Department of Public Works Nassau County, N.Y.
Beech St. Roadway Improvements
Bid Sheets for Contract: H60045-04G

Item No.	Engineers Estimate	Unit	Item Description			
2	6,414	CY	Unclassiffied Excavation	For:		
3	2,556	CY	Trench, Culvert and Bridge Excavation	For:		
4A	8,415	SY	Cement Concrete Breaking (Pavement)	For:		
4B	30	CY	Cement Concrete Breaking (Structures)	For:		
5C	281	CY	Selected Fill	For:		
7	15,703	SY	Preparing Fine Grade	For:		
9	259	CY	Topsoil	For:		
10A	30,205	SF	Temporary Sheeting and Bracing	For:		
12A-4-15	389	LF	15" Class IV Concrete Pipe	For:		
12P-18-PERF	2,063	LF	18" Corrugated Polyethylene Smooth Interior Drainage Pipe (Perforated)	For:		
12H	2,227	LF	Cleaning Existing Drainage System	For:		
13A	62	CY	Catch Basin	For:		
13BP-4	47	LF	Manhole - 4' Diameter Precast	For:		
14	4	EA	Connections to Existing Drainage Facilities	For:		
15	8	EA	Altering Catch Basins	For:		
15X	7	EA	Rehabilitation of Existing Catch Basin	For:		
16SS-1	21	EA	Change Elevations of Sanitary Sewer Manholes-Minor Adj.	For:		
16SS-3	101	EA	Change Elevations of Drainage/Misc Manholes-Minor Adj.	For:		

Department of Public Works Nassau County, N.Y.
Beech St. Roadway Improvements
Bid Sheets for Contract: H60045-04G

Item No.	Engineers Estimate	Unit	Item Description			
20	1,190	CY	Broken Stone Total	For:		
22C-2	5,388	TON	Base Course Asphalt Concrete	For:		
24V	90	CY	Concrete Valley Gutter	For:		
26CG	10,675	LF	Combination Concrete Curb and Gutter	For:		
27	51,371	SF	Cement Concrete Sidewalk	For:		
27DW	1,226	SF	Dectectable Warning Surface	For:		
28	597	SF	Cement Concrete Driveways and Driveway Aprons	For:		
29	597	SF	Driveway Restoration	For:		
30	67	SY	Metal Reinforcement for Concrete Pavement	For:		
34	28,658	LB	Miscellaneous Metals	For:		
36C	1,459	TON	Asphalt Concrete, Truing and Leveling Course Type 1A	For:		
36DRAR	2,918	TON	Rut Avoidance Asphalt Concrete Type 1A	For:		
36T	737	TON	Temporary Pavement	For:		
58A	98	LF	Sawcut Existing Non-Roadway Asphalt	For:		
58RPC	15,290	LF	Saw Cutting Existing Roadway Pavement & Concrete	For:		
60	4	EA	Alter Water Service Connections	For:		
63	50	LF	Alter Sanitary Sewer House Service Connection*	For:		
102	1	LS	Work Zone Traffic Control - Maintenance & Protection of Traffic	For:		
107	32,489	LF	Cleaning Filling and Sealing Existing Joints and Cracks in Asphalt Pavement	For:		

FOR INFORMATIONAL USE ONLY-DO NOT USE TO PREPARE A BID

Department of Public Works Nassau County, N.Y.
Beech St. Roadway Improvements
Bid Sheets for Contract: H60045-04G

Item No.	Engineers Estimate	Unit	Item Description			
116A	36,373	SY	Profiling and Removal of Asphalt Pavement	For:		
121	1,403	CY	Drybound Base Course	For:		
122	26	EA	Test Holes	For:		
136	1	LS	Survey Stakeout	For:		
158A	51,150	SF	Geotextile Cloth	For:		
360	10	EA	Pruning Existing Deciduous Tree	For:		
361A	54	EA	Planting Trees and Shrubs - Minor*	For:		
363	1,551	SY	Grass Seeding	For:		
372B	54	EA	Tree Removal - B - (6" - <12" Caliper)	For:		
411-A1	32	EA	Furnish & Install Concrete Foundation, Type A1	For:		
411-S1	4	EA	Furnish & Install Concrete Foundation, Type S1	For:		
411-S2	8	EA	Furnish & Install Concrete Foundation, Type S2	For:		
412G	9	EA	Furnish & Install A Push Button Post Assembly	For:		
412MB-25	0	EA	Furnish & Install Mast Arm Pole - 25 foot arm	For:		
412MB-30	3	EA	Furnish & Install Mast Arm Pole - 30 foot arm	For:		
412MB-35	1	EA	Furnish & Install Mast Arm Pole - 35 foot arm	For:		
412MB-40	6	EA	Furnish & Install Mast Arm Pole - 40 foot arm	For:		
412MB-45	3	EA	Furnish & Install Mast Arm Pole - 45 foot arm	For:		

