in 109.06 and in accordance with the following schedule of partial payments.

1. One half of the contract lump sum amount bid for mobilization or one half of the amount shown in 624.04, whichever is less, will be released to the Contractor with the first estimate payable, but not sooner than 15 days after the start of work at the project site.

2. The second one half of the contract lump sum bid for mobilization or the second one half of the amount shown in 624.04, whichever is less, will be released with the first regular estimate after 10 percent of the original total contract amount including payments for delivered materials but excluding mobilization, is earned.

3. Upon completion of all work on the project, payment of any amount of the contract lump sum price bid for mobilization in excess of the total amount shown in the table above for partial payments will be made.

Payment will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
624	Lump sum	Mobilization

ITEM 625 OUTSIDE LIGHTING

- 625.01 Description**
- 625.02 Materials**
- 625.03 General**
- 625.04 Working Plans**
- 625.05 Light Poles and Towers**
- 625.06 Foundations**
- 625.07 Luminaires**
- 625.08 Glare Shields**
- 625.09 Ground Rods**
- 625.10 Pull Boxes**
- 625.11 Trench**
- 625.12 Conduit**
- 625.13 Cable**
- 625.14 Unit Type Duct-Cable Systems**
- 625.15 Concrete Poles**
- 625.16 Connections**
- 625.17 Service Pole**

- 625.18 Control Center**
- 625.19 Structure Grounds**
- 625.20 Junction Boxes**
- 625.21 Electrical Tests**
- 625.22 Light Pole Identification**
- 625.23 Method of Measurement**
- 625.24 Basis of Payment**

625.01 Description. This work shall consist of furnishing and installing electrical materials and equipment complete and ready for service, in reasonably close conformity with locations, dimensions, and grades shown on the plans or ordered by the Engineer. Outside lighting includes expressway lighting; street lighting; park security lighting, walkway and sports lighting; and parking lot lighting. This work shall also include necessary excavation and backfill, and disposal of discarded materials and restoration of disturbed facilities and surfaces in accordance with 104.06 and 104.07 and also electrical testing as specified.

625.02 Materials. New first quality materials shall be furnished. They shall comply with the Underwriters Laboratories requirements. The materials shall also comply with the National Electrical Code and local codes for the area of installation. All electrical parts, wire, switches and other elements of the installations shall be of ample capacity to carry the required current without excessive heating or causing an excessive drop of potential.

Except as otherwise provided herein, each individual item of equipment shall bear a nameplate, or other type of indelible marking or brand that shall identify it as to type, catalog number and manufacturer.

Specific materials and items shall be as follows:

Anchor bolts and nuts	713.01, 713.21
Cable	713.02
Cable connectors and connector kits	713.15
Concrete	499, 511
Conduit	713.04, 713.07
Ground rods	713.16
Lamps.....	713.14
Light poles.....	713.01
Light towers	713.21
Luminaires	713.11, 713.12, 713.13, 713.21
Portable power units	713.21
Pull boxes	713.08
Reinforcing steel	509.02
Sand.....	703.06
Junction boxes.....	713.10
Unit type duct-cable systems	713.03
Wood service poles	713.19
Control center components.....	713.20

625.03

Cable splicing kits	713.15
Structure ground cable.....	713.17

625.03 General. In general, definitions of electrical terms used shall be in accordance with Appendix F of the American National Standard Practice for Roadway Lighting ANSI D12.1. Exceptions are as follows:

(a) A luminaire shall include direct appurtenances such as a reflector, refractor, housing and supports that are integral with the housing and high intensity discharge (HID) or fluorescent ballasts when applicable. The luminaire shall include the lamp.

(b) A light pole shall be considered to include anchor or transformer base, shaft, bracket arm if required, and integral hardware to support luminaires at heights of less than 70 feet above the foundations.

(c) A light tower shall be considered to include a shaft with base plate, pole head, luminaire ring and integral lowering mechanism, internal power cable, and connecting and associated hardware, to support luminaires at heights of 70 feet and greater, above the foundation.

Items of electrical equipment shall consist of products of the same manufacturer, as far as practicable.

Each system shall conform as to voltage, amperage, frequency and type specified. Unless otherwise noted on the plans, the Contractor shall furnish and install all incidentals necessary to provide a complete and practical working unit or system.

All installations shall be in accordance with the National Electrical Code and National Electrical Safety Code, and shall also conform to local laws and codes governing such work.

The Contractor shall obtain and pay for all permits required.

In order to provide all necessary requirements for the proposed lighting system, the Contractor shall cooperate with the agency which will furnish electrical service also hereinafter referred to as the supplying agency.

625.04 Working Plans. The Contractor shall submit to the Engineer for review and approval eight sets of detail plans, drawings, photographs, photometric curves, templates and specifications of all apparatus and equipment he proposes to furnish. They shall show clearly the design, construction dimensions, quantities and such other information as may be necessary or desirable for a proper understanding of the equipment offered. All material submittal sheets, curves, etc., defining the above shall identify the specific project to which the material applies, and if more than one catalog number, style or type is listed on one sheet, the item to be furnished must be identified clearly by circling, underlining, or otherwise marking.

The Contractor shall not install electrical material until written approval of such submissions is received from the Engineer. After approval by the Engineer, such plans shall be taken as supplemental to, but in no sense a substitute for, the original plans.

The approval of working plans by the Engineer shall not relieve the Contractor of responsibility for erroneous or inconsistent dimensions, notations, omissions or other errors, or the proper functioning of the completed installation.

625.05 Light Poles and Towers. Light poles and towers conforming to approved shop drawings shall be erected upon the completed concrete foundations or other specified type of mounting. Poles shall be plumbed or aligned by the double nutting method. After erection, each metal light pole shall be adequately grounded as provided for in 625.09 or 625.19, and have hand hole covers or transformer base doors fastened in place.

After erection, galvanized poles shall be inspected for defects in the galvanized surfaces. Minor scratches shall be given two coats of an approved zinc-rich paint. The second coat shall not be applied until after the first coat has adequately dried. Poles having major scratches or defects in the galvanized surfaces will not be accepted.

When specified, galvanized poles shall be painted. They shall be given shop coats as specified in 713.01. After erection, two field coats of paint specified or approved by the Engineer shall be applied. Painting shall be in accordance with the applicable provisions of 514.

625.06 Foundations. Excavation for foundations shall be completed as nearly as practicable to the dimensions shown for the foundations. Concrete shall be cast-in-place, Class C, and construction shall be in accordance with 511 except that forms will not be required for portions of foundations extending more than 6 inches below the ground line, unless the soil does not have sufficient stability to stay in place during the placing of the concrete. When bedrock is encountered, the total depth of foundation may be reduced up to 50% of the depth of rock excavation but not less than the length of the anchor bolts. Where, in the opinion of the Engineer, an excavation for a foundation has revealed an unstable condition at the bottom of the excavation, the foundation shall be deepened or enlarged in size as directed by the Engineer. Payment for additional quantities of excavation and foundation concrete required by the Engineer for this purpose shall be made as specified in 104.02.

Reinforcing steel as specified shall be placed in accordance with 509.

Anchor bolts for light poles and towers shall be installed in the foundations in accordance with approved shop drawings and anchor bolt setting templates. The tops of foundations shall be finished smooth and even with surrounding surfaces.

625.07

Anchor bolt settings for light poles shall provide that light poles predominantly illuminating a mainline roadway shall be positioned with the arm of the pole perpendicular to the roadway.

After forms have been removed, excavated spaces around the foundations shall be backfilled with suitable material placed and tamped in thin layers as directed by the Engineer.

625.07 Luminaires. Light pole luminaires shall be adjusted vertically and horizontally to provide the required mounting height and the specified alignment with the roadway. At pole locations where the profile grade exceeds 4 percent, the luminaires shall be oriented so that the vertical axis of the luminaire shall be perpendicular to the longitudinal centerline of the roadway at that location. Tower luminaires shall be leveled by means of the adjustment device provided.

Floodlighting luminaires shall be aimed at night as directed by the Engineer. The Contractor shall submit aiming diagram for approval prior to aiming.

After all other work has been completed and just prior to leaving job, refractors and reflectors shall be cleaned so as to provide the maximum lumen output possible.

Lamps shall be compatible with ballasting characteristics of the specific luminaires.

Luminaires mounted on non-metallic poles shall be grounded as provided for in 625.09 or 625.19.

625.08 Glare Shields. Glare shields shall be furnished and installed where designated. The shield shall be obtained from the manufacturer of the luminaires with which they are to be used.

625.09 Ground Rods. A ground rod unit shall consist of furnishing one ground rod of the specified type and size installed as shown on the plans. Each ground rod shall be tested as specified in 625.21. If the earth resistance measurement exceeds 25 ohms for conventional light pole ground rods or 10 ohms for tower ground rods, a second ground rod shall be installed as shown on the plans. The two rods shall be temporarily connected together with ground cable and the earth resistance measured. If the earth resistance still exceeds the above values, a 10 foot rod shall be exothermically welded to the top of the second rod to constitute a continuous 20 foot long rod. After this is driven into the earth, it shall be temporarily connected to the first rod and the earth resistance measured. If the earth resistance still exceeds the required value, this procedure of lengthening and driving the second rod shall continue until either an acceptable value of earth resistance is obtained or the extended rod cannot be driven further. The rods shall be permanently interconnected with a ground cable.

If the measured earth resistance still exceeds the required value after the last rod is driven and interconnected, the Engineer shall be contacted for his final determination and further instructions.

Where rock is encountered and acceptable earth grounds cannot be accomplished by driving as described above, a grounding grid utilizing direct buried messenger cable or rods exothermically welded end to end shall be used to bond light poles and structures in continuous series to some point on a type of terrain that will permit obtaining an acceptable earth ground. Payment for this change shall be made as specified in 104.02.

Connections between rods and cable shall be made by exothermic welds with two coats of insulating varnish applied over welds and exposed cable.

625.10 Pull Boxes. The types and sizes of pull boxes and covers furnished shall be as specified, and they shall be located where designated on the plans. Excavation shall be performed as nearly as practicable to the outside dimensions of the pull box. After boxes are set to proper grades, excavated spaces around the boxes shall be backfilled with suitable material placed and thoroughly tamped in thin layers.

625.11 Trench. Trenches shall have a minimum depth of 2 feet and shall not exceed 12 inches in width without prior approval of the Engineer. Trenches located adjacent to and parallel with curbs or pavements shall not deviate more than 6 inches from the lines designated, without the approval of the Engineer.

Sawcut lines in paved areas shall follow existing joints or grooves where possible, and shall be premarked and be approved by the Engineer before sawing.

Trench backfill shall be placed in layers not to exceed 4 inches uncompacted depth and compacted with mechanical tampers or other approved methods as directed.

Backfill material for trenches in areas of pavement, paved shoulders, or stabilized aggregate shoulders shall consist of granular material. Backfill material for trenches in other areas shall consist of suitable soil or granular material, except that the backfill material around and in the first 4 inches above the top of duct cable or PVC conduit not encased in concrete shall not contain pieces larger than 1/2 inch.

Direct burial cable shall be surrounded by a minimum of 6 inches of sand material conforming to 703.06. All trench for direct burial cables shall be identified with a warning tape, approved by the Engineer, placed 6 inches below final grade centered over cable.

625.12 Conduit. Conduit of the type and size shown on the plans shall be installed at locations designated by the plans or as directed. Where the size is not specified, the Contractor shall submit to the Engineer for approval, plans showing the size and location of each conduit and the number and size of wires contained in each. Such

625.12

conduit shall comply with the National Electrical Code insofar as conduit fill is concerned.

Where underground conduits are to be encased in concrete, the concrete encasement shall be Class C and shall have a minimum thickness of 3 inches. Spacers shall be used to insure proper encasement of conduit. Conduit shall be anchored to prevent floating during concrete placement.

Bends in conduit shall be used only when absolutely necessary. The total bending between adjacent junction boxes and/or pull boxes shall not exceed 180 degrees, and the total bending between adjacent light poles shall not exceed 270 degrees. The radius of any field bend shall be not less than 12 times the internal diameter of the conduit. Bends in conduit shall be so made that the protective covering will not be injured and the internal diameter at the bend will not be reduced.

All rigid ferrous metal conduit, and fittings and appurtenances thereto, shall be galvanized inside and outside. They shall be of such size that the wires can be easily drawn into the conduit without excessive pull. All cut ends of metallic conduit shall be reamed to remove rough edges. All conduit threads shall be painted with an electrical conductive paint in such a manner that there will be no unprotected surfaces, and the joint will be watertight and will electrically bond the joined sections of conduit. A conduit on a structure shall be securely fastened or built into the structure, and properly drained using a T coupling at the low point of each concrete encased run, unless the conduit is sloped to drain into junction boxes. In the latter case, junction boxes shall be provided with drains. Expansion fittings shall be provided at all expansion joints on structures, and they shall be provided with suitable copper jumpers to assure electrical continuity of the grounding system.

All metallic conduit shall have electrical continuity and be adequately grounded. The ends shall be fitted with approved bushings and all boxes, fittings, expansion joints and other appurtenances to the conduit shall be so designed and connected that adequate electrical continuity from one conduit to another will be secured. Where boxes or fittings are not used, suitable means shall be provided to accomplish adequate electrical continuity between the several parts.

Where conduit enters a junction box through a slip hole, locknuts shall be provided to fasten the conduit to the junction box.

All PVC conduit and fittings shall be joined by means of an approved solvent welding cement to provide a watertight joint. All PVC conduit shall be terminated with end bells.

After installation, all conduit which will not have circuit wire or cable pulled into it during construction shall have an adequately secured 1/4" jet line twisted polypropylene 1100 pound tensile strength pull rope installed in it, and the ends shall be closed with capped bushings or otherwise sealed in an approved manner to completely keep all moisture and foreign matter out of the conduit. Terminal points

of all conduits containing wire or cable shall be completely sealed in an approved manner with a removable sealing compound or a molded plastic or rubber device which is compatible with the cable jacket, the insulation and the conduit material. Equivalent temporary sealing approved by the Engineer shall be provided immediately after placement of conduit where conductors or cable are not installed promptly in the conduit.

Conduit to be placed under pavements, sidewalks or paved shoulders may be installed by horizontal drilling or jacking methods subject to the approval of the Engineer. Such conduit shall be on the same grade and line, as nearly as possible, as the rest of the conduit system to avoid excessive bends. If the drilling method is used, the bore diameter shall not exceed the outside diameter of the conduit by more than 5 percent.

The Contractor shall check each conduit run by rodding or by pulling a mandrel through the conduit run. Any obstructions which may develop in the conduit shall be removed.

625.13 Cable. Copper wire cables of the types and sizes required shall be installed as designated or as ordered.

Cable installed in light poles shall be supported by cable grips attached to J hooks at the tops of the poles or other methods approved by the Engineer.

All cables, except structure grounding system cables and pole and bracket cable, entering an accessible enclosure such as a pull box, handhole, transformer base, device housing, etc., for the purpose of being terminated or connected to another cable shall be identified in such enclosure with tags or bands as described in 713.18. No splices will be permitted between terminations. Exothermically welded joints in structure grounding systems are not considered as splices.

625.14 Unit Type Duct-Cable Systems. Duct-cable shall not be installed when the temperature of the duct is below 45°F.

Prior to installation, the duct-cable shall be "paid-out" from its reel as the reel is moved alongside and parallel to the trench. Duct-cable shall not be pulled off a reel located in a stationary position. It shall be provided in sufficient length to be installed without splices between terminations in pull boxes, handholes, junction boxes, etc. Allowances shall also be made for extensions into pull boxes for splicing, and for extension of the conductors through the handholes in light poles.

Duct-cable shall be installed as straight as possible to facilitate cable replacement.

After backfilling over an entrenched section of duct-cable, the Contractor shall, in the presence of the Engineer, demonstrate that the conductors move freely within the duct by pulling the conductor out a minimum length of 2 feet unless the duct cable

625.15

length is greater than 2,650 feet or if the run includes more than two 90 degree bends.

All conductors or cables shall be identified as specified in 713.18.

625.15 Concrete poles. These specifications apply to the manufacture of multi-sided concrete lighting standards to be used for the support of lighting units.

(a) Aggregate shall be graded uniformly from 3/8 inches to #100 sieve with no more than 5% passing through the #100 sieve. Aggregates shall not contain more than 5% unsound particles such as chert, mud balls, etc.

(b) Cement shall be high early strength and shall conform to current American Society for Testing Materials specification C-150.

(c) The water shall be free from acids, alkalies, oil or vegetable matter, and cement shall be the proportion required to produce a concrete with a minimum compressive strength of 3,500 psi in 24 hours under steam curing as specified, before prestressing is released.

(d) Prestressing steel reinforcing shall have a minimum ultimate tensile strength of 240,000 psi and shall be prestressed in accordance with the provisions set forth in the "Recommended Practice for Prestressed Concrete," ACI-ASCE joint report. The steel shall conform to ASTM A-416-59T or A-421-59T requirements. The design of the steel shall be such as to offer sufficient steel area to meet load requirements for the particular type of standard specified. The steel shall be maintained in a rigid position to provide a minimum cover of at least 1/2 inch at all times. Where 1/2 inch minimum cover cannot be maintained next to cable entrance, handhole, wire outlet, etc., the reinforcing shall be protected with a non-corrosive sleeve.

(e) All standards furnished shall be cast in metal molds true to design. Time of mixing shall not be less than three minutes. Concrete shall be placed in one continuous operation. When filled, the mold shall be rotated at high speed to insure a dense concrete by centrifugal force, and produce a cable raceway throughout the length of the standard not less than 1-3/4 inches in diameter.

(f) Following the centrifugal operation, the concrete shall be cured with low temperature water saturated steam. The curing temperature should not exceed 160°F.

(g) The finish shall be as specified in the plans.

(h) The metal brackets shall consist of standard black steel pipe ASTM A-120-57T, Schedule 40, welded to fabricated steel clamps of the design and dimensions shown on the Engineer's drawing. After welding, the spatter and flux shall be removed and the entire bracket galvanized in accordance with ASTM A-123-53. All nuts and bolts shall be stainless steel or silicon bronze.

(i) All poles shall be furnished with a removable metal cap which will protect the required open cable raceway at the top from the weather. All poles shall be furnished with nonferrous inserts for securing accessories such as ornamental pole cap, ballast adapter cap, bracket brace, handhole door, etc. All metal accessories furnished on or with concrete poles shall be aluminum or hot dipped galvanized steel and/or cast iron.

(j) Tests. The Engineer may require the approval of poles to be based on complete testing, including destructive testing at the factory prior to delivery. Destructive tests shall be supervised by a representative of the Engineer and shall be performed on poles selected at random. Approval of subsequently produced poles will generally be based on the Engineer's evaluation of mill tests and factory certified test results on the materials and fabricated components.

625.16 Connections. Cable connections in the handholes or transformer bases of all light poles, and above pavement elevation, shall be accomplished by the use of approved factory preassembled cable connector kits and, in addition, the kit used in the hot leg shall be of a fused type. Where used in pole handholes or transformer bases, the kits shall be of a quick disconnect type. When Type II or Type III cable connection kits are specified, Type IX kits may be substituted.

(a) Cable connections in pull boxes, median mounted junction boxes, other junction boxes, and all enclosures below ground line shall be accomplished by the use of a permanent water resistant cable splicing kit. Each kit shall provide a splice in compliance with ANSI C 119.1 when applied in accordance with manufacturer's instructions.

(b) Connector kits used in cable connections installed at the last light pole or pull box on a circuit shall have the vacant wire opening plugged in accordance with the manufacturer's recommendations.

Until cable connections have been completed, all cable connector kits and exposed cable ends shall be adequately protected by enclosing in plastic bags, taping or other approved means.

625.17 Service Pole. Where and as specified, the Contractor shall furnish and install a wood pole with all necessary equipment, devices and materials to provide a complete electrical service for the facilities.

All service equipment housing, conduit and grounded neutral service wires shall be grounded in accordance with 625.09. Ground cable shall be installed and protected on the pole with wood or plastic ground wire molding.

Where a grounded primary neutral is brought to the service pole, it may be grounded to the secondary ground rod. Primary lighting arresters shall be grounded on a

625.18

separate ground rod located a minimum of one foot from the base of the pole and all other ground rods.

A coating of an approved creosote base paint shall be liberally applied to all holes field bored in treated poles.

The Contractor shall make all arrangements with the supplying agency for connections to establish electrical service at the service pole.

625.18 Control Center. Where and as specified, the Contractor shall furnish and install all equipment, including equipment enclosures and the necessary wiring and wiring devices to provide a completely functional control center for the required electrical system.

If more than one enclosure is required, there shall be one enclosure designated to house the disconnecting device assembly controlling the in-coming supply circuit and such other equipment as specified. It shall be located at the base of the support upon which it is mounted and be stenciled "MAIN SWITCH" on the outside of the enclosure door in black weather-resistant paint, or other approved method.

All other disconnecting devices within the Control Center shall be connected to the load side of the main switch.

Each additional enclosure shall be identified as shown on plans, such as "PANEL A," "TRANSFORMER," or "CONTRACTOR", etc., by having the appropriate designation stenciled on the outside of the enclosure door or cover in black, weather-resistant paint, or other approved method.

All enclosures shall be grounded to a common ground. This common ground shall be a part of the service pole ground. Grounding connections for secondary lighting arresters shall be made to the secondary neutral.

At the time of installation, the "window" of the sensing device in the photo-electric cell shall be faced due north if no marking is provided to indicate aiming the device.

625.19 Structure Grounds. A complete grounding system shall be provided for each bridge, wall, or other structure having electrical elements contained therein or attached thereto.

The furnishing of all materials necessary to provide the entire structure grounding system including ground rods, complete in place, shall be included in this item.

In order to provide continuity in the grounding of conduit at light poles on bridge structures, ground cable shall be installed between grounding lugs of each grounding bushing and the ground lug or bolt in the pole base. Where the plans require the use of a raceway employing a junction box, the cable shall be connected between three grounding bushings through 1-1/2 inch conduit to the pole ground connection.

In order to minimize potential differences between units of a bridge structure, each unit shall be electrically tied to each adjacent unit both longitudinally and transversely, with grounding cable connecting the outside girders or beams together as shown on the plans. Transverse electrical ties need not be made when the lateral separation between sections of parallel bridges is 6 feet or greater.

Two coats of insulating varnish shall be applied over all exothermic welds and exposed cable.

625.20 Junction Boxes. Junction boxes of the sizes and types specified shall be furnished and installed as required. All junction boxes embedded in concrete structures shall be provided with drains.

625.21 Electrical Tests. The Contractor shall be responsible for furnishing all personnel and equipment required to successfully perform the following tests, and shall furnish six certified copies of complete test records to the Engineer on test reporting forms supplied to the Contractor by the Engineer or alternate certification approved by the Engineer.

Prior to the commencement of each required electrical test, the Contractor shall submit to the Engineer the types, styles, or catalog numbers of all testing equipment to be used for such tests. At the same time, the Contractor shall include a written certification that the testing equipment was last calibrated by a testing agency, whose qualifications as such are acceptable to the Engineer, not more than 90 days prior to the date when such tests are performed.

(a) Ground Test. Each ground rod, structure ground, and ground grid shall be measured for earth resistance immediately after being installed and before the ground wire is attached to pole or structure. If the earth resistance measurement exceeds 10 ohms for tower lighting ground rods or 25 ohms for all other ground rods, the Contractor shall proceed as specified in 625.09. Units of measurement for reporting shall be expressed in ohms.

(b) Cable Continuity Test. Prior to the performance of any cable insulation tests, high voltage tests or performance tests on primary feeder cable, secondary feeder cable, distribution cable or other special circuits, a continuity test shall be performed with a volt-ohmmeter or other approved instrument. Continuity tests shall be conducted with electrical loads, power sources and grounds, including earth grounds, disconnected.

Each conductor shall also be measured against every other conductor and ground, including earth ground, to assure that no short circuits, cross circuits or other improper connections exist. No voltage shall exist between any conductor and another conductor, including ground. One at a time, each circuit branch shall then be temporarily shorted at its termination and measured for continuity to assure that

625.21

no open circuits exist, that the circuit branch is according to plan, that no high resistance connections exist and that each circuit is properly identified.

(c) Cable Insulation Test. The insulation resistance shall be measured for each insulated cable, except pole and bracket cable, located in each primary feeder, secondary feeder, and distribution circuit, including duct cable used in distribution circuits. The test shall be performed on each cable of each circuit with all ballasts disconnected and all connections to earth grounds, including ground rods and grounding connections to light poles, disconnected. Units of measurements for reporting shall be expressed in megohms. The cable insulation resistance shall exceed 10 megohms. The above testing requirements are waived for those circuits on which a high voltage direct current test is to be performed.

(d) High Voltage Direct Current Test. The high voltage direct current test shall be performed separately on each circuit as follows:

a. The main disconnect device shall be locked in the open position. Pole and bracket cables shall be disconnected at each light pole. Sign lights, underpass lights, and other devices normally fed by the circuit shall be disconnected.

b. The test shall be performed on each insulated conductor of the circuit and the results recorded and plotted as directed by the Engineer.

c. Conductors shall be tested in the following sequence: (1) on the neutral conductor before it is grounded, and (2) on the power conductors with the neutral and other conductors permanently or temporarily grounded.

d. With voltage at zero, attach high-voltage lead to the circuit conductor to be tested and the low-voltage lead to ground. Ground the companion conductors of the circuit and proceed as follows: (1) Select a voltage scale that will permit continuous measurements without changing scales. (2) Slowly increase the voltage from 0 to 1500 volts and hold for one minute, then to 3000 volts, then to 4500 volts and finally to 6000 volts, reading the current at each step. Record leakage current values and plot a "Leakage vs Step Voltage Curve" on a form similar to that shown in Figure 1. (3) Maintain the voltage at 6000 volts for five minutes, taking a current reading at the end of each minute. Record leakage current values and plot a "Leakage vs Time Curve" as an extension of the "Leakage vs Step Voltage Curve." (4) Return voltage to zero and ground the tested conductor to remove any capacitive charges.

e. Determine and record temperature of the air and relative humidity at the time of testing.

f. Faulted conductors shall be replaced and the circuit retested until satisfactory test results are obtained.

g. The test results shall be considered as satisfactory if both of the following conditions are met: (1) The maximum required value of 6000 volts can be obtained

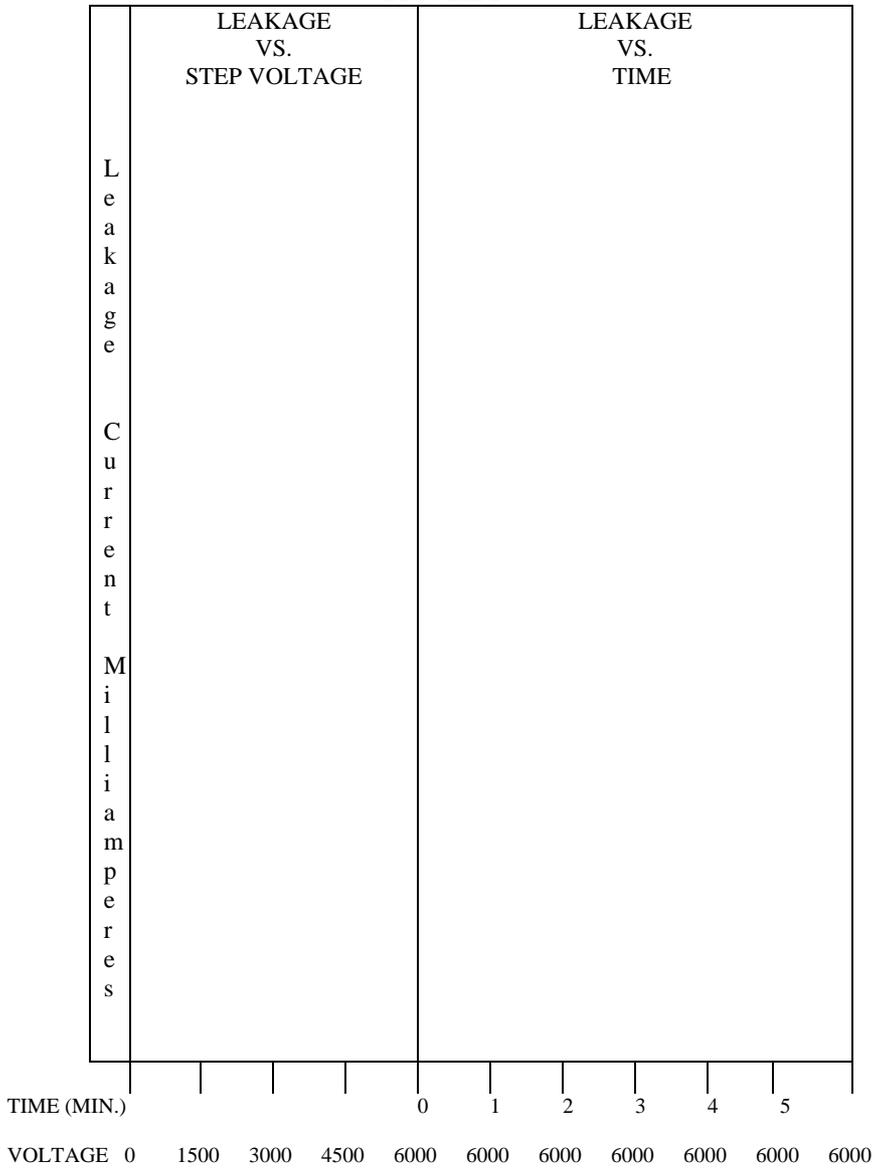
as provided in d(2) above. 2) There is no significant increase in the leakage current values during the 5 minute period described in d(3) above.

h. Six certified copies of all test records shall be furnished to the Engineer.

(e) Performance Test. Prior to acceptance, and after all other tests are performed, the Contractor shall operate the lighting system, including automatic control equipment and other specified apparatus, from sunset to sunrise for 7 consecutive days without interruption or failure. If a lamp or ballast should fail, it shall be immediately replaced.

This shall not require a restart of the test. The Contractor shall record each fault, the method and date of correction of each, and the beginning and end of the 7 day test. The Engineer shall be notified at least 3 days prior to the commencement of this performance test.

FIGURE I



The Contractor shall arrange with the supplying agency to purchase electric power necessary to conduct the performance test. Portable generating plants will not be considered a suitable source of power for the performance test.

(f) Tower Lowering Device. Prior to acceptance, the Contractor shall demonstrate to the Engineer the workability of the tower lowering devices by lowering and raising the luminaire assembly on each tower on two separate occasions during the 7 day performance test. The Contractor shall record the cause of, and the method and date of correction for each malfunction.

(g) All costs of labor, materials, equipment, electrical energy and incidentals required for performing the above electrical tests shall be included in the contract unit prices for the respective items tested.

625.22 Light Pole Identification. Each light pole and light tower shall be identified by a number which will indicate both the circuit number and the pole number. Identifying numbers shall be as indicated on the circuit drawings, in the plans or as specified by the maintaining agency. Identification shall be located approximately 7 feet above the ground line, on the quadrant of the surface of the pole that faces oncoming traffic and shall be applied when the ambient temperature is above 40°F. Payment for furnishing and placing light pole identification shall be included in the unit price bid for light poles and light towers.

625.23 Method of Measurement. When the contract stipulates that payment will be made for various elements of an electrical installation on a linear foot, lump sum or each basis, measurement will be made as follows:

(a) Trench. The number of linear feet of trench completed will be measured from center to center of foundations, pull boxes, etc., and shall include all excavation, sawing and removal of pavement, granular and other backfill material, compaction, disposal of surplus materials and restoration of disturbed facilities and surfaces. Trench in walks or pavements 6 inches or less thick will be measured as Type A, and in pavements greater than 6 inches will be measured as Type B.

(b) Conduit. The number of linear feet of conduit furnished and installed will be measured from center to center of pull boxes, foundations, etc., and shall include all fittings and appurtenances, joints, bends, grounds, and concrete encasement where specified.

(c) Primary Feeder Cable. The number of linear feet of primary feeder cable furnished and installed will be measured as the sum of the distances from the top of the primary cable pot head to the primary terminals on the pad-mounted transformer plus ten feet per pull box, manhole, etc., to allow for slack and splicing leads, multiplied by one of the following, as applicable:

(1) By one for single conductor cable with a concentric neutral.

(2) By two for a feeder composed of one primary cable and one neutral cable.

(d) Secondary Feeder Cable. The number of linear feet of three-wire secondary feeder cable furnished and installed will be measured as three times the distance

625.23

between the service pole and the load center being supplied plus 30 feet to allow for slack and leads.

(e) Distribution Cable. The number of linear feet of distribution cable furnished and installed will be measured as the sum of the distances from center to center of foundations, pull boxes, etc., plus 10 feet per each spacing to allow for slack and splicing leads multiplied by one of the following, as applicable:

(1) By two for two wire distribution circuits.

(2) By three for three wire distribution circuits.

(f) Pole and Bracket Cable. The number of linear feet of pole and bracket cable furnished and installed will be measured as twice the light pole mounting height plus twice the designated arm length or lengths.

(g) Duct-cable. The number of linear feet of duct-cable furnished and installed will be measured from center to center of pull boxes, foundations, etc., plus 10 feet per each spacing to allow for slack and splicing leads.

(h) Ground Rods. The number of ground rods furnished and installed will be the actual number of each 10 foot section of rod, complete in place, and shall include grounding cable and all specified tubing, fittings and connections.

(i) The number of light poles, light towers, light tower foundation pads, portable power units, luminaires, glare shields, pull boxes, connector kits, and structure grounding systems furnished and installed will be the actual number of each, complete in place.

(j) Service Pole and Control Center. The service pole and the control center will be measured as a lump sum for each of the installations specified and shall include all materials, equipment, and incidentals, complete in place.

(k) Junction Boxes. The number of junction boxes furnished and installed will be the actual number of each, complete in place.

(l) Foundations. The accepted number of light pole foundations and light tower foundations furnished and installed will be the actual number of each, complete and in place, and shall include reinforcing steel, anchor bolts, and all incidentals as specified in the plans.

When the contract stipulates that payment will be made for specific complete electrical equipment installation on a lump sum basis, the pay item stipulated will include all electrical materials, equipment and incidentals, including specified tests required at the locations and within the limits specified on the plans, complete in place.

625.24 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
625	Each	Light pole, _____
625	Each	Light pole foundation, _____
625	Each	Light tower
625	Each	Light tower foundation
625	Each	Light tower foundation pad
625	Lump Sum	Service pole
625	Each	Luminaire, _____
625	Each	Glare shield
625	Each	Ground rod
625	Each	Pull box, _____
625	Linear Foot	Trench
625	Linear Foot	Trench in paved areas, Type _
625	Linear Foot	Conduit
625	Linear Foot	Conduit, jacked under pavement
625	Linear Foot	No. ____ AWG, ____ -volt primary feeder cable
625	Linear Foot	No. ____ AWG, ____ -volt secondary feeder cable
625	Linear Foot	No. ____ AWG, ____ volt distribution cable
625	Linear Foot	No. ____ AWG, pole and bracket cable
625	Linear Foot	____ inch Duct-cable with ____ No. ____ AWG, ____-volt cables
625	Each	Connector kit, Type
625	Each	Cable splicing kit
625	Lump Sum	Control center
625	Each	Structure grounding system
625	Each	Junction box
625	Each	Portable power unit

ITEM 626 GEOTEXTILE FABRIC

626.01 Description

626.02 Construction Method

626.03 Materials

626.04 Method of Measurement

626.05 Basis of Payment

626.01 Description. This item shall consist of furnishing and installing geotextile fabric as designated on the construction plans and as directed by the Engineer.