Department of Public Works Nassau County, N.Y.
Beech St. Roadway Improvements
Bid Sheets for Contract: H60045-04G

Item No.	Engineers Estimate	Unit	Item Description			
412P-8	14	EA	Furnish & Install 8 Foot Aluminum Signal Post	For:		
412P-10	8	EA	Furnish & Install 10 Foot Aluminum Signal Post	For:		
413PL	50	EA	Furnish & Install 12 inch Polycarbonate Traffic Signal Face	For:		
415-2	8,234	LF	Furnish & Install 2-Conductor, # 14 Cable on Span Wire, In Conduit, or Roadway	For:		
415-3	5,770	LF	Furnish & Install 3-Conductor, # 14 Cable on Span Wire, In Conduit, or Roadway	For:		
415-5	1,606	LF	Furnish & Install 5-Conductor, # 14 Cable on Span Wire, In Conduit, or Roadway	For:		
415-7	473	LF	Furnish & Install 7-Conductor, # 14 Cable on Span Wire, In Conduit, or Roadway	For:		
415-10	1,392	LF	Furnish & Install 10-Conductor, # 14 Cable on Span Wire, In Conduit, or Roadway	For:		
415-15	968	LF	Furnish & Install 15-Conductor, # 14 Cable on Span Wire, In Conduit, or Roadway	For:		
415P-2	776	LF	Furnish & Install 2-Conductor Power Cable	For:		
419R-1	7	EA	Furnish & Install 1" Riser Assembly	For:		
419S-075	127	LF	Furnish & Install 3/4" Diameter Steel Conduit	For:		
419S-1	913	LF	Furnish & Install 1-1/4" (1.25") Diameter Steel Conduit	For:		
419S-3	7,590	LF	Furnish & Install 3" Diameter Steel Conduit	For:		
420-1	71	EA	Furnish & Install Standard Pullbox	For:		
420-4	2	EA	Furnish & Install Concrete Fiber Optic Pullbox	For:		
422L	2,695	LF	Furnish & Install Loop Wire	For:		
422LS	1,348	LF	Furnish & Install Loop Saw Cut	For:		

Item No.	Engineers Estimate	Unit	Item Description			
424-4	193	EA	Remove Any Post	For:		
424-6A	14	EA	Remove Mast Arm Pole and Mast Arm	For:		
424-9A	7	EA	Remove Controller and Cabinet-Shaft Mount	For:		
424-10	1	EA	Remove Ancillary Cabinet (for count station)	For:		
424-11A	54	EA	Remove One Signal Face from any support	For:		
424-11B	8	EA	Remove One Pedestrian Signal Face from any support	For:		
424-14	3,410	LF	Remove Cable	For:		
424-22	4	EA	Remove Single Lane Magnetic Housing	For:		
424-23	15	EA	Abandon Foundation	For:		
424-25	21	EA	Remove Pullbox	For:		
424-27	14	EA	Remove Pushbutton	For:		
424-28	8	EA	Remove Riser	For:		
426L	38	EA	Furnish & Install an L.E.D. Countdown Pedestrian Signal	For:		
427-2APS	30	EA	Furnish & Install a Push Button & Sign Assembly (APS Type)	For:		
427-2	8	EA	Furnish & Install a Push Button & Sign Assembly (Latching)	For:		
450	215	EA	Furnish and Install Post Mounted Signs	For:		
455-1	7	EA	Furnish & Install a Power Connection Assembly, 30 Amp	For:		
603.51180010	3	EA	Inline Check Valve, 18-inch Diameter	For:		