626.02

626.02 Construction Method. When specified, place the geotextile fabric at the bottom of the cut or at locations designated in the construction plans and as directed by the Engineer.

Place the geotextile fabric smooth and free of tension or wrinkles.

Fold or cut the geotextile fabric to conform to curves.

Overlap a minimum of 18 inches at the ends and sides.

Hold the fabric in place with pins or staples.

Place the suitable material on the fabric and do not operate the equipment directly on the fabric.

Unless stated otherwise, spread the suitable material and maintain a minimum lift thickness of 12 inches.

626.03 Materials. All geotextile fabric shall meet the requirements of 712.09.

626.04 Method of Measurement. This provision shall include measurement of the actual square yards of surface area covered with geotextile fabric and approved. Overlapped areas shall be measured only once. Final quantities will be determined from the Engineer’s final measurement.

626.05 Basis of Payment. All costs to perform the above stated work including all materials, equipment, tools, labor, and all incidental and associated costs shall be paid for under:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
626	S.Y.	Geotextile fabric, Type _____

ITEM 629 STREET NAME SIGNS

629.01 Description

629.02 Construction Method

629.03 Materials

629.04 Method of Measurement

629.05 Basis of Payment

629.01 Description. This item shall consist of the removal, storage, disposal, resetting, or replacement of existing ground-mounted street name sign assemblies. It shall also consist of the installation of new ground-mounted and overhead mast-arm-

mounted street name sign assemblies. Replacement may consist of replacing the entire street name sign assembly or any part(s) making up the assembly.

A ground-mounted street name sign assembly shall consist of one (1) or two (2) street name signs, pole, foundation, mounting hardware, and all equipment, labor, and associated costs required to provide the assembly complete, in place, and accepted by the Engineer. No other signs shall be attached to the street name sign pole or assembly.

An overhead mast-arm-mounted street name sign assembly shall consist of one (1) street name sign, mounting hardware, and all equipment, labor, and associated costs required to provide the assembly complete, in place, and accepted by the Engineer.

629.02 Construction Method. All existing ground-mounted street name sign assemblies to be salvaged or reset shall be carefully removed from the construction site prior to beginning any construction activities. Street name signs mounted on utility poles may remain in place during the construction activities unless otherwise directed to be removed and or replaced by the plan sheet set or Engineer.

The Contractor shall fully dismantle the street name sign assembly and store and protect the same until time to reset, unless designated for replacement, in which event, the existing street name sign assembly shall be properly disposed.

The Contractor shall remove the existing concrete foundation from the existing street name sign pole without damaging the pole.

If the City chooses to salvage a particular street name sign assembly or any part of that assembly, the Contractor shall exercise care in removing the assembly, completely dismantle the assembly, protect the salvageable assembly or part from damage, deliver to the Traffic Engineering Division at 1420 Triplett Blvd., and properly dispose of the unsalvageable parts.

The Contractor shall not reset any existing ground-mounted street name sign assemblies, or erect any new ground-mounted street name sign assemblies until just prior to surface restoration activities or as directed by the Engineer. If the surface adjacent to a street name assembly is concrete, asphalt, brick, or another surface-type other than sodding, then the assembly may be installed prior to the surface installation. The assemblies shall be protected during the surface installation and throughout the remaining construction activities. Costs to protect the assemblies shall be considered inclusive in the cost of the assembly.

The street name sign assemblies shall be placed so that the street names are clearly visible to drivers as they approach the intersection from all directions. The preferable location of a ground-mounted street name sign assembly is at the northeast or southwest corner of the intersection and within the designated curb return area, but not outside the City right-of-way. The location of the assembly shall not hinder, obstruct, or otherwise interfere with a pedestrian's use of sidewalks or

629.03

curb ramps and shall maintain minimum pedestrian clear widths in accordance with Standard Drawing BP- 5.0.

The street name signs shall be parallel to the corresponding street they represent so that as a driver approaches the intersection, the name of the approaching intersecting street can be easily read.

Overhead mast-arm-mounted assemblies shall be rigid-mounted and positioned to not interfere with visibility or operation of the signal head.

Street name sign poles shall be embedded and centered in a concrete foundation. The foundation shall be a minimum of 42 inches deep and not less than 11 inches in diameter. The pole shall be embedded a minimum of 36 inches into the foundation with the remainder of the pole exposed above-ground. When the street name signs have been mounted on the pole, the pole shall have been of sufficient length so that the street name sign measures 9 feet from the finished ground surface to the bottom of the lowest street name sign.

629.03 Materials.

(a) Street Name Sign. Street name signs shall be extruded aluminum blanks at least 0.080 inch thick and shall be covered with a green-reflective sheeting with white-reflective lettering. The lettering shall be upper case and “C” style. The cardinal direction and suffix may be abbreviated.

Street name signs for ground-mounted assemblies shall be double-faced, 9 inches in height, and of variable length. The street name lettering shall be 6 inches in height. The cardinal direction and suffix lettering shall be 3 inches in height and aligned evenly with the top edge of the street name lettering.

Street name signs for overhead mast-arm-mounted assemblies shall be 12 inches in height and of variable length, but not less than 48 inches. The lettering shall be 8 inches in height.

Reflective sheeting shall conform to ASTM Type III.

(b) Street Name Sign Pole. Street name sign poles shall be fabricated of 2-3/8 inch O.D., not less than 0.019 inch wall thickness, bright aluminum equal to ASTM B 241. The pole shall be 12 feet overall length.

(c) Street Name Sign Pole Foundation. Class “C” concrete.

(d) Street Name Sign Mounting Hardware. Street name sign mounting hardware shall conform to 630.06 and incidental to whichever part(s) replacement requires the use of the new mounting hardware.

629.04 Method of Measurement. The quantity to be paid for shall be the number of ground-mounted street name sign assemblies reset, replaced, and new assemblies installed. Quantities shall be paid for the number of replacement street name signs and poles. Final quantities will be determined from the Engineer's final measurement.

When Item 629 - Street Name Sign Assembly is bid as a separate item it shall consist of installing a new ground-mounted street name sign assembly or entirely replacing an existing ground-mounted street name sign assembly and shall include one (1) or two (2) street name signs, pole, foundation, mounting hardware, and all equipment, labor, and associated costs required to provide and assemble a new ground-mounted street name sign assembly complete, in place, and accepted by the Engineer. If this item consists of entirely replacing an existing street name sign assembly, then it shall further include the removal, salvaging, and disposal of the existing assembly.

When Item 629 - Street Name Sign Assembly on Mast Arm is bid as a separate item it shall consist of installing a new overhead mast-arm-mounted street name sign assembly and shall include one (1) street name sign, mounting hardware, and all equipment, labor, and associated costs required to provide and assemble a new overhead mast-arm-mounted street name sign assembly complete, in place, and accepted by the Engineer.

When Item 629 - Street Name Sign Assembly Reset is bid as a separate item it shall consist of resetting an existing ground-mounted street name sign assembly including any replacement part(s) designated by the plan sheet set or directed by the Engineer and shall consist of one (1) or two (2) street name signs, pole, foundation, mounting hardware and include all equipment, labor, and associated costs required to remove, dismantle, protect, store, reassemble, and reset an existing ground-mounted street name sign assembly complete, in place, and accepted by the Engineer.

When Item 629 - Street Name Sign is bid as a separate item it shall consist of replacing one (1) existing street name sign with a new street name sign on an existing assembly to be reset. It shall include all equipment, labor, and associated costs required to provide the street name sign for the existing assembly, but does not include the cost to remove, dismantle, protect, store, reassemble, or reset the existing assembly.

When Item 629 - Street Name Sign Pole is bid as a separate item it shall consist of replacing an existing street name sign pole with a new pole in an existing assembly to be reset. It shall include all equipment, labor, and associated costs required to provide the street name sign pole for the existing assembly, but does not include the cost to remove, dismantle, protect, store, reassemble, or reset the existing assembly.

629.05 Basis of Payment. Payment for accepted quantities shall be made at the contract price for:

630.01

<u>Item</u>	<u>Unit</u>	<u>Description</u>
629	Each	Street Name Sign
629	Each	Street Name Sign Pole
629	Each	Street Name Sign Assembly
629	Each	Street Name Sign Assembly on Mast Arm
629	Each	Street Name Sign Assembly Reset

ITEM 630 TRAFFIC SIGNS AND SIGN SUPPORTS

630.01 Description

630.02 Materials

630.03 Working Drawings

630.04 Sign Fabrication

630.05 Foundations

630.06 Sign Supports

630.07 Sign Erection

630.08 Sign Storage

630.09 Signs Refurbished

630.10 Covering of Signs

630.11 Barrier Wall Assembly for Sign Supports

630.12 Removal, Storage or Re-erection of Signs and Supports

630.13 Traffic Signs, Each

630.14 Inspection

630.15 Method of Measurement

630.16 Basis of Payment

630.01 Description. This work shall consist of furnishing and installing reflectorized traffic signs, sign supports and foundations complete and ready for service, in conformance with the types, colors, locations, dimensions, and grades shown in the plans or as ordered by the Engineer. This work shall also include necessary excavation and backfill, and disposal of discarded materials and restoration of disturbed facilities and surfaces in accordance with 551.10

630.02 Materials. All materials and equipment furnished shall be new, of first quality and free from defects.

Acceptance of material and products will be based on Certified Test Data, furnished in triplicate, or on test results of samples in accordance with 106.02, as required by the Laboratory.

Materials shall be:

Concrete 499, 511

Steel:

Structural steel.....	711.01
Reinforcing steel	509.02
Drive posts	712.20
Tube and pipe	730.01
Anchor bolts	730.02
Bolts and nuts (high strength)	711.09
Poles and arms	730.03
Anchor bases	730.04
Handhole covers.....	730.05
Pole caps	730.06
Arm caps	730.07
Hardware.....	730.08
Stainless steel	730.09
Stainless steel hardware	730.10
Messenger wire	730.26

Other Materials:

Sheet and plate	730.11
Extrusions	730.12
Tube and pipe	730.13
Castings	730.14
Forgings	730.15
Welding rods	730.16
Hardware	730.17
Reflective sheeting, Type F	730.18
Reflective sheeting, Type G	730.19
Nonreflective sheeting	730.20
Reflector units	730.21
Silk screen paste	730.22
Clear coating	730.24
Plywood	730.25
Decals	730.18

630.03 Working Drawings. The Contractor shall submit to the Engineer for review and approval, four sets of drawings, catalog cuts, specifications, etc., of apparatus and equipment proposed to be furnished. The material shall show clearly the design, quality, dimensions, and other such information as may be necessary for a proper evaluation of the items submitted. Submitted documents shall identify the specific project with the bid item reference number to which the material applies. If more than one catalog number or type is listed on a sheet, the item intended to be finished shall be identified by an appropriate mark.

The Contractor shall not install any material until written approval is received from the Engineer. After approval, working drawings shall be considered as supplemental to, but not a substitute for, the original plans. Approval of working drawings shall not relieve the Contractor of responsibility for omissions and erroneous or inconsistent dimensions, notations or other errors.

630.03

Sign support working drawings submitted shall cover all design types such as ground mounted, rigid overhead, span wire mounted, and overpass structure mounted supports. The drawings shall show overall height, sign clearance above foundation, span length, sign locations, sign overall heights and widths, and glare shield height and location if applicable.

Extrusheet sign working drawings submitted shall show overall dimensions including glare shield, panel type and length, overlay sign dimensions and location on the covered sign, lighting support arm notch arrangement in the glare shield if applicable, and the type and quantity of assembly and mounting hardware.

Sign legend working drawings submitted shall show all guide sign legends with copy type, character size and spacing, and reference and/or code numbers. The color of guide sign background and legend shall be indicated. Sign layout shall conform to standards maintained by the City and the Ohio Department of Transportation. Drawings of standard warning, regulatory, or route marker signs need not be submitted unless required by the Engineer.

The following code for sign materials, colors, and processes shall be adhered to on submitted sign legend working drawings. When special colors are required they shall be so indicated.

<u>Codes</u>	<u>Description and Color</u>
RSW	Reflective sheeting silver white
RWS-G	Reflective sheeting silver white (Type G)
RSTR	Reflective sheeting silver white, with reverse screen transparent red overlay
RSTB	Reflective sheeting silver white, with reverse screen transparent blue overlay
RSTG	Reflective sheeting silver white, with reverse screen transparent green overlay
RSTRB	Reflective sheeting silver white, with reverse screen transparent red and blue overlay
RSY	Reflective sheeting yellow
RSB	Reflective sheeting blue
RSG	Reflective sheeting green
RSBR	Reflective sheeting brown
RSO	Reflective sheeting orange
RSO-G	Reflective sheeting orange (Type G)
NRSW	Nonreflective sheeting white
NRSY	Nonreflective sheeting yellow
NRSG	Nonreflective sheeting green
NRSBK	Nonreflective sheeting black
SPBK	Silk screen paste, black
DAW	Direct applied copy, reflective sheeting silver white

DAB	Direct applied copy, nonreflective sheeting black
DCW	Demountable embossed copy, white with reflectors
DCBK	Demountable embossed copy, black
DCFW	Demountable flat copy, reflective sheeting silver white
DCFBK	Demountable flat copy, black

630.04 Sign Fabrication. Sign types shall include flat sheet, extrusheet and overlay. Flat sheet signs shall be one piece units made of aluminum. Legend on flat sheet signs shall be silk screened by the direct or reverse screen process, unless otherwise specified. Extrusheet signs shall be made up of a number of horizontal panels assembled to form a complete sign. Overlay signs shall be of aluminum sheet to cover portions or entire surfaces of signs when specified. Legend on extrusheet or overlay signs, except for shields described hereafter, shall be demountable embossed copy, unless otherwise specified. Letter and numeral style shall be in accordance with the FHWA Standard Alphabets for Highway Signs. Sign legend shall be in accordance with the Ohio Manual of Uniform Traffic Control Devices for Streets and Highways.

1. Sheet or Panel Fabrication.

(a) Flat sheet signs of aluminum material shall be cut complete from sheets into blanks of the thickness, size and shape specified. Bolt holes shall be drilled or punched to finish size.

Plywood flat sheet signs shall be sawed to the size and shape with mounting holes drilled. Edges and holes shall be sound, smooth and free of tears. All woodworking shall be completed before application of sheeting.

(b) Extrusheet signs consist of horizontal panels assembled to form a sign. Panels shall be continuous for the sign length.

Horizontal panels shall be fabricated of aluminum sheet and extrusions, joined by spot welding and shall be assembled by bolting or interlocking of extrusions to form tight joints. Bolted panels shall have extrusions which can be assembled by bolts through channel webs. Interlocking panels shall have extrusions which can be assembled by deformation within the elastic limit of alternate male and female shapes. Panels shall be joined or separated without damage to the joint and without the use of special tools. Interlocked panels shall be assembled with a male extrusion shape at the top of the sign. There shall be no appreciable deviation from flatness on the face of an assembled sign.

(c) Overlay signs shall consist of 0.063 inch aluminum sheeting. Overlay signs may be shop attached to cover the legend of signs or may be separate units for installation in the field. Overlay signs shall be furnished in sections no larger than 5 by 4 feet. The method of attachment shall be by blind rivets at maximum spacings of 12 inches on peripheries and 24 inches within the interior of sign or sign sections. Rivets shall be positioned so as not to disturb copy on the underlying sign.

(d) Double-faced signs shall be aluminum at least 0.080 inch thick. Double-faced signs shall be covered with reflectorized sheeting on both sides and shall be furnished with necessary mounting hardware.

2. Surface Preparation.

(a) Aluminum sign surfaces shall be thoroughly cleaned and then etched by an acid solution before painting or application of sheeting. The cleaning process shall be by total immersion in a tank containing an alkaline solution of the manufacturer's specification, followed by a thorough rinsing with running water, or steam cleaning with an alkaline solution of the manufacturer's specification, followed by a thorough rinsing with running water. The cleaning shall be followed by a surface etching. The surface shall then be thoroughly dried. Cleaned and etched surfaces shall not be allowed to become contaminated by contact with oil or grease.

(b) Plywood sign faces shall be cleaned of all grease, wax or dirt and wiped dry before application of reflective sheeting.

3. Background Sheeting and Application. Sheeting for reflectorized surfaces shall be Type F. After sign face preparation is completed, sheeting shall be cut, matched, and applied to the surface according to the manufacturer's recommendations. Background sheeting shall be cut oversize, and after application shall be trimmed to the exact size specified. The finished application shall have no blisters, wrinkles, tears or blemishes.

4. Legend Application. Copy for extrusheet or overlay signs shall conform to the type, size and arrangement specified and shall consist of letters, numbers, border portions and shields.

(a) Demountable Embossed Copy with Reflector Units. Copy units of this type shall be manufactured with beveled edges and a recess on the reverse side to accommodate the thickness of reflector units. Material shall be 0.040 inch thick aluminum sheet and shall be free of irregularities, burrs and other defects. Reflector openings shall be provided with spacing and diameter suitable for the copy size. Copy units shall be finished with at least two coats of white baked enamel and fitted with reflector units. Attachment shall be by aluminum blind rivets.

(b) Demountable Embossed Copy, Black. Copy units shall be similar to the foregoing except there shall be no openings for reflector units and the copy shall be finished with at least two coats of black baked enamel.

(c) Demountable Flat Copy, Reflective. Copy units of this type shall be cut from 0.063 inch aluminum sheet and shall be covered with Type F silver white reflective sheeting. Flat demountable copy, when used, shall be dimpled to provide a 1/32 inch minimum clearance from the sign face. Attachment shall be by aluminum blind rivets.

(d) Demountable Flat Copy, Black. Copy units shall be similar to the foregoing except units shall be finished with black nonreflective sheeting or with a minimum of two coats of black baked enamel.

(e) Shields. Ohio and U.S. Shields mounted on guide signs shall be covered with Type F silver white reflective sheeting with legend of silk screened black paste.

Interstate shields mounted on guide signs shall be covered with Type F silver white reflective sheeting with legend of reverse screened red and blue. Numbers and border shall be white demountable copy with reflector units.

Shields shall be mounted as separate and complete units and shall be attached by steel truss head bolts with standard washers used to provide a clearance from the sign face.

(f) Direct Applied Copy, Reflective. When specified, legend for extrusheet, overlay or flat sheet signs shall be direct applied. The legend shall be cut from Type F silver white reflective sheeting and applied by the adhesive backing.

(g) Direct Applied Copy, Black. Legend shall be applied in the same manner as reflective copy except black nonreflective sheeting shall be used.

5. Glare Shields. Illuminated extrusheet signs will incorporate a glare shield which shall be an extension of similar construction. The glare shield shall be below the sign unless otherwise indicated. 12 inch extrusheet glare shields shall be notched to accommodate luminaire support arms. Glare shields made of a rectangular tube and a 6 inch extrusheet portion do not require notching. Glare shields and tube shall be covered with nonreflective sheeting matching the color of the sign under daylight viewing conditions.

6. Sign Identification. Signs shall be identified on the reverse side by decals of Type F silver white reflective sheeting with silk-screened black numerals in accordance with Figure 630.04-1. Information shall be coded by punched-out numerals before decal application and shall include: quarter and year of sheeting purchase, sheeting manufacturer, and month and year of sign fabrication. Separate decals applied at time of erection shall be coded with the month and year of erection.

Figure 630.04-1

Punched and Applied by Fabricator (* indicates a typical punched- out numeral)

12*4	Quarter of Year Sheeting Purchased
01234567*9	Last digit of Year Sheeting Purchased
01*345	Sheeting Manufacturer's Number*
1234567*9101112	Month Sign is Fabricated
01234567*9	Last Digit of Year Sign is Fabricated

630.05

*(from list furnished by City)

Punched and Applied by Contractor

12345678910*12

Month Sign is Erected

01234567*9

Last Digit of Year Sign is Erected

7. Sign Protection for Shipment and Storage. Signs shall be suitably protected and identified for shipment and storage. Extrusheet signs shall be kept rigid by backbracing or crating, and the sign face covered with protective material. The backbracing shall extend sufficiently below the sign's lower edge to keep the sign off the ground.

Extrusheet signs shall be identified by information in a detachable form on the sign back giving the project number and year, sign reference and/or code number, sign legend sketch, and station location. Signs shipped with an attached overlay sign shall also identify the underlying sign.

Extrusheet shall be shipped completely assembled except for signs over 8 feet in height, which may be shipped in two pieces for field assembly. Exit number signs may be shipped separated from the parent sign, if desired. Sign hardware shall be shipped in sturdy containers which will not rupture during handling.

630.05 Foundations. Sign support foundations shall be located so the plane of the sign surface shall be at a right angle to the roadway lanes served. Foundations shall be located by the Contractor and staked with the proper elevation. When problems such as underground or overhead obstacles are encountered during staking, and to correct slope and subsurface difficulties and sign sight distance obstructions, foundation location and orientation may be changed with the approval of the Engineer. The Contractor shall be responsible for the correct location, elevation and orientation for all signs and supports installed on the foundations.

Excavation for foundations shall be made by an earth auger to specified dimensions in accordance with 503.04. Caution shall be exercised by the Contractor when excavating in areas of underground installations to avoid their disturbance or damage. If a cave-in should occur during excavation, the Contractor may continue excavating using casing, sleeving or other methods, with the approval of the Engineer. When subsurface obstructions are encountered, the Contractor may remove the obstruction or may replace the excavated material and relocate the foundation, with the Engineer's approval. When bedrock is encountered, that portion of the specified foundation depth within the bedrock may be reduced up to 50 percent.

Sign support foundation work shall conform to the requirements of 511. The concrete shall be placed against undisturbed soil or compacted embankment. Foundations shall be formed from the top to a nominal depth of six inches below the proposed finish grade.

Cylindrical foundations for embedded ground mounted supports shall have concrete placed with the support braced in a vertical position until the concrete has set. The foundation top surface shall be sloped to provide for drainage.

Anchor base foundations for overhead sign supports shall contain required reinforcing rods, anchor bolts and conduit ells. Forms shall be used for the upper foundation portion, and the anchor bolts and conduit ells shall be accurately held by a template until the concrete has set.

630.06 Sign Supports. Sign supports consist of ground mounted, rigid overhead, span wire, or overpass structure mounted types. Structural aspects of design and materials shall comply with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Fabrication shall be according to applicable sections of 513 and welding shall comply with 513.17. The approval of fabricators according to 501.04 will not apply. Steel structural members shall be hot dipped galvanized in accordance with 711.02. Steel hardware shall be galvanized according to 730.08.

Threaded fasteners shall be tightened by the "turn of the nut" method or by means of a torque wrench to obtain a tension of 100 percent (maximum) and 80 percent (minimum) of the proof load listed in the SAE Handbook for the size and grade of fastener used.

Anaerobic adhesive complying with Federal Standard MIL S 46163 Type II, Grade N shall be applied to anchor bolts and other threaded connections 1/2 inch diameter or larger, according to the manufacturer's recommendations. Anaerobic adhesive shall not be used with torque-limiting nuts.

1. Ground Mounted Supports. Ground mounted supports consist of structural sections of the material and weights required and shall be driven into the earth or embedded in concrete as specified. The support lengths appearing on the plans are approximate, and the Contractor shall be responsible for determining the exact length of required supports before fabrication. Sign supports may consist of two or more structural members of the nonbreakaway or breakaway type.

A. Post Supports. Ground mounted supports of the post type shall be made of channels of the section, material and of the weights indicated. Each post shall be marked with a line of paint 6 inches above the specified minimum driving depth. Two posts may be bolted together back to back to form a heavier post when specified.

Posts shall be driven to the specified minimum depth without bending, distortion or end mutilation. When the post cannot be driven at the specified location, the post may be moved with the approval of the Engineer at no additional cost to the City. Posts shall not be placed in drainage ditches.

630.06

Posts located in walk or paved areas shall be driven through a hole provided by sleeving or core drilling. After the post is in position, the hole shall be patched with asphaltic concrete or an approved bituminous material.

Groupings of flat sheet signs in multiple arrangements mounted on posts shall have sign backing assemblies.

One-way sign posts incorporate a square tubular top extension for mounting signs at right angles to other signs on the post.

Temporary sign posts are attached to drums or beam rail.

B. Beam Supports Assembled. Ground mounted supports of the beam type shall be rolled steel sections of the nonbreakaway or breakaway type, sizes, and weights specified.

Breakaway beam connections shall allow the beam under impact to separate at a slip base and bend at a hinge point under the sign. Beams shall consist of three parts: a bottom stub for concrete embedment and a two piece upper portion. The pieces of each beam shall be bolted together and the assembly bolts given a preload before delivery to the project. Assembled breakaway beams shall be carefully handled during transportation and erection. Upon erection, the final specified torquing shall be performed on all threaded fasteners.

2. Rigid Overhead Supports. Rigid overhead supports consist of single poles with cantilevered arms, or span types supported between end frames. Supports shall include brackets for attachment of disconnection switch enclosures and pipe couplings for sign wiring. Anchor bolts and conduit ells for installation in the foundation shall be furnished with the supports. Support poles and end frames, upon erection, shall be set on their foundations and plumbed using the leveling nuts, followed by secure tightening of the nuts on the anchor bolts. Concrete grouting shall not be used in the space between the foundation surface and support base.

Cover bases or individual anchor bolt covers shall be provided on support anchor bases located in sidewalks, traffic islands, curbed areas, and seeded areas, unless otherwise directed by the Engineer.

Overhead sign supports shall be furnished with sign attachment assemblies for the mounting of extrusheet signs to the support chords. Each sign attachment assembly shall consist of a mounting bracket, U-bolts, clamps, and hardware. When overhead signs are to be lighted, overhead sign supports shall be furnished with luminaire support assemblies. Each luminaire support assembly shall consist of a support arm, other necessary structural members, bracing rods when required, and miscellaneous hardware.

When specified, each overhead sign support shall be identified by a decal listing the County, Route, and Section Number (example: SUM-18-11.58). Decals shall be

applied only when the ambient temperature is above 40°F. The decal shall be located approximately 8 feet above groundline on the quadrant of the sign support facing approaching traffic. Sign supports spanning opposing directions of traffic shall be identified with two decals, each on a support member facing traffic.

Single pole supports may have cantilevered arms which are symmetrical or nonsymmetrical. Single arms or dual arms are made up of tapered or nontapered members.

Rigid span supports consist of a box truss supported by single plane truss end frames. Box trusses shall be fabricated of aluminum or steel tubular members with built-in camber, and each section shall be marked "TOP". Box trusses may be erected provided at least one sign is in place within 8 hours, or the trusses are fitted within the same period with damping devices approved by the Engineer.

Combination overhead sign supports with light pole extension shall provide for the attachment of a luminaire bracket arm.

3. Span Wire Supports. Span wire supports shall include strain poles of the anchor base type. Components for span wire sign supports shall consist of strain poles, messenger wire, sign hanger assemblies and 3 bolt clamps. Alternate span wire attachment will require span wire clamps, anchor shackles and thimbles. Poles shall be furnished with anchor bolts and conduit ells for installation in the foundation. Sign hanger assemblies shall consist of all parts necessary to attach an individual sign, and shall include span wire hangers, braces, lengths of post, and miscellaneous hardware.

The span wire sag under load shall not be greater than 5 percent or less than 4 percent of the span. Poles shall be adjusted so that under span wire tensioning within the above sag limits the poles will be in an essentially vertical position.

4. Overpass Structure Mounted Supports. Overpass structure mounted supports shall be designed for the attachment of extrusheet signs. The supports shall be a flush mounted type or a skew mounted type. The supports shall be mounted on the overpass structure so the bottom of signs shall be in a level position regardless of bridge slope.

5. Miscellaneous Attachment for Signs. Signs suspended from signal messenger wire or mast arms shall be attached by a sign hanger assembly consisting of all parts necessary to attach an individual sign. Signs mounted on poles or bridge parapets shall be attached by a support assembly.

630.07 Sign Erection. Signs shall be erected on ground mounted or overhead supports in conformance with the schematic signing layout.

630.08

1. Flat Sheet Sign Erection. Typical placement of flat sheet signs shall use steel bolts of the specified grade and plating, wide washers, lockwashers and nuts. Bearing plates shall be placed between the sign and post at each bolt.

Flat sheet signs mounted on messenger wire or mast arms shall be field drilled to match holes in brackets.

2. Extrusheet Sign Erection. Typical placement of extrusheet signs on ground mounted or overhead supports shall be as specified. Sign attachment shall be by self-aligning aluminum mounting clips. Bolts for the clips shall be aluminum with rectangular head and hex stop nuts.

Exit number panels and supplemental guide signs, when required, shall be attached to guide signs by sign backing assemblies consisting of post members and clips. Large extrusheet signs which are delivered in two pieces shall be assembled with all demountable sign legend attached prior to erection.

3. Overlay Sign Erection. Overlay signs which are shipped separately and are to be erected on existing guide signs shall be attached according to the requirements of 630.04 Section 1(c). In preparation for erecting overlay signs, the Contractor shall remove existing demountable legend to be covered by the overlay.

4. Revised Demountable Copy on Existing Signs. When demountable copy on existing signs is to be changed, the designated existing copy shall be removed, the sign face cleaned, the remaining copy respaced as necessary, and new copy installed with aluminum blind rivets. Any single revised line of legend shall have all new copy and reflector units, or all reused compatible copy and reflector units.

630.08 Sign Storage. When the plans state the signs are to be furnished by the City, and erected by the Contractor, the Contractor shall be responsible for the storage and care of the signs after transferral by the City. Adequate covering or shelter acceptable to the Engineer shall be provided. Extrusheet signs shall be stored in a vertical position with the sign top upward. Flat sheet signs with Type G sheeting shall be stored in a vertical position.

630.09 Signs Refurbished. Sign refurbishment shall include cleaning, installation of overlay signs, repair of panels, replacement of damaged or missing copy, and use of clear coating.

630.10 Covering of Signs. Temporary covers shall be installed and subsequently removed and disposed of when indicated by the plans or when directed by the Engineer. Covering material shall be a sturdy opaque material and the proposed method of covering and attachment shall be approved by the Engineer.

630.11 Barrier Wall Assembly for Sign Supports. Where an existing overhead sign support is located in a median in which concrete barrier is to be placed, a barrier wall assembly shall be provided as detailed on the plans.

630.12 Removal, Storage or Re-erection of Signs and Supports. Signs and sign supports indicated for removal shall be carefully dismantled and stored on the project for salvage by the City or for re-erection. To assure maintenance of adequate traffic control at all times, signs shall be removed only with the approval of the Engineer.

Sign supports shall be removed in a manner avoiding damage. Sign service to the support shall also be removed by disconnecting and removing cables at the service pullbox. Connection of remaining cables shall conform to 625.16. Support foundations shall be removed to at least three feet below subgrade or finished groundline. Backfilling, restoration of surfaces and disposal of surplus material shall be in accordance with 551.10.

Signs to be re-erected may require field drilling and the furnishing of mounting hardware. Anchor bolts and conduit ells for installation in the foundation shall be furnished when overhead supports are re-erected.

Overlay signs shall be removed so as not to damage the underlying sign. The legend of the underlying sign shall be inspected, and any loose or missing rivets shall be replaced.

630.13 Traffic Signs, Each. When ITEM 630 – TRAFFIC SIGNS is used, this item shall include removal, storage, disposal of existing signs with their supports and replacement or installation of new signs or resetting of the existing sign, which shall include mounting hardware, ground-mounted support, equipment, labor, and all other associated costs to complete this work and accepted by the Engineer.

All signs shall comply with the “Ohio Manual of Uniform Traffic Control Devices for Streets and Highways” (O.M.U.T.C.D.S.H.), including the latest revisions, according to placement, size, shape, color, and reflectorization.

All traffic signs shall be mounted on a their own new ground-mounted support. Under no circumstances shall a traffic sign be mounted on a utility pole or any other mountable surface not intended for traffic sign mounting.

If an existing traffic sign is mounted on a utility pole or any other mountable surface not intended for traffic sign mounting, then the new traffic sign shall be installed on a new ground-mounted support.

If the City chooses to salvage a particular traffic sign or any part of that traffic sign, then the Contractor shall exercise care in removing and dismantling the sign, shall protect the salvageable part from damage, deliver to the Traffic Engineering Division at 1420 Triplett Blvd., and properly dispose of the unsalvageable parts.

All ground-mounted supports shall be a combination of a green-painted U-channel post with a nominal weight before punching of 3-lb./ft. for an 8-foot post and a 2-

630.13

lb./ft. for a 6-foot post. The 8-foot 3-lb. post shall be driven into the ground to a depth of 3½-4 feet and the traffic sign shall be attached to the 6-foot post. The 6-foot post, with sign, shall then be attached to the 8-foot post at the state specified height with standard fastening devices unless otherwise designated on the plan sheet set or directed by the Engineer.

When a ground-mounted support is to be mounted in a sidewalk or otherwise finished surface, the contractor shall install a 4-inch inside diameter PVC sleeve in the sidewalk or surface prior to placing that surface. The ground-mounted support shall be driven into the ground through the sleeve and grouted full.

When a traffic sign is designated to be reset, the Contractor shall exercise care in removing the sign and shall carefully dismantle the sign. The sign to be reset shall be stored and protected until time to reset. The unsalvageable parts shall be properly disposed.

All traffic signs to be salvaged or reset shall be removed from the construction site prior to any construction activities beginning. The Contractor shall not set post any new signs or reset any existing signs until all surface restoration has been completed, but prior to sub-final inspection.

All signs shall be classified based on the following categories of types:

Type A

All signs which have an area of 400 square inches or less. Typical:

O.M.U.T.C.D.S.H.

<u>Ref. number</u>	<u>Function</u>
R1-3	Multiway Stop Installations
R1-4	Multiway Stop Installations
R7-1	No Parking Anytime
R7-8	Reserved Parking For Handicapped
OM4-1	Object Marker, Type 4

Type B

All signs which have an area greater than 400 square inches, and up to and including 1000 square inches. Typical:

O.M.U.T.C.D.S.H.