Item No.	Engineers Estimate	Unit	Item Description			
606.18	160	LF	Weak Post Corrugated Beam Guide Rail	For:		
606.26	2	EA	Corrugated Beam Guide Railing End Terminal	For:		
606.71	160	LF	Removing and Disposing Corrugated Beam Guide Railing	For:		
619.0901	26,038	LF	Temporary Pavement Markings Stripes (Traffic Paint)	For:		
619.1611	84	INTM	Maintain Traffic Signal Equipment, Requirement "A"	For:		
637.13	15	MNTH	Engineer's Field Office - Type 3	For:		
680.321001NA	7	EA	2070 Controller, Lite	For:		
680.336002NA	7	EA	336SX Controller Cabinet & Aux. Equipment	For:		
680.51000010	8	EA	Alter Elevation of Pullbox	For:		
680.51100010	6	EA	Clean Existing Pullbox	For:		
683.030300NA	2	EA	HD CCTV Top Mount IP Camera Assembly (Nassau County)	For:		
683.090100NA	7	EA	Furnish & Install 8 Port Hardened 10/100 Ethernet Switch with 10/100/1000 Port	For:		
683.090600NA	7	EA	Furnish & Install 10/100 MBPS Optical Ethernet Converter, Shelf Mount	For:		
683.115100NA	1	EA	Wi-Fi Travel Time Reader	For:		
683.921048NA	6,468	LF	Single Mode Fiber Optic Trunk Cable, 48 Fibers	For:		
683.921072NA	5,995	LF	Single Mode Fiber Optic Trunk Cable, 72 Fibers	For:		
683.921500NA	891	LF	Fiber Optic Drop Cable	For:		
685.07200210	12	EA	White Epoxy Reflectorized Pavement Letters - 20 Mils (wet night visibility spheres)	For:		

Item No.	Engineers Estimate	Unit	Item Description			
685.07200310	13	EA	White Epoxy Reflectorized Pavement Symbols - 20 Mils (wet night visibility spheres)	For:		
685.16010009	11,151	LF	White Epoxy Paint With White Wet-Night Reflective Elements -20 Mils	For:		
685.17010009	11,252	LF	Yellow, Epoxy Paint With Yellow Wet-Night Reflective Elements -20 Mils	For:		
685.16010014	9,876	LF	White, Epoxy Paint with White Grooved-In Wet-Night Reflective Beads- 20 mils (Grooved Pavement Method)	For:		
685.17010014	20,069	LF	Yellow, Epoxy Paint with Yellow Grooved-In Wet-Night Reflective Beads- 20 mils (Grooved Pavement Method)	For:		
697.03	523,000	DC	Field Change Payment	For: One Dollar Zero Cents	$1.00	
698.04	20,000	DC	Asphalt Price Adjustment	For: One Dollar Zero Cents	$1.00	
698.05	8,000	DC	Fuel Price Adjustment	For: One Dollar Zero Cents	$1.00	
698.06	100	DC	Steel Price Adjustment	For: One Dollar Zero Cents	$1.00	
699.040001	1	LS	Mobilization	For:		

ITEM 12P-18-PERF
18" SMOOTH INTERIOR CORRUGATED POLYETHYLENE DRAINAGE PIPE (PERFORATED)

All of the provisions of Item 12P-18-PERF of the Nassau County Department of Public Works Standard Specifications and Detail Sheets for Civil Engineering and Site Development Construction dated 2009 as currently revised shall apply and all work shall be provided in accordance with the Contract Drawings and Specifications, with the following modification.

Materials: The smooth lined, **perforated**, corrugated polyethylene pipe shall conform to the requirements of AASHTO M294. All other material requirements identified in the above referenced document shall apply.

END OF ITEM

ITEM 413PL
FURNISH & INSTALL 12 INCH TRAFFIC SIGNAL FACE

Description - Under this item, the Contractor shall furnish and install a Polycarbonate Traffic Signal Face and assemble traffic signal heads.

Installation – The requirements of Nassau County Department of Public Works (NCDPW) Basic Item 413 (Traffic Signal Face) except Sections 3.2.1 and 3.15 shall apply.

Basic Requirements – Each traffic signal face shall be furnished with two (2) pair of approved aluminum stiffening plates. Each plate shall be a minimum of 1/8 inch thick. The stiffening plates shall be placed on both surfaces of the mounting ends of the signal section.