<u>Ref. number</u>	<u>Function</u>
R1-1	Stop Sign
R1-2	Yield Sign
R10-6	Stop Here On Red
R15-1	Railroad Crossing Signs (Crossbuck)
R2-1	Speed Limit Sign
R2-H5	Signs For Reduced Speed Ahead
S5-H5	School Speed Limit Signs

R10-11B	No Turn On Red
R10-H5a (Left)	Lane Use Control Signs
R10-H5b (Right)	Lane Use Control Signs
R5-H2b	Truck and Through Traffic Exclusion
W14-2	Dead End/No Outlet Sign
W11	Crossing Signs
S1-1	School Crossing Advance Sign

Type C

All signs which have an area greater than 1000 square inches, and up to and including 2400 square inches, and mounted on U-channel type posts. Typical:

O.M.U.T.C.D.S.H.

<u>Ref. number</u>	<u>Function</u>
S5-H3	School Speed Limit Sign
W9-1	Lane Reduction Transition Signs

630.14 Inspection. After erection, signs will be inspected under both day and night conditions, and any deficiencies in lateral position or visibility shall be corrected to the satisfaction of the Engineer.

To assure a proper functioning of the breakaway feature, the Contractor shall verify bolt torques on breakaway beam connections at least four weeks following installation.

630.15 Method of Measurement. Measurement will be made for specific items, furnished and installed in place, complete and accepted, in accordance with the following items.

Foundation concrete will be measured as the number of cubic yards as determined by calculations from plan dimensions, including excavation, reinforcing steel, concrete, backfilling, and disposal of surplus excavation. No deduction will be made for the volume of beams, reinforcing steel, anchor bolts, conduit ells and pole butts within the concrete.

Ground mounted supports will be measured as the actual length in linear feet and shall include driving, sign backing assemblies, and the furnishing of patching materials for excavations in paved areas.

One-way sign supports will be measured in a manner similar to ground mounted supports. The linear measurement will include the tubular extension. The supports shall include the tube, spacers and necessary hardware.

Temporary sign posts attached to drums or beam rail will be measured as the length in linear feet.

630.15

Breakaway beam connections will be measured as the number of sets of connection parts with necessary welding and drilling of holes as required for the breakaway function in one beam. Beams shall include base plates, fuse plate, hinge plate, bolt retainer plate, and bolts assembled to specified torques.

Rigid overhead sign supports will be measured as the number of supports, including anchor bolts and conduit ells furnished for the foundation, sign attachment assemblies, luminaire support assemblies when required, and cover bases and identification decals when specified.

Sign attachment assemblies separately itemized will be measured as the number of assemblies, including one overhead sign bracket, U-bolts, clamps, and miscellaneous hardware.

Luminaire support assemblies separately itemized will be measured as the number of assemblies, including one support arm, other necessary structural members, bracing rods when required, and miscellaneous hardware.

Combination overhead sign supports with light pole extension will be measured in a manner similar to rigid overhead sign supports. Bracket arms and luminaires for roadway lighting are not included.

Span wire sign supports will be measured as the number of each support assembly, including two strain poles with span wire clamps and anchor shackles, anchor bolts, and conduit ells, furnished for foundations, messenger wire, clamps, thimbles, and sign hanger assemblies with hangers, braces, lengths of post and miscellaneous hardware.

Overpass structure mounted sign supports will be measured as the number of each support assembly, including attachment work and hardware.

Miscellaneous attachment of small signs to signal messenger wire or mast arms will be measured as the number of hanger assemblies. Hanger assemblies shall consist of all parts necessary to attach one individual sign. Attachment to poles or bridge parapets will be measured as the number of support assemblies.

Signs will be measured as the area in square feet of signs, including the furnishing of identification decals, sign backing assemblies, mounting bolts, washers, nuts, bearing plates, clips, and rivets. Measurement for square, rectangular, circular, or irregular shaped signs will be determined by multiplying the largest dimensions of width and height. Measurement for triangular shaped signs will be determined by multiplying the largest dimension of width and one-half the largest dimension of height. The area of the glare shields for lighted signs will be included with and measured as an integral part of the sign.

Double-faced signs will be measured as the number of double-faced signs, including mounting fittings and hardware.

Sign backing assemblies separately itemized will be measured as the number of assemblies, including back bracing for multiple flat sheet sign installations and backing posts for exit and/or supplementary signs attached to guide signs, with required hardware.

Existing signs revised with demountable copy will be measured as the number of signs revised. Revised copy will include the removal of existing copy, respacing of existing copy, and the furnishing of mounting hardware.

Refurbishing signs will be measured as the area in square feet of signs refurbished, and shall include the furnishing and installation of overlay signs, adjustment of demountable copy, replacement of missing or damaged copy, repair of panels, clear coating, or other required work.

Covering of signs will be measured as the area in square feet of sign face covered, including the subsequent removal and disposal of the covering.

Barrier wall assemblies will be measured as the number of assemblies.

Removal and storage or re-erection of signs and supports will be measured as the number of ground mounted signs and supports, overhead mounted signs and supports, and overlay signs, removed and stored or re-erected. Major signs are defined for measurement as being 40 square feet or larger. Support removal shall include removal of foundations and restoration of surfaces. Re-erection, when required, shall include furnishing of anchor bolts and conduit ells, necessary field drilling and hardware.

Signs erected will exclude the furnishing of signs and mounting hardware. This item will be measured as the area in square feet of signs erected. Signs erected shall include the assembly of signs delivered in more than one piece and the installation of required sign backing assemblies. Measurement for square, rectangular, circular, or irregular shaped signs will be determined by multiplying the largest dimensions of width and height. Measurement for triangular shaped signs will be determined by multiplying the largest dimension of width and one-half the largest dimension of height. The area of the glare shields for lighted signs will be included with and measured as an integral part of the sign. Overlay signs which are shipped attached to extrusheet signs and erected with the signs are included with the signs for erection payment. Overlay signs which are shipped separately and erected on existing extrusheet signs and including the removal of underlying legend will be paid for under this item.

Traffic signs designated to be removed, replaced, installed, or reset will be measured as the number of traffic signs removed, replaced, installed, and reset.

630.16 Basis of Payment. Quantities of specific items measured as provided above, in place, complete and accepted, will be paid for under:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
630	Cubic Foot	Concrete for anchor base foundations
630	Cubic Foot	Concrete for embedded foundations
630	Linear Foot	Ground-mounted supports, _____ post
630	Linear Foot	Ground-mounted supports, _____ beam
630	Linear Foot	One way supports
630	Linear Foot	Temporary sign posts,
630	Each	Breakaway beam connection
630	Each	Overhead sign support, type _____, design __, span _____ feet
630	Each	Combination overhead sign support, type __, design _____, span _____ feet
630	Each	Sign attachment assembly
630	Each	Luminaire support assembly, type _____
630	Each	Span wire sign support, type _____, design _____, span _____ feet
630	Each	Overpass structure mounted sign support, type _____, design _____
630	Each	Sign hanger assembly ("span wire" or "mast arm")
630	Each	Sign support assembly ("pole" or "bridge mounted")
630	Square Foot	Signs ("flat sheet", "extrusheet" or "overlay")
630	Each	Signs, double faced
630	Square Foot	Signs erected ("flat sheet", "extrusheet" or "overlay")
630	Each	Sign backing assembly
630	Each	Existing signs revised with demountable copy
630	Square Foot	Refurbishing signs
630	Square Foot	Covering of signs
630	Each	Barrier wall assembly, type _____, design _____
630	Each	Removal of ground mounted (major) sign and ("storage" or "re-erection")
630	Each	Removal of ground mounted ("beam" or "post") support
630	Each	Removal of overhead mounted sign and ("storage" or "re-erection")
630	Each	Removal of overhead sign support and ("storage" or "re-erection"), type _
630	Each	Removal of overlay sign
630	Each	Traffic Sign - Type _
630	Each	Traffic Sign Removed
630	Each	Traffic Sign Reset

ITEM 631 SIGN LIGHTING AND ELECTRICAL SIGNS

631.01 Description

631.02 Materials

- 631.03 Working Drawings**
- 631.04 General, Sign Lighting**
- 631.05 Service Pole**
- 631.06 Sign Service**
- 631.07 Signs Wired**
- 631.08 Disconnect Switch with Enclosure**
- 631.09 Switch Enclosure Mounting Bracket Assembly**
- 631.10 Transformer**
- 631.11 Ballast**
- 631.12 Photoelectric Control**
- 631.13 Mercury Vapor Luminaire**
- 631.14 Fluorescent Fixture**
- 631.15 Electrical Signs**
- 631.16 Removal, Storage or Re-erection of Sign Lighting Luminaires**
- 631.17 Inspection and Testing**
- 631.18 Method of Measurement**
- 631.19 Basis of Payment**

631.01 Description. This work shall consist of furnishing and installing sign lighting or electrical sign equipment, complete, tested, and ready for service, in conformance with the specified material quality and dimensions, and at the locations shown in the plans or as ordered by the Engineer.

631.02 Materials. All equipment and materials furnished shall be new, of first quality, of current design, and free from defects. The equipment and materials shall comply with the National Electrical Code and City of Akron Building Code including revisions.

All electrical parts, wire, switches and other elements of the installations shall be of ample capacity to carry the required current without excessive heating or drop of potential.

Except as otherwise provided herein, each individual item of equipment shall bear a nameplate, indelible marking or brand that shall identify it as to type, model, catalog number and manufacturer.

Materials shall conform to the following:

Service pole	713.19
Conduit, rigid	713.04
Conduit, flexible	731.08
Cable and wire	713.02 600 Volt
Ground rod	713.16
Sealing, conduit	625.12
Disconnect switch	713.19
Switch enclosure	713.20
Mercury vapor ballast	713.11
Photoelectric control	713.20

631.03

Mercury vapor luminaire	731.01
Mercury vapor lamp	713.14
Fluorescent fixture	731.02
Fluorescent lamp	731.02
Changeable message sign, lamp type	731.03
Changeable message sign, drum type	731.04
Internally illuminated sign	731.05
Sign flasher assembly	731.06
School speed limit sign assembly	731.07

631.03 Working Drawings. The Contractor shall submit to the Engineer for review and approval four sets of drawings, catalog cuts, specifications, brochures, data sheets, wiring drawings, etc., of apparatus and equipment proposed to be furnished. The material shall show clearly the design, quality, dimensions, and other such information as may be necessary for a proper evaluation of the items submitted. All submitted documents shall identify the specific project with the bid item reference number to which the apparatus or equipment applies. If more than one catalog number or type is listed on a sheet, the item intended to be furnished shall be indicated by an appropriate mark.

The Contractor shall not install any material until written approval is received from the Engineer. After approval, working drawings shall be considered as supplemental to, but not a substitute for, the original plans. Approval of working drawings shall not relieve the Contractor of responsibility for omissions and erroneous or inconsistent dimensions, notations or other errors.

631.04 General, Sign Lighting. Overhead sign lighting shall be by mercury vapor luminaires, and electric power shall be integrated with roadway lighting circuits.

Wire and cable shall be protected by installation entirely within support structure interiors, enclosures, junction boxes, and rigid or flexible conduit. Methods, materials and locations of splicing, and methods of connecting and identification of wire and cable, shall conform to the requirements of 625, 713 and the plans. Grounding systems shall be provided in accordance with 625.09 and will be paid for separately.

631.05 Service Pole. Service poles shall be furnished and installed when specified. Each pole shall include all necessary equipment, devices and material to provide a complete service unit conforming to 625.17, 713.19 and plan details. Poles shall be furnished and paid for under 625.

631.06 Sign Service. Sign service shall consist of all cable and other equipment to provide a complete electrical service from either an underground or overhead source to the disconnect switch.

Sign service cable from a pullbox shall be routed to the switch enclosure for overhead supported signs by means of underground conduit, foundation conduit ell, and the interior of the structural member supporting the enclosure. Service for overpass structure mounted signs shall be routed through underground and structure attached conduit terminating at a switch enclosure. The conduit shall be attached by 0.02 inch thick by 3/4 inch wide passivated stainless steel straps spaced at intervals of not more than 5 feet. Sign service shall include trenching, conduit, fittings, backfilling, and cable.

Sign service cable from a distribution system direct drop shall be routed to the switch enclosure by means of a conduit riser with weatherhead. The sign service shall include cable, conduit riser and fittings, weatherhead, and other hardware necessary to complete the installation. A drip loop shall be formed into the cable. The weatherhead shall be of cast aluminum or galvanized ferrous metal and shall be of threaded design. The conduit shall be attached by straps as described in the foregoing paragraph.

Cable for sign service shall be 600 volts rated, single conductor and not smaller than Number 4 AWG.

631.07 Signs Wired. Signs wired shall complete the electrical system from the disconnect switch to the luminaires or fixtures and shall consist of wiring, connectors, junction boxes, rigid or flexible conduit, condulets, conduit clamps and miscellaneous hardware.

Wiring shall be continuous from the disconnect switch to a junction box mounted on the sign support or overpass structure. Installation of the junction box shall permit sign removal as a unit by the disconnection of the wires and the removal of sign attachment hardware. A junction box shall be installed for each sign. Wiring shall be continuous from the junction box to the first luminaire and continuous between additional luminaires.

Wire shall be 600 volts rated, single conductor and not smaller than Number 10 AWG.

Wire routing on overhead sign supports shall be from the disconnect switch enclosure through structural member interiors. Wire hanging within the interior of steel vertical members shall be supported by looping over the J-hook provided. After completion of wiring in the disconnect switch enclosure, the nipple in the enclosure back shall be sealed in accordance with 625.12.

Flexible or rigid conduit on the sign structure or lighting support arms shall be assembled with condulets and attached to structure by clamps located within 6 inches of each conduit end and separated by not more than 24 inches.

631.08 Disconnect Switch with Enclosure. Lighted signs shall be provided with a disconnect switch within a lockable, weatherproof enclosure. The switch shall be a

631.09

two-pole (minimum), single-throw, fused safety disconnect type, rated at 600 volts, 30 amperes with the fuse size as specified. A solid neutral bar shall be provided.

The enclosure shall be NEMA ICS 1-110.15 Type 4 with sufficient volume to accommodate an internal transformer when specified. Space for a chase nipple shall be available in the enclosure back. The hole for the nipple shall be field drilled through the enclosure and the nipple installed. Enclosures shall also have a 1/4 inch diameter weep hole located in the bottom surface.

Each enclosure shall be furnished with at least one padlock. Padlocks shall have a corrosion resistant body and a corrosion protected steel shackle. All padlocks for a project shall be keyed alike, and the Contractor shall obtain the appropriate master key number from the City.

631.09 Switch Enclosure Mounting Bracket Assembly. Bracket assemblies, when separately specified, shall be furnished and installed on existing overhead sign supports or on concrete structure and shall consist of all parts necessary for mounting an enclosure. Bracket assemblies shall be of steel galvanized in accordance with 711.02, or aluminum, and shall include two brackets, necessary field drilling and hardware.

631.10 Transformer. When fluorescent lighting is used and line voltages are other than 120 volts, a step-down transformer shall be installed in the disconnect switch enclosure. The transformer shall be of the single-phase dry type with 480/240 volt primary and 240/120 volt secondary at 60 hertz and shall be of the KVA rating specified.

631.11 Ballast. Ballasts for mercury vapor luminaires or fluorescent fixtures shall be located remotely in a position on the support pole or end frame. Ballast housings shall be weatherproof and of corrosion resistant materials.

631.12 Photoelectric Control. Photoelectric controls shall be furnished when sign lighting is fed by uncontrolled circuits.

631.13 Mercury Vapor Luminaire. Mercury vapor luminaires shall include a lamp of the wattage specified.

631.14 Fluorescent Fixture. Fluorescent fixtures shall include a lamp of the length and output type specified. Fixtures may be single or multiple mounted in a continuous row.

631.15 Electrical Signs.

(a) Changeable message signs shall consist of the following designs unless otherwise specified.

(1) limited message -- lamp type,

(2) unlimited message -- lamp type and
 (3) drum type. Line units of these types may be used as inserts in a panel sign, used singly, or grouped to provide a multiline sign.

(b) Internally illuminated signs shall be of the single or double faced type. The signs may be mounted by span wire, mast arm, pedestal top or pole type bracket arms. Suspended signs shall hang plumb and shall be properly oriented and locked in place.

(c) Sign flasher assemblies shall consist of a pair of flashing beacons and source of illumination for a sign face. Incandescent lamps shall be included. The sign, support and foundation are furnished under other items.

(d) School speed limit sign assemblies shall consist of a sign fitted with a pair of flashing beacons with or without an internally illuminated speed limit sign display unit and shall include equipment to operate and control the sign. Mounting parts and incandescent lamps shall also be included.

631.16 Removal, Storage or Re-erection of Sign Lighting Luminaires. Luminaires or fixtures for sign lighting and associated ballasts shall be carefully removed and stored on the project for salvage by the City or shall be re-erected elsewhere on the project. Luminaires to be re-erected shall be cleaned and restored to an operating condition, fitted with new lamp boots, relamped with the proper type and size lamp and provided with new hardware.

631.17 Inspection and Testing. Sign lighting systems and electrical signs shall meet all requirements of the ground, cable insulation, and performance tests specified in 625.21. Failure of lamps, ballasts and transformers during the performance test shall be corrected by replacement of the faulty component but will not require restart of the entire test period.

During the performance test, final adjustment shall be made to sign lateral position and aiming angles of luminaires or fixtures to eliminate excessive brightness and glare, and to obtain optimum sign face reflected brightness, uniformity of illumination, visibility and legibility, to the satisfaction of the Engineer.

When a low-voltage-tap transformer is used with fluorescent fixtures, measurement of the available line voltage and current shall be made for determination of the proper tap. The result shall be reported to the Engineer with the test information required under 625.22.

631.18 Method of Measurement. Measurement will be made for specific items, furnished and in place, complete and accepted, in accordance with the following:

Sign service shall be measured as complete units for each support, and will include conduit, fittings, cables, trenching and backfilling.