The traffic signal faces, when required, shall be assembled into configurations as specified on the plans, specifications, or by the orders of the Engineer. Signal faces shall be LED type and meet the requirements of New York State Department of Transportation (NYSDOT) Items 680.810101 through 680.810107:

- 680.810101 Traffic Signal Module - 12 Inch, Red Ball, LED
- 680.810102 Traffic Signal Module - 12 Inch, Red Arrow, LED
- 680.810103 Traffic Signal Module - 12 Inch, Yellow Ball, LED
- 680.810104 Traffic Signal Module - 12 Inch, Yellow Arrow, LED
- 680.810105 Traffic Signal Module - 12 Inch, Green Ball, LED
- 680.810106 Traffic Signal Module - 12 Inch, Green Arrow, LED
- 680.810107 Traffic Signal Section – Type I, 12 Inch

Method of Measurement – The quantity to be paid shall be the number of polycarbonate traffic signal faces furnished and installed.

A traffic signal face is defined as a grouping of 12-inch signal sections of uniform size or a combination of sizes, consisting of one to five sections.

Basis of Payment - The unit bid price to furnish and install the traffic signal face shall include the cost of the traffic signal face, stiffening plates, mounting assembly, hanger assembly, bracket assembly, wiring, lamps, backplates, all labor, miscellaneous hardware, equipment, tools, transportation, and handling necessary to complete this work.

END OF ITEM

ITEM 426L
FURNISH & INSTALL AN L.E.D. COUNTDOWN PEDESTRIAN SIGNAL

Description - Under this item, the Contractor shall furnish, install, and configure LED Pedestrian Signal Assemblies with Countdown timers and mounting brackets in accordance with the contract documents and as directed by the Engineer.

Materials and Installation – The Materials and Installation shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18", with the following exception:

1. Housing:
   Housings shall be constructed of cast or fabricated aluminum and shall be painted silver or aluminum in color.

LED Countdown Pedestrian Module – The LED Countdown Pedestrian Module shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18".

Electrical Requirements – The Electrical Requirements shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18".

Compatibility – The Compatibility shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18".

Module Construction – The Module Construction shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18".

Documentation Requirements – The Documentation Requirements shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18".

Painting – The cast aluminum or sheet aluminum shall be painted with two coats of silver or aluminum paint. The interior of the visor shall be finished with two coats of high quality, synthetic resin flat enamel paint, black in color, baked after application.

Construction Details – The Construction Details shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.813108NA, LED Pedestrian Signal with Countdown Timer Assembly, 16" X 18".

Method of Measurement – This work will be measured by the number of LED Pedestrian Signals with Countdown Timer assemblies that are furnished and installed as shown on the plans or as directed by the Engineer.

Basis of Payment - The unit price bid to furnish and install each LED Pedestrian Signal with Countdown Timer Assembly shall include the cost of the 16" X 18" LED pedestrian signal and countdown module, the pedestrian signal housing, all necessary internal wiring, mounting hardware including all post top and shaft mount brackets, elbows, strapping, and all labor, incidental materials, tools, transportation, and equipment necessary to complete this work to produce a fully functional pedestrian display including all tests to the satisfaction of the Engineer.

END OF ITEM

Description - Under this item, the Contractor shall furnish, install, and configure an ADA-compliant pedestrian push button station with audio capability, and its control unit, at each location as indicated in the contract documents or where directed by the Engineer.

Materials and Installation – The Materials and Installation shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.8151 (Accessible Pedestrian Signal (APS) without Post) and Item 680.8152 (Accessible Pedestrian Signal (APS) with Post), with the following exception:

1. Pedestrian Push Button Station:

   The station housing shall be constructed of cast aluminum, have a powder coated paint finish and be federal yellow in color.

   The station shall include a weatherproof ADA compliant 2" diameter push button that is pressure activated and includes a raised direction arrow. The push button shall be constructed of cast aluminum, have a powder coated paint finish and be federal yellow in color.

Operational Features – The Operational Features shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.8151 (Accessible Pedestrian Signal (APS) without Post) and Item 680.8152 (Accessible Pedestrian Signal (APS) with Post).

Audio Specifications – The Audio Specifications shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.8151 (Accessible Pedestrian Signal (APS) without Post) and Item 680.8152 (Accessible Pedestrian Signal (APS) with Post).

Environmental Specifications – The Environmental Specifications shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.8151 (Accessible Pedestrian Signal (APS) without Post) and Item 680.8152 (Accessible Pedestrian Signal (APS) with Post).