631.19

Signs wired will be measured as complete units of wiring for each individual sign, and will include junction boxes, rigid or flexible conduit, condulets, clamps, wires and miscellaneous hardware.

Disconnect switches with enclosure will be measured as the number of each, and will include field drilling, mounting hardware and padlocks.

Switch enclosure mounting bracket assemblies will be measured as the number of each, including two brackets, field drilling and hardware.

Mercury vapor luminaires will be measured as the number of each, and will include lamps and luminaire attachment hardware.

Fluorescent fixtures will be measured as the number of each, and will include lamps.

Changeable message signs will be measured as the number of each, and will include lamps, dimmer control and auxiliary components.

Internally illuminated signs will be measured as the number of each, and will include lamps, ballasts and support hardware.

Sign flasher assemblies will be measured as the number of each, and will include sign lighting fixtures, beacons, flasher control unit with enclosure, lamps, and mounting hardware.

School speed limit sign assemblies will be measured as the number of each, and will include sign, speed limit display, beacons, flasher control unit with enclosure, timer, lamps and attachment members.

Ballasts, transformers and photoelectric controls will be measured as the number of each. Remote ballasts will include a housing on the support and additional wiring required.

Removal of luminaires will be measured as the number of luminaires removed and stored or re-erected. Re-erection, when required, shall include cleaning, restoring, lamp boots, relamping and mounting hardware.

631.19 Basis of Payment. Quantities of specific items measured as provided above, in place, complete, tested and accepted, will be paid for under:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
631	Each	Sign service
631	Each	Signs wired
631	Each	Signs wired, overpass structure mounted
631	Each	Disconnect switch with enclosure, type
631	Each	Switch enclosure mounting bracket assembly
631	Each	Transformer, type_____

631	Each	Ballast, type _____
631	Each	Photoelectric control
631	Each	Mercury vapor luminaire, type _____, with _____ watt lamp
631	Each	Fluorescent fixture with type _____ lamp
631	Each	Changeable message sign ("limited message", "unlimited message" or "drum type")
631	Each	Internally illuminated sign, type _____
631	Each	Sign flasher assembly
631	Each	School speed limit sign assembly, type _____
631	Each	Removal of luminaire and ("storage or "re-erection")

ITEM 632 TRAFFIC SIGNAL EQUIPMENT

- 632.01 Description**
- 632.02 Contractor Personnel Requirements**
- 632.03 Materials and Equipment**
- 632.04 Certified Drawings**
- 632.05 General**
- 632.06 Vehicular Signal Head, Conventional**
- 632.07 Vehicular Signal Head, Optically Programmed**
- 632.08 Pedestrian Signal Head**
- 632.09 Pedestrian Pushbutton**
- 632.10 Loop Detector Unit**
- 632.11 Detector Loop**
- 632.12 Foundations**
- 632.13 Signal Support**
- 632.14 Strain Pole**
- 632.15 Wood Pole**
- 632.16 Down Guy Assembly**
- 632.17 Pedestal**
- 632.18 Conduit Riser**
- 632.19 Cable Support Assembly**
- 632.20 Messenger Wire**
- 632.21 Cable and Wire**
- 632.22 Power Service**
- 632.23 Covering of Vehicular Signal Heads**
- 632.24 Removal of Traffic Signal Installation**
- 632.25 Reuse of Traffic Signal Equipment**
- 632.26 Testing**
- 632.27 Pull Box**
- 632.28 Method of Measurement**
- 632.29 Basis of Payment**

632.01

632.01 Description. This work consists of furnishing and installing traffic signal equipment, complete and ready for service. This work also includes necessary excavation and backfill, disposal of discarded materials, restoration of disturbed facilities, and surfaces to a condition equal to that existing before the work started, and electrical testing as specified.

Pull boxes, conduits, ground rods, and cable splicing kits required for traffic signal equipment installations are specified in 625.

632.02 Contractor Personnel Requirements. Conform to the requirements of ODOT Supplement 1063 for the installation or testing of traffic signal equipment.

632.03 Materials and Equipment. Furnish new materials and equipment of first quality, of current design, and free from defects.

Use electrical parts, wire, switches, and other elements of the installations capable of carrying the required current without excessive heating or drop of potential.

Ensure that major items or assemblies of equipment bear a nameplate, indelible marking, or brand that identifies the type, model, catalog number, and manufacturer.

Furnish materials and equipment conforming to:

Concrete, Class C.....	499, 511
Steel*:	
Poles, supports, arms, appurtenances and anchor bases.....	730.02, 730.03, 730.04, 730.05, 730.06, 730.07, 732.11, 732.12
Pedestals.....	732.15
Bolts and nuts (High Strength)	711.09
Hardware	730.08
Stainless steel hardware.....	730.10
Other Items:	
Conduit, rigid	713.04
Ground rod	713.16
Pull boxes.....	713.08
Identifying tags or bands	713.18
Signal heads	732.01, 732.02, 732.03, 732.05
Lamps.....	732.04
Pushbuttons	732.06
Detectors	732.07, 732.08, 732.09
Probes.....	732.10
Wood poles.....	732.13
Down guys	732.14
Conduit risers	732.16
Cable supports	732.17
Messenger wire	732.18
Cable and wire.....	732.19
Power service	732.20
Disconnect Switch with enclosure.....	732.21

- * Acceptance of materials and products is based on certified test data, furnished in triplicate, or on test results of samples according 106.04, as required by the Laboratory.

Furnish vehicular signal lamps conforming to 732.04 and prequalified according to ODOT Supplement 1046.

632.04 Certified Drawings. Furnish certified drawings according to 625.04.

632.05 General. Ensure that major items of traffic signal equipment used in combination are compatible, interchangeable, and, whenever feasible, provided by the same manufacturer or supplier. Furnish electrical materials, equipment, and installations according to the National Electrical Code and the National Electrical Safety Code, and conform to local laws and codes.

Ensure that the traffic control equipment installed in controller cabinets are shop prewired according to a wiring diagram that conforms to plan and specification requirements of the specific project and intersection, and show all wire harness and field connections required, with abbreviations according to Table 632.05-1. Furnish a neat and legibly drawn wiring diagram, reproduced on durable paper, and place two copies in a plastic envelope fastened to the inside of the controller cabinet.

Identify cable and wire by tags or bands at pull boxes and controller cabinets, with size, material, and method of marking that conform to 713.18, except ensure that the identification on the tags or bands conforms to the wiring diagram with abbreviations according to Table 632.05-1. The Contractor may identify field wiring using an indelible pen on a plastic tag instead of embossed letters.

Use spade terminals for wiring connected at signal heads and the wiring connected at terminal blocks within controller cabinets. However, for incoming power wiring, use either spade terminals or bared conductor wire connected to terminal points utilizing screw or spring applied clamping surfaces compatible with both cooper and aluminum wire and providing a positive grip. Neatly lash and fasten completed wiring to interiors with clamps and/or ties.

Table 632.05-1 Table and Wire Identification

Cable	Tag
Ground	GND
Power (2 wire) 1Ø 120 volt	AC +AC- or CAN
Power (3 wire) 1Ø 120/240 volt	AC + 1
AC + 2	
Neutral wire	AC- or CAN
Phase A	Ø A
Phase 1	Ø 1
Phase 1 northbound left turn lanes	Ø 1 NBLT
Phase A, pedestrian signal	Ø A PD
Overlap, phase A + C	Ø A + C
Overlap, phase 1 + 6	Ø 1 + 6
Detector lead-in, phase A	DET A
Detector lead-in, phase 1	DET 1
Detector lead-in, phase 1 northbound left turn lanes	DET 1 NBLT
Detector lead-in, phase A (call type)	DET A CALL
Detector lead-in, phase 1 (call type) northbound thru lanes	DET 1 CALL NB-THRU
Detector harness ^[1]	DET A
Interconnect	IC
Pre-emption, fire	PE FIRE
Pre-emption, railroad	PE RR

[1] Place the tag next to the MS plug at the detector amplifier.

When constructing the traffic control system, cooperate with the agency supplying the electric service. Supply 120/240 volt, single-phase, three-wire (grounded neutral) power to the disconnect switch.

After completion of the 10-day performance test in compliance with 632.26 and until acceptance, the Contractor is responsible for the care and maintenance of traffic control equipment installed or reused as part of the Contract.

Upon acceptance of the project, transfer to the City of Akron all manufacturers' guarantees or warranties covering installed electrical or mechanical equipment. Furnish two copies of wiring diagrams, service manuals, and instructions on installation and maintenance for each different type, model, or system of equipment used on the project.

632.06 Vehicular Signal Head, Conventional. All signal heads shall be Federal yellow polycarbonate with tunnel hood and LED lenses in all faces. Furnish heads in arrangements such that from one to a maximum of five sections assembled with the specified lens size, color, and circular or arrow configuration form a specific signal face. Mount signal faces alone as a one-way head, or combined with additional faces to form a two-way, three-way, or a maximum of a four-way head.

Furnish multi-way heads with top and bottom brackets for mounting purposes. Fit faces of lesser height in multi-way heads with pipe spacers. Close openings unused for mounting purposes with weatherproof caps.

Signals shall be rigid-mounted using cable-style Astrobrac mountings of the appropriate size.

Orient each signal face to its traffic approach, and lock faces in place by the serrated or other type device incorporated in signal housing and support hardware.

Install LED lenses of the proper wattage in each section.

632.07 Vehicular Signal Head, Optically Programmed. Shall not be used in the City of Akron, Ohio.

632.08 Pedestrian Signal Head. Furnish heads with LED Hand\Person combination Type D2. Orient each signal head to its crosswalk, and lock heads in place by the serrated or other type device incorporated in signal housing and support hardware. Close openings unused for mounting purposes with weatherproof caps. Pedestrian signals shall be field rigid mounted by use of quick-disconnects.

632.09 Pedestrian Pushbutton. Properly orient and install pushbuttons on poles or pedestals. Service pushbuttons mounted on steel poles by wiring inside the poles. Furnish 3/4-inch (19 mm) diameter holes through the back of the housing and the pole wall, install a rubber grommet, and route wiring through until no external wiring is visible. Plug any unused conduit attachment holes. Attach the housing by machine or self-tapping screws in the housing back wall. Service pushbutton mounted on wooden poles through conduit. Furnish pedestrian pushbutton signs of the legend and size required. All pedestrian pushbutton installations shall conform to the latest ADA requirements.

632.10 Loop Detector Unit. Install and tune detector units to their loops with the sensitivity set for optimum operation and any interference or cross talk eliminated between other detector units in the cabinet. Perform a field check to ensure that no extraneous detections are occurring by observing each detector unit's operation to determine that a signal occurs only when a vehicle enters its associated loop. If actuations are observed when there is no vehicle in the loop, eliminate the extraneous detections.

632.11 Detector Loop. Saw slots in the pavement for installation of vehicle detector loop wire in the configuration, dimensions, and combinations required. Cut an extension from the loop to the pavement edge to allow wire routing to an adjacent pull box.

Furnish slots 1/16 to 1/8-inch wider than the outside diameter of the loop wire or tubing. Ensure that the slot depth provides a covering of not less than 3/4-inch above the uppermost detector wire tubing after the loop installation is completed. Before installing loop detector wire, brush and blow all slots clean of loose material and completely dry. Install loop detector wire according to 632.21.

Fill the slots completely with a flexible embedding sealant, prequalified according to ODOT Supplement 1048. Do not disturb slots until sealant has cured.

632.12

For loop detector wire installations in new asphalt, the Contractor may saw slots and embed sealant in a subsurface course with subsequent covering by the surface course, subject to the Engineer's approval.

632.12 Foundations. Locate support foundations, and stake with the proper elevation. If underground or overhead obstacles are encountered during stakeout, or to correct slope and subsurface difficulties, change foundation location and orientation with the approval of the Engineer. Ensure that the approved location provides a safe clearance from overhead power lines for construction operations, in compliance with the National Electric Safety Code. The Contractor is responsible for the correct location, elevation, and orientation for all poles and pedestals installed on the foundations.

Excavate for foundations using an earth auger to specified dimensions according to 503.04. Exercise caution when excavating in areas of underground installations to avoid their disturbance or damage. When a cave-in occurs, excavate using casing, sleeving, or other methods, with the Engineer's approval. If subsurface obstructions are encountered, remove the obstructions, or replace the excavated material and relocate the foundation, with the Engineer's approval. If bedrock is encountered, the Contractor may reduce that portion of the specified foundation depth within the bedrock up to 50 percent. Perform all necessary dewatering of the excavation.

Perform foundation concrete work according to 511, except that the loading restrictions in 511.14 are modified by this subsection. Place the concrete against undisturbed soil or compacted embankment. The top 12 inches of the foundations shall be formed and finished square per Traffic Engineering standard drawings.

Before placing foundation concrete for embedded supports, position and brace the supports with any necessary rake to ensure that the supports, after tensioning, assume an essentially vertical position. For foundations for anchor base type supports, provide the required reinforcing rods, and have anchor bolts and conduit ends accurately held by a template. All signal pole foundations shall have one 1" diameter, one 2" diameter, and one 3" diameter conduit installed unless otherwise specified on the plans.

Remove forms and templates once the concrete has hardened sufficiently so as not to be susceptible to damage. Remove bracing for embedded supports after 7 days. After 14 days, load embedded supports, and erect and load supports on anchor base foundations. The Contractor may erect and load supports after 7 days if the tests of two beam specimens of concrete yield an average modulus of rupture of not less than 650 pounds per square inch.

632.13 Signal Support. Furnish supports with mast arms with the required pole and arm length, anchor bolt circle diameter, and anchor bolt size. Signal poles and mast arms shall conform to 732.11, and shall be galvanized in accordance with 713.01 if specified on the plans.

Ensure that the combination signal supports with light pole extension provide for the attachment of a luminaire bracket arm.

Support designs shall conform to ODOT Construction Standard TC-81.20 or TC 12.30, unless otherwise specified on the plans.

Furnish individual anchor bolt covers or cover bases for poles erected in sidewalks, traffic islands, curbed areas, and seeded areas, or when directed by the Engineer. Do not use concrete grouting in the space between the foundation surface and support base.

Conform to the requirements of 630.06 for threaded fasteners, anchor bolts, anchor bolt nuts, and anaerobic adhesive.

632.14 Strain Pole. Furnish strain poles for the attachment of messenger wire with the required pole length. Use anchor base type strain poles unless the type for concrete embedment is specified. Poles shall conform to 732.12, and shall be galvanized in accordance with 713.01 unless otherwise specified on the plans.

Ensure that the combination strain poles with light pole extension provide for the attachment of a luminaire bracket arm.

Adjust anchor base type poles, and set embedded type poles with the initial rake so that when loaded the poles assume an essentially vertical position.

Conform to the requirements of 630.06 for threaded fasteners, anchor bolts, anchor bolt nuts, and anaerobic adhesive.

Furnish individual anchor bolt covers or cover bases under conditions as per 632.13.

632.15 Wood Pole. Set wood poles in holes excavated by an earth auger to a minimum depth of 6 feet. Use an auger with a diameter approximately 4 inches greater than the pole butt. Hold poles with initial rake, up to a maximum of 12 inches, while tamping backfill into place, so that under messenger wire tensioning conforming to 632.20, the poles assume an essentially vertical position. Furnish backfill material no greater than 1 inch in size, and thoroughly tamp material in lifts not exceeding 6 inches, to the satisfaction of the Engineer. If concrete embedment is specified, brace the poles until the concrete has set.

Liberally coat field holes bored for the attachment of messenger or guy wire with approved creosote base paint and fitted with 5/8-inch thimble-eye through-bolts and 3-inch washers. Securely attach and protect ground wire furnished as part of another work item with a wood or plastic molding for a minimum distance of 10 feet above groundline.

632.16 Down Guy Assembly. Install and tension guy assemblies before erecting signals such that they will resist the major portion of the horizontal loading caused by loading of the messenger wire.

632.17 Pedestal. Furnish pedestals for the support of traffic control equipment with a plate steel base, unless a transformer type base is specified.

632.18 Conduit Riser. Attach risers to poles to provide a wiring raceway and include a weatherhead, conduit, necessary fittings, and pole attached clamps. Attach risers to poles by clamps spaced at intervals not exceeding 5 feet. Paint conduit risers mounted on painted poles to match the poles.

632.19

632.19 Cable Support Assembly. Use cable support assemblies to eliminate strain on cables, or groups of cables up to a maximum of four, entering the interior of poles through a weatherhead or mast arm. If required, include a length of messenger wire forming a sling with ends formed of lapped wire, thimbles, and clamps as part of the assembly.

632.20 Messenger Wire. Arrange messenger wire with accessories between two or more poles to provide support and attachment for traffic control equipment. Accessories used with messenger wire include bullrings, thimbles, preformed guy grip dead ends, and three bolt clamps. Furnish bullrings at messenger wire network corners. Use thimbles to attach messenger wire to the shackles of strain pole clamps and bullrings.

Adjust the length of the messenger wire under the load of traffic control equipment so the sag at the lowest point is not greater than 5 percent or less than 3 percent of the span. Attach signal cable to messenger wire with lengths of preformed helical lashing rod that are of a proper internal diameter to tightly secure the cable to the messenger wire. Attach interconnect cable with preformed lashing rod or spinning wire.

632.21 Cable and Wire. Fashion cable at traffic signal equipment weatherhead entrance fittings into a drip loop that extends at least 6 inches below the entrance. Do not allow the cable to chafe on the equipment. Support cables installed in strain poles and signal supports with cable support assemblies according to 632.19.

Do not use splices in any cable or wire, except at the following locations:

- A. At the junction of detector wire and lead-in cable.
- B. At the junction of power cable and the power supply source or service cable.
- C. On long lengths of interconnect or service cable.

For splices allowed in aerial installations, accomplish splicing in weathertight splice enclosures. For splices allowed in underground installations, accomplish splicing in pull boxes or poles where the splice is encapsulated with poured waterproof epoxy insulation according to 713.15.

Install signal cable between signal heads and controller cabinets, and install interconnect cable between controller cabinets of different intersections. Route signal and interconnect cable by aerial installation supported by messenger wire or within underground conduit. If specified, use aerial self-supporting integral messenger type interconnect cable with a figure "8" cross-section and include pole clamps and splice enclosures. Ground the supporting messenger wire of interconnect cable.

Provide loop detector wire consisting of detector wire inserted into flexible plastic tubing. Ensure that the tubing encases the wire continuously from the splice at the lead-in cable, through the entire loop turns, and back to the splice. Install loop detector wire in sawn roadway slots forming loops according to 632.11. Furnish the required number of turns of wire installed for each loop, and push the wire carefully into the slots with a blunt tool to avoid damaging the tubing. Run the wire continuously around the loop perimeter and through a slot leading to the pavement

edge and by underground conduit to a roadside pull box or pole with 5 feet at each end for slack and splice. Uniformly twist wires and tubing installed from the loop to the splice with lead-in cable at 3 to 5 turns per foot. Splice the loop ends to lead-in cable, which are connected to the controller cabinet. Join the wires by a mutually twisted in-line splice, rosin core soldered, and wrapped in vinyl or equivalent electrical tape, and encapsulate wires with an approved poured waterproof epoxy insulated splice according to 713.15. Extend and seal the tubing ends into the poured epoxy splice. Also, solder crimped terminals to the conductors and the shield for connections inside the cabinet.

For magnetometer sensor probe installations, splice the leads from the probes to the specified lead-in cable by the same method. Route lead-in cable within underground conduit or by aerial installation supported by messenger wire.

Install power cable from the power supply source to the controller cabinet. If multi-conductor power cable is specified, the Contractor may substitute multiple single conductors.

Install service cable aerially from a remote power source to the vicinity of the controller cabinet with the support cable functioning as the electrical neutral. Furnish connections used with aluminum power or service cable of an approved type for aluminum to aluminum or aluminum to copper connections, and insulate connections with an approved vinyl mastic pad.

Where called for on the plans, traffic signal interconnect cables shall be single-mode fiber optic cable as specified in ODOT Supplemental Specification 904.

632.22 Power Service. Furnish and install all equipment necessary to provide complete electrical service to each signal installation as shown on the plans. Make all necessary arrangements with the local electrical power company for connections to establish electrical service. The City of Akron will reimburse the Contractor by Supplemental Agreement for power company fees for establishment of service and electricity. This compensation is for invoiced cost without mark up.

Power service consists of equipment to provide a pole attached wiring raceway with power cable routed from the service entrance to the controller cabinet. The power service installation includes a weatherhead, conduit and fittings, and attachment clamps.

Bend the conduit away from the pole at the top and bottom of the riser to allow the conduit to enter straight into the enclosure, and to provide space for the weatherhead when the riser is pulled tight against the pole. Furnish watertight conduit connections to the enclosure by using conduit hubs listed on the enclosure UL label.

Paint conduit risers mounted on painted poles to match the poles.

632.23 Covering of Vehicular Signal Heads. Cover vehicular signal heads if erected at intersections where traffic is maintained before energizing the signals. Use a sturdy opaque covering material and method of covering and cover attachment as approved by the Engineer. Maintain covers, and remove them when directed by the Engineer.

632.24 Removal of Traffic Signal Installation. Remove signal heads, cable, messenger wire, strain poles, cabinet, controller, or other incidental items required by the Engineer. Remove support foundations to at least 1-foot below subgrade or finished groundline. Backfill, restore surfaces, and dispose of surplus material according to 203. Store removed items on the project for salvage by the City of Akron Traffic Engineering Division, or reuse removed items as part of a new installation on the project under another item of work. Contact the City of Akron Traffic Engineering Division to arrange pickup of salvaged items. Dispose of all items not designated for salvage or reuse. As specified in 614.03, do not remove signals until a new signal system or a temporary traffic control method approved by the Engineer is in operation. Suitably protect stored equipment.

632.25 Reuse of Traffic Signal Equipment. Reinstall or re-erect specified traffic equipment, removed from existing signal installations within the project. Clean and restore reused equipment to an operating condition, and relamp signals with the proper type and size lamp. Furnish all additional hardware and incidentals necessary to allow reuse of the equipment.

632.26 Testing.

A. General. Furnish all personnel and equipment required to successfully perform the following tests, and furnish to the Engineer six certified copies of complete test records, test reporting forms supplied by the Engineer, or alternate certification approved by the Engineer.

B. Ground Test. Measure each ground rod for earth resistance according to 625.21, except that measurements are not necessary immediately after installation.

C. Short-Circuit Test. Before performing any cable insulation tests or performance test, perform a short-circuit test with a volt-ohmmeter or other approved instrument. Conduct short-circuit tests with electrical loads, power sources, equipment grounds, and earth grounds disconnected. Test signal cable routed to signal heads with connections made to lamp sockets without lamps installed. Measure each conductor against every other conductor and ground to ensure that no short-circuits, cross-circuits, or other improper connections exist. Ensure that continuity does not exist between any conductor and another conductor including ground.

D. Circuit Continuity Test. Temporarily jumper each circuit branch at its termination and the temporarily looped circuit measured for continuity to ensure that no open circuits exist, that the circuit branch is according to plan, that no high resistance connections exist, and that each circuit is properly identified. Test the lead-in cable for loop detector wire before and after splicing the cable to the loop wire. As an alternative, perform the circuit continuity testing of signal head cable by applying 120 volts to each outgoing circuit and observing that only the proper lamps are lighted.

E. Cable Insulation Test. Ensure that the insulation resistance measured to ground is not less than 10 megohms for each conductor of cable or wire terminating at the controller cabinet. Perform insulation testing with all conductors disconnected from their points on the terminal blocks. Measure insulation resistance for the wire

of roadway loops after the embedding of the wire with sealant in slots. Include a list of the resistance readings for each conductor in the test results. After completing the cable insulation test, connect all cabinet wiring according to the wiring diagram. Demonstrate to the satisfaction of the Engineer that all circuits are continuous and operating correctly with freedom from shorts, crosses, and unintentional grounds.

F. Functional Test. Before the 10-day performance test begins, make the following checks and demonstrate to the Engineer that the system is ready for the performance test. Ensure that the incoming AC voltage is a nominal 120 volts. If the supplied voltage under load is less than 100 or more than 130 VAC, contact the power company to arrange correction. Ensure that the cabinet ventilating fan, fan thermostat, and convenience outlet with lamp is operational. Correct timing settings on the controller as shown on the plans. Check all cabinet switches including the power on/off switch and flash switch. Check all controller functions to verify correct operation. Check the detector units to determine which pavement loop is associated with which detector unit. Check the visual indication of detector units to determine that each vehicle class (truck, car, or motorcycle) entering sensor areas is detected on the associated detector unit and that no extraneous calls occur when the sensor area is vacant. Check the flash switch to verify transfer of signal operation to flash and return to stop-and-go. Check the conflict monitor to verify that it is not activated by normal signal operations or by the manipulation of cabinet switches. If the monitor is activated, determine the cause of the problem and make appropriate changes and adjustments before beginning the performance test. Test the conflict monitor by artificially causing a number of different conflicting indications, and verify that at each test the monitor causes the signals to begin flashing and places the controller in a “stop timing” mode. Obtain artificial causation either by touching a jumper wire between two conflicting load switch outputs or by other methods approved by the Engineer. Ensure that the signal flashes when the monitor is disconnected.

G. Performance Test. At least 7 days before the performance test begins, notify the Engineer of the starting date. The Engineer will notify the maintaining agency. Before acceptance, operate the traffic control system continuously for 10 consecutive days without major malfunction or failure. Immediately replace or repair minor failures (such as lamps, a single detector unit, or an individual signal head, etc.) that do not cause restart of the test. Major malfunctions or failures (such as a master or local controller, interconnect equipment, etc.) will cause termination of the test and, after replacement or repair, the beginning of a new 10-day test. Monitor items that have been repaired or that are replacements for a 10-day period to provide assurance of their reliability. Record, for inclusion in the test result, the method and date of correction of each fault, and the beginning and end of the test.

632.27 Pull Box. Pull boxes shall be of the size specified on the plans, and shall be reinforced polymer concrete type with a bolted 20,000 lb. capacity lid, and shall be located where designated on the plans. Excavation shall be performed as nearly as practical to the outside dimensions of the pull box. After boxes are set to proper grade on a 6” min. thick bed of crushed limestone, excavated spaces around the boxes shall be backfilled with suitable material placed and compacted in thin layers. Pull boxes shall include all excavation, backfilling, grading, crushed limestone

drainage fill, ground rod, and ground wire lead. Pull boxes shall be manufactured by Oldcastle Precast and shall display the legend "TRAFFIC" or "TRAFFIC SIGNAL" on the lid.

632.28 Method of Measurement. The City of Akron will measure Vehicular Signal Head and Pedestrian Signal Head by the number of complete units, and will include all support or mounting hardware, disconnect hangers, closure caps, dimmers, and lamps or gas-filled grids as required.

The City of Akron will measure Pedestrian Pushbutton by the number of individual units, and will include pedestrian pushbutton signs.

The City of Akron will measure Loop Detector Unit by the number of individual units, adjusted and tuned, and will include a wiring harness. If multi-channel detector units are used, the City of Akron will consider each channel as an individual detector unit up to the number of units specified.

The City of Akron will measure Detector Loop by the number of complete detector loops installed in the pavement, and will include pavement cutting, loop detector wire with tubing in place, application of sealant, conduit, trenching, backfilling, and surface restoration from the edge of pavement to the pull box.

The City of Akron will measure Strain Pole Foundation, Signal Support Foundation, and Pedestal Foundation by the number of complete units, and will include excavation, dewatering, sleeving, casing, reinforcing steel, concrete, backfilling, disposal of surplus excavation, and installation only of anchor bolts and conduit ells.

The City of Akron will measure Signal Support, Combination Signal Support, Strain Pole, Combination Strain Pole, Strain Pole Embedded, Combination Strain Pole Embedded, Wood Pole, and Pedestal by the number of complete units of each, and will include pole arms, weather-heads and blind half couplings, anchor bolts and conduit ells furnished for foundations, and required individual anchor bolt covers or cover bases.

The City of Akron will measure Down Guy by the number of individual units, and will include messenger wire, pole clamp or thru-bolt, washer, clamps, guy grips, insulator, guy guard, and anchor.

The City of Akron will measure Conduit Riser by the number of complete units, and will include weatherhead, conduit, fittings, clamps, and hardware.

The City of Akron will measure Messenger Wire by the number of feet in place, and will include all necessary accessories such as, grips, thimbles, clamps, bullrings, and lashing rod. The City of Akron will measure from pole center to pole center, or pole center to bullring, or bullring to bullring. The City of Akron will not measure any length of messenger wire for attachment to poles, or bullrings by bending, lapping, or wrapping.

The City of Akron will measure Signal Cable, Interconnect Cable, Loop Detector Lead-In Cable, Magnetometer Lead-In Cable, Power Cable, and Service Cable by the number of feet (meters) in place. Cable inside of poles shall include cable

support assemblies. Aerial cable shall include pole attachment hardware, splices, splice enclosures, and ground connection. Lead-in cable shall include poured epoxy insulated splices. The City of Akron will measure: (1) horizontally from center-to-center of pull boxes, poles, cabinets, power sources, and signal heads with an additional allowance of 5 feet at each pull box and terminating points for slack and connections; and (2) vertically between pole or conduit outlets. If single-conductor power cable is substituted for multi-conductor cable, the City of Akron will measure required length of multi-conductor cable.

The City of Akron will measure Power Service by the number of complete units, and will include weatherhead, conduit, fittings, clamps and other necessary hardware.

The City of Akron will measure Covering of Vehicular Signal Head by the number of individual signal heads covered, and will include materials and labor to erect, maintain, and remove the covering.

The City of Akron will measure Removal of Traffic Signal Installation by the number of installations removed, and will include storage when required.

The City of Akron will measure Removal of (*Item*) and (*Storage or Reerection*) by the number of specific traffic signal installation parts (such as a signal head, controller unit, or pole) removed, and will include storage when required.

The City of Akron will measure Reuse of (*Item*) by the number of traffic signal equipment items reused, and will include cleaning, restoring, and relamping.

632.29 Basis of Payment. The costs to arrange service by the supply agency are included under Power Cable.

The costs of personnel, materials, equipment, electrical energy, and incidentals required to conduct performance tests are included under the contract unit price for the respective items tested.

The City of Akron will pay for accepted quantities at the contract prices as follows:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
632	Each	Vehicular Signal Head, ___-Section ___ inch Lens ___-Way
632	Each	Pedestrian Signal Head, Type ___
632	Each	Pedestrian Pushbutton
632	Each	Loop Detector Unit
632	Each	Detector Loop
632	Each	Pull box, ___"x___"x___" Reinforced Polymer Concrete
632	Each	Strain Pole Foundation
632	Each	Signal Support Foundation
632	Each	Pedestal Foundation
632	Each	Signal Support, Type TC-___, Design ___
632	Each	Combination Signal Support, Type TC-___, Design ___
632	Each	Strain Pole, Type TC-___, Design ___
632	Each	Combination Strain Pole, Type TC-___, Design ___
632	Each	Strain Pole Embedded, Type TC-___, Design ___

633.01

632	Each	Combination Strain Pole Embedded, Type TC-____, Design ____
632	Each	Wood Pole, Class ____, (<i>Length</i>)__ feet
632	Each	Down Guy
632	Each	Pedestal, (<i>Length</i>) __ feet
632	Each	Pedestal, (<i>Length</i>) __ feet ,Transformer Base
632	Each	Conduit Riser, __ inch Dia.
632	Foot	Messenger Wire, (<i>No.</i>)Strand __ inch Dia., with Accessories
632	Foot	Signal Cable, __- Conductor No. __ AWG
632	Foot	Interconnect Cable, __- Conductor No. __ AWG
632	Foot	Interconnect Cable, Integral Messenger Wire Type, __- Conductor No. __ AWG
632	Foot	Loop Detector Lead-In Cable
632	Foot	Power Cable, __- Conductor No. __ AWG
632	Foot	Service Cable, __- Conductor No. __ AWG
632	Each	Power Service
632	Each	Covering of Vehicular Signal Head
632	Each	Removal of Traffic Signal Installation
632	Each	Removal of (<i>Item</i>) and (<i>Storage Or Reerection</i>)
632	Each	Reuse of (<i>Item</i>)

ITEM 633 TRAFFIC SIGNAL CONTROLLERS

633.01 Description

633.02 Contractor Personnel Requirements

633.03 Materials and Equipment

633.04 Certified Drawings

633.05 General

633.06 Testing and Prequalification

633.07 Controllers

633.08 Cabinets

633.09 Cabinet Riser

633.10 Foundations

633.11 Controller Work Pad

633.12 Flasher Controller

633.13 Controller, Master, Traffic Responsive

633.14 Remote Monitoring Station

633.15 Telephone Service

633.16 Training

633.17 System Analysis

633.18 Method of Measurement

633.19 Basis of Payment

633.01 Description. This work consists of furnishing and installing traffic signal control equipment, including controllers, cabinets, auxiliary equipment, and

specified accessories, completely wired, at the locations shown on the plans and ready for service.

633.02 Contractor Personnel Requirements. Conform to the requirements of ODOT Supplement 1063 for the installation or testing of traffic signal equipment.

633.03 Materials and Equipment. Furnish new materials and equipment of first quality, of current design, and free from defects.

Use electrical parts, wire, switches, and other elements of the installation capable of carrying the required current without excessive heating or drop of potential.

Ensure that each item of equipment bears a nameplate, indelible marking, or brand that identifies the type, model, catalog number, and manufacturer. Use equipment conforming to the types, models, and systems specified.

Furnish material and equipment conforming to:

Concrete (cabinet foundations and work pads)	499, 511
Conduit.....	713.04, 713.07
Controller unit.....	733.02
Cabinet and auxiliary equipment.....	733.03
Cabinet riser	733.04
Flasher controller	733.05
Controller, master, traffic responsive	733.06
Remote monitoring station.....	733.07
Telephone service	733.08

633.04 Certified Drawings. Furnish certified drawings according to 625.04.

633.05 General. Ensure that major items of traffic signal control equipment used in combination are compatible, interchangeable, and, whenever feasible, provided by the same manufacturer or supplier.

Ensure that controller cabinets are shop prewired according to 632.05.

Before starting installation, furnish to the Engineer, two copies of each cabinet wiring diagram, service manuals, and installation and maintenance instructions for each installation, including all components and interconnections. Supply one additional copy of the cabinet wiring diagrams in a clear plastic pouch fastened to the inside of the controller door. Before beginning the 10-day performance test, replace or modify these documents as necessary to reflect current conditions. Upon completion of the work and before its acceptance, replace or modify the documents as necessary.

Transfer manufacturers' guarantees or warranties on all installed traffic signal control equipment to the maintaining agency upon completion and acceptance of the project.

If required by the plans to install equipment furnished by others, store and care of the equipment upon receipt.

633.06 Testing and Prequalification. For all traffic control equipment, perform functional tests and a 10-day performance test according to 632.26. Do not clear conflict monitor logs during the 10-day test. Ensure that logs note power-up to start

633.07

the test and all events until the test is complete. Restart the test upon correcting a noted event. Notify the Engineer at least 3 days before beginning the 10-day performance test. The Engineer will notify the maintaining agency of the beginning of the test. Ensure that the following testing and prequalification requirements are met:

A. For traffic control equipment required by this specification to meet NEMA Standards Publication TS-1 or TS-2/NTCIP, conform to the following:

1. Furnish a certified test report indicating compliance to all requirements of NEMA Standards Publication TS-1 or TS-2/NTCIP as applicable.
2. Furnish the name and location of the laboratory testing facility as well as the identification of the principal personnel who conducted the equipment testing and a summary of their qualifications.
3. Ensure that the laboratory provides City of Akron representatives access to those parts of the laboratory where the testing was done.
4. Upon request, furnish a copy of the actual test data results for review and analysis.

B. For traffic control equipment required by this specification to meet CalTrans specifications, use a product or manufacturer as stated in this specification that is listed on the CalTrans Qualified Products List.

633.07 Controllers. Install controller units, consisting of the timing unit, software, and signal timing, into the specified type of prewired cabinet.

Program controller units as shown on the plans unless otherwise directed by the Engineer. If the plan timing data or the supplemental timing data supplied by the Engineer does not exactly fulfill the timing requirements of the installed equipment, notify, in writing, the Engineer of the problem and identify the discrepancies. The Engineer will consult with the maintaining agency and notify the Contractor within 2 weeks. After programming, briefly operate controllers, with the signals turned off by means of the signal shutdown switch, to ensure that operation is reasonable and conforms to the plans.

If the plans show two or more intersection controllers operated in a progressive signal system, coordinate signals by relating the various controller cycle start times to a zero time base, or other cycle start time at an adjacent signalized intersection. Ensure that the controller unit software provides coordination capability to allow associated controllers to be operated within the progressive traffic system. Coordination equipment shall supervise the operation of its associated controller by causing the end of certain phases and the beginning of the following phases to occur at set points. Program coordination timing according to the coordination timing data shown on the plans or provided by the Engineer.

633.08 Cabinets. Mount cabinets by attaching to pedestal or pole or by installing on a concrete foundation. Arrange foundation mounted cabinets so that control equipment, terminal blocks, or shelves are no closer than 6 inches to the top of the foundation and at least 18 inches from the ground line or sidewalk level.

Attach pole or pedestal mounted controller cabinets at a height that allows convenient access to all controller components by service personnel.

Make field connections for the conductors of signal cable, power cable, interconnect cable, and detector lead-in cable. Connect conductors so the outgoing traffic signal circuits are of the same polarity as the line side of the power supply. For traffic signal circuit common return, use the same polarity as the grounded side of the power supply. Ground the grounded side of the power supply to the cabinet in an approved manner. Neatly arrange and route all field wiring to the appropriate terminal blocks. Identify field wiring according to 713.18 except mark with either indelible pen or embossed letters.

Except for power wiring, fit field wiring entering the cabinet with spade terminals to ensure a good connection. For incoming power wiring, either use spade terminals or connect the bare conductor wire to terminal points utilizing screw or spring applied clamping surfaces compatible with either copper or aluminum wire and providing a positive grip. After completing field wiring, seal the conduit entering the cabinet in an approved manner with a removable sealing compound (no foam sealants), or a molded plastic or rubber device that is compatible with the cable jacket, the insulation, and the conduit material.

For foundation mounted cabinets, seal the joint between the controller cabinet and the foundation with a quality, clear silicon caulk.

633.09 Cabinet Riser. Cabinet risers provide an extension of the cabinet between the ground mounted cabinet and the foundation. Bolt the riser to the foundation, and bolt the cabinet to the riser.

Use a type (size and shape) of cabinet riser compatible with the type of controller cabinets specified for the project.

Seal the joints between the controller cabinet and cabinet riser, and between the cabinet riser and foundation with a quality, clear silicon caulk.

633.10 Foundations. Construct foundations for controller cabinets according to 632.12, except that excavation by earth auger is not required and the foundation does not require reinforcing steel. Controller foundations shall be formed using the Traffic Engineering Division standard form, available from the Traffic Engineering Division. All foundations shall have two 3" diameter conduits for signal cable, one 2" diameter conduit for source, and one 1" diameter conduit for ground wire. Anchor bolts, conduit ells, and similar appurtenances in the proper position until the concrete has set.

633.11 Controller Work Pad. Construct controller work pad according to 456.03, except that transverse joints are not required. Provide the top of the pad nominally 1 inch above ground line. If the controller cabinet has both front and back doors, the work pad shall encompass three sides of the cabinet foundation to include the non-hinged cabinet door side of the foundation.

633.12 Flasher Controller. Furnish and install a flasher controller with cabinet and mounting hardware when indicated. The flasher controller is for the operation of flashing beacons.

633.13

633.13 Controller, Master, Traffic Responsive. The traffic responsive master controller supervises and controls the operation of an interconnected system of local controllers. Ensure that the master controller is able to communicate with a remote monitoring station. Locate this master controller in a local intersection controller cabinet unless otherwise shown on plans. If the local controller cabinet size is not sufficient to accommodate the master controller and its associated wiring, furnish the proper size cabinet for the local intersection controller to house the local controller, master controller, modem, and all auxiliary devices.

633.14 Remote Monitoring Station. Install, test, and operate the remote monitoring station, consisting of computer equipment, communications equipment, and software, in one or more locations in the maintaining agency's facilities as shown on the plans. The maintaining agency shall furnish telephone service at these stations.

633.15 Telephone Service. Make arrangements with the local telephone company to have telephone service furnished to intersection cabinet locations shown on the plans. Maintain the telephone account until the signal system has been tested and accepted by the Engineer. After acceptance of the signal system, transfer the telephone account to the maintaining agency.

Furnish and install a minimum size 1-inch conduit, twisted pair, shielded telephone cable, and conduit risers necessary to bring the telephone line from the telephone company service location into the controller cabinet. Furnish and install the modem and the lightning protection for the telephone lines in the controller cabinet.

633.16 Training. Furnish training for the traffic signal control equipment installed as part of the Contract. Furnish all handouts, manuals, and product information. For the training, use the same models of equipment furnished for the project. The maintaining agency shall furnish the facilities in which the training will take place. Furnish all media and test equipment needed to present the training. Unless otherwise shown on the plans, the minimum training requirements are as follows:

- A. Sixteen hours on how to operate the system, analyze system performance, and revise critical operating parameters.
- B. Eight hours of field trouble-shooting and maintenance procedures.
- C. Eight hours of follow-up training after the maintaining agency has operated the system for a minimum period of 30 days.
- D. Four hours for preemption device training if emergency vehicle preemption is shown on the plans.

633.17 System Analysis.

A. General. Prepare signal timing and traffic progression programs, load the programs into the signal system, evaluate the performance of the system, and refine the programs as necessary to optimize traffic flow and operation. Collect and evaluate traffic data, analyze traffic signal progression and timing, develop traffic adjusted pattern selection parameters, perform the system evaluation and refine the

system operation, and prepare and submit a summary report for review and approval by the Engineer.

If a project contains individual sub-systems that are connected to the remote monitoring station, perform all work as outlined in this subsection for each sub-system. If required, analyze signal “sub-systems” together and coordinate traffic progression programs to optimize the overall traffic flow between the various sub-systems.

Optimize only the cycle lengths, phase splits, permissives, and offsets without changing the actual controller phasing provided in the plan.

B. Systems Engineer or Technician. Employ a systems engineer or technician to perform the work required by this subsection and submit to the Engineer for approval three copies of a resume documenting the following qualifications:

1. A minimum of 5 years experience in traffic engineering or traffic engineering technology.
2. The systems engineer or technician’s education including training in traffic engineering technology and signal system design.
3. The systems engineer or technician’s familiarity with the closed loop system installed and experience in setting up and fine tuning a system of that type. Furnish a list of other closed loop systems that the systems engineer or technician has programmed into the traffic responsive mode for documentation purposes.

Also, submit to the Engineer for approval a brief description of proposed methodology of data collection and analysis of:

- a. System parameter usage in system evaluation.
- b. Frequency and measurement of travel time and delay.
- c. Comparison of actual versus system measurements of delays (level of service).

The systems engineer or technician, under authority of the Contractor, is responsible for the operation of the system from the completion of the signal system acceptance until completion and acceptance of the final summary report by the Engineer. The systems engineer or technician shall provide a 24-hour emergency phone number and shall respond to system related problems as deemed necessary by the Engineer 24 hours a day, 7 days a week. If there is a guarantee period, the Engineer reserves the right to request a systems analysis throughout the entire duration of this period, if new or continuing problems occur with the operation of the traffic responsive system.

The Engineer reserves the right to request that the Contractor furnish a new systems engineer or technician if the current systems engineer or technician fails to perform the required duties in a timely and professional manner or fails to have a firm understanding of the operation and programming of the closed loop system constructed.

C. Traffic Programs. The systems engineer or technician shall develop signal progression and timing programs from count and occupancy data obtained from the

local intersection and system loop detectors, supplemented by field counts and measurements as required. The systems engineer or technician shall develop the following signal progression programs and parameters:

1. Three inbound preferential (a.m. peak).
2. Three outbound preferential (p.m. peak).
3. Three average (off peak).

The three average programs should utilize varying cycle lengths based on traffic volume, density, and occupancy to minimize overall intersection approach delay time.

4. Two special programs for either high congestion or queue backup.
5. A minimum of three timing plans for a back up time base coordinated system. The systems engineer or technician shall program the timing plans into the system, to supplement the timing plans shown on the plans.

6. Define system parameters that enable the system to automatically transfer into a “free operation” mode during light traffic volume periods and to automatically transfer to a computer selected coordinated mode during heavy traffic volume periods. The systems engineer or technician shall establish the following system parameters:

- a. Volume, occupancy and directionality thresholds.
- b. Transition smoothing factors.
- c. System detector assignment.
- d. System detector weighting.

The systems engineer or technician may use the software provided with the remote monitoring station to help assist in the analysis of the operation of the closed loop system.

D. System Travel Time Studies. The systems engineer or technician shall conduct a series of travel time studies for each system or sub-system artery constructed as part of the project, to measure the time it takes to travel from 0.25 mile in advance of the beginning of each system or sub-system to 0.25 mile (0.4 km) after the end of that system or sub-system, in each direction. Ensure that the travel time study parameters are based on the posted speed limit; however, be aware that during peak periods it may not be possible to obtain the posted speed due to larger traffic volumes.

The systems engineer or technician shall conduct four separate sets of travel time studies for each of the following field conditions:

1. Before beginning construction, with the existing signal system in operation (no lane closures shall be in effect during this analysis).
2. Before implementing the traffic responsive mode, while the new traffic signal system is operating under the “time of day” mode (as is shown on the plans).

3. After placing the system(s) in the traffic responsive mode.
4. After the system operation meeting and making final system adjustments.

Each set of travel time studies shall include a minimum of five runs through the system per direction. The systems engineer or technician shall conduct travel time studies during good weather conditions (i.e., no snow, rain, or fog). The Engineer may omit the pre-construction travel time studies if the project includes substantial changes to the roadway geometrics (i.e., roadway widening, reconfiguring of pavement markings, etc.) that would affect the results of a comparison of the level of improvement over preexisting conditions.

The four separate sets of travel time studies shall include the following:

1. Conduct the first set of travel time studies between the hours of 7:00 a.m. and 9:00 a.m. on weekdays.
2. Conduct the second set of travel time studies between the hours of 11:30 a.m. and 1:00 p.m. weekdays.
3. Conduct the third set of travel time studies between the hours of 4:00 p.m. and 6:00 p.m. weekdays.
4. Conduct the fourth set of travel time studies during any of the following non-peak hour periods:
 - a. 9:00 a.m. to 11:00 a.m. Monday through Saturday.
 - b. 7:00 p.m. to 10:00 p.m. Monday through Saturday.
 - c. 7:00 a.m. to 10:00 p.m. Sunday.

The systems engineer or technician shall furnish a written report documenting, at a minimum, the date of travel time study, day of week, time of day, total time of travel, and total time the vehicle was stopped for each trip.

The systems engineer or technician shall use the reports furnished from each of the four field conditions for which system travel time studies are prepared as one means of measuring the efficiency of the new system.

E. Draft System Summary Report. The systems engineer or technician shall prepare a draft system summary report after travel time studies for the first three field conditions are performed. Submit two copies each to the Engineer and the maintaining agency(s) of the signal system for the evaluation and review of the system programming, operation, and efficiency.

The report shall summarize the signal progression and timing programs that were entered into the system. The report shall also include a copy of the systems log after operating in the traffic responsive mode to verify the number of programs used throughout the day as well as the frequency of program changes. The systems engineer or technician shall provide a minimum of at least 4 days of systems logs. The systems engineer or technician shall limit three of the four logs to the weekdays of Monday through Friday; the fourth log shall be on a Sunday. The systems engineer or technician shall include copies of all data and analysis calculations for the system timing in the report. The draft system summary report shall include an

633.18

evaluation of the system operation, efficiency, and performance and copies of all travel time study data.

F. System Operation Meeting and Final System Summary Report. After the draft system summary report has been submitted, the Engineer will schedule a meeting that includes the systems engineer or technician, the Contractor, the Engineer, and representative(s) from the maintaining agency(s) to discuss the operation of the traffic responsive closed loop signal system. This meeting shall occur within 4 weeks after the draft system summary report has been submitted to the Engineer and maintaining agency(s).

The purpose of this meeting is to discuss the operation of the traffic responsive closed loop signal system and to receive comments and recommendations from the Engineer and/or the maintaining agency(s) regarding potential modifications to the operation of the system. The systems engineer or technician shall answer questions regarding the system summary report as well as the operation of the closed loop system.

The systems engineer or technician shall make final adjustments to the system as directed by the Engineer to address any concerns discussed at this meeting. The systems engineer or technician shall perform the final travel time study before submitting the final report. The systems engineer or technician shall submit one copy of a final system summary report to the Engineer and one additional copy for each maintaining agency for review and approval. The final report shall include any revisions to the draft report that are required as a result of the system operation meeting.

633.18 Method of Measurement. The City of Akron will measure Controller Unit, Type ____, with Cabinet, Type ____ by the number of each complete unit, and will include controller unit with software, all required auxiliary equipment, loop detector units, and a prewired cabinet, with all items completely wired and tested. Ground mounted cabinets will include anchor bolts and conduit ells for installation in the foundation. Pole mounted cabinets will include pole mounting hardware.

The City of Akron will measure Controller Unit, Type ____ by the number of each controller timing unit with software, and will include any signal timing programming or installation. The City of Akron will measure Controller Unit, Type ____, Furnish Only by the number of each controller timing unit with software, and will exclude any signal timing programming or installation.

The City of Akron will measure Cabinet, Type ____ by the number of each complete prewired cabinet installed, and will include all required auxiliary equipment and loop detector units (excluding controller unit), with all items completely wired and tested. Ground mounted cabinets will include anchor bolts and conduit ells for installation in the foundation. Pole mounted cabinets will include pole mounting hardware. The City of Akron will measure Cabinet, Type ____, Furnish Only by the number of each complete prewired cabinet, and will include pole mounting hardware and anchor bolts, but will exclude installation, controller unit, and detector units.

The City of Akron will measure Cabinet Riser by the number of each unit, and will include materials, mounting hardware, and installation.

The City of Akron will measure Cabinet Foundation and Controller Work Pad by the number of each complete unit, in place, complete and accepted, and will include excavation, concrete, backfilling, and disposal of surplus excavation. One complete Controller Work Pad unit may encompass several sides of a controller cabinet installation.

The City of Akron will measure Flasher Controller by the number of each complete flasher assembly with cabinet installed and tested.

The City of Akron will measure Controller, Master, Traffic Responsive by the number of each unit, and will include installation, signal system software, programming, and any increase in cabinet size to house the master controller in the local intersection cabinet. The City of Akron will measure Controller, Master, Traffic Responsive, Furnish Only by the number of each unit, and will include software, but exclude any programming or installation.

The City of Akron will measure Remote Monitoring Station by the number of each location shown on the plans, and will include all equipment, testing, and software.

The City of Akron will measure Telephone Service by the number of each location shown on the plans for furnishing telephone service to an intersection controller, and will include the modem, conduit, trenching, and wiring.

The City of Akron will measure Training on a lump sum basis, and will include providing the instruction materials, instructor travel expenses, and test or media equipment for presenting the training material.

The City of Akron will measure System Analysis on a lump sum basis, and will include providing all materials, labor, software, printing reports, and incidentals to analyze all traffic responsive sub-systems included in the project.

633.19 Basis of Payment. If a project contains individual sub-systems that are connected to the remote monitoring station, the cost for performing work, as specified in 633.17 is incidental to the bid item price for System Analysis.

The costs to obtain and maintain telephone service by the supply agency are included under Telephone Service.

The City of Akron will pay for accepted quantities at the contract unit prices as follows:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
633	Each	Controller Unit, Type ____, with Cabinet, Type ____
633	Each	Controller Unit, Type ____
633	Each	Controller Unit, Type ____, Furnish Only
633	Each	Cabinet, Type ____
633	Each	Cabinet, Type ____, Furnish Only
633	Each	Cabinet Riser
633	Each	Cabinet Foundation

633.19

633	Each	Controller Work Pad
633	Each	Flasher Controller
633	Each	Controller, Master, Traffic Responsive
633	Each	Controller, Master, Traffic Responsive, Furnish Only
633	Each	Remote Monitoring Station
633	Each	Telephone Service
633	Lump	Training
633	Lump	System Analysis