Post – The post installed (if applicable) shall be in accordance with the New York State Department of Transportation (NYSDOT) standard sheet for Pedestrian Signal Details.

Construction Details – The Construction Details shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.8151 (Accessible Pedestrian Signal (APS) without Post) and Item 680.8152 (Accessible Pedestrian Signal (APS) with Post), with the following exception:

Unless otherwise waived, the Contractor shall submit to the **Nassau County Department of Public Works Traffic Signal Construction Unit**, within 30 days following the award of contract, detailed specifications and catalog cuts of all equipment that is to be installed or furnished.

Method of Measurement – The Method of Measurement shall follow the New York State Department of Transportation (NYSDOT) specification for Item 680.8151 (Accessible Pedestrian Signal (APS) without Post) and Item 680.8152 (Accessible Pedestrian Signal (APS) with Post).

Basis of Payment - The unit price bid shall include the cost of all labor, material and equipment necessary to complete the work. Where the pushbutton and sign assembly is installed on its own post, the unit price bid shall also include the cost of post, sawcutting, excavation, backfill, concrete, restoration of surfaces, and conduit bend and fittings.

END OF ITEM

ITEM 603.51NN0010 – INLINE CHECK VALVE (EA)

DESCRIPTION

This work item shall consist of furnishing and installing an inline check valve in a pipe of the type, size, and at the locations shown on the plans.

MATERIALS

The nominal diameter indicated for the inline check valve is the inside diameter (I.D.) of the pipe to receive the valve. The valve shall be sized to fit the inside diameter of the pipe.

The inline check valve shall be manufactured by one of the following companies:

Wapro Inc.
150 North Michigan Ave
Chicago IL 60601

Proco Products, Inc.
2431 North Wigwam Dr.
P.O. Box 590
Stockton, CA 95205

Red Valve Company, Inc.
600 North Bell Avenue
Carnegie, PA 15106

Or equal as approved by the Engineer

CONSTRUCTION DETAILS

Prior to ordering the inline check valve, field measurements shall be taken by the Contractor or the manufacturer's representative of the inside diameter of the existing or new pipe to receive the valve to assure a proper fit.

INSTALLATION

A. Valve shall be installed in accordance with manufacturer's written installation and Operation Manual and approved submittals.
B. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

ITEM 603.51NN0010 – INLINE CHECK VALVE (EA)

All adjustments, repairs or replacement of damaged or defective valves shall be performed at no cost to the State.

METHOD OF MEASUREMENT

This work will be measured by the number of check valves of the appropriate size installed.

BASIS OF PAYMENT

The unit price bid for this item shall include the cost of all labor, materials and equipment necessary to complete the work.

Payment will be made under the following items:
603.51NN0010 – Inline Check Valve (EACH)

Where NN is the serialized item number for valve diameter size in INCHES

ITEM 680.321001NA - MODEL 2070LX CONTROLLER
DESCRIPTION

This work shall consist of furnishing and installing Model 2070LX Controllers in accordance with the contract documents and as directed by the Engineer.

MATERIALS

1. Qualification

    1.1 All components supplied under this specification shall be listed on the CalTrans Qualified Product List (QPL) that is in effect on the issue date of this invitation (see section 1.2 for 2070LX controller qualification). Equipment that is not defined by the CalTrans "Transportation Electrical Equipment Specifications" (TEES) that is in effect on the issue date of this invitation is not covered by this requirement. For each piece of equipment that is covered by this requirement, the vendor shall submit a notarized certification the equipment is listed on the QPL that was in effect as of the date of issue of this invitation. Failure to provide this certification shall cause the bid to be rejected as unresponsive. If during the course of the contract, any piece of equipment ceases to be listed on the current QPL, the County may, at its option, require the vendor to provide a suitable replacement that is listed on the current QPL at no additional cost.

    1.2 Model 2070LX controllers furnished as part of this item specification must be listed on the Nassau County Qualified Products List (QPL) for 2070LX Traffic Signal Controllers.

2. Requirements

    2.1 All materials furnished, assembled, fabricated and installed shall be new, corrosion resistant and in strict accordance with the latest provisions set forth by the California Department of Transportation (CalTrans) Specifications.

    The specifications for the Model 2070LX Controller Unit will be as stated in the CalTrans document TEES 2020, January 25, 2001 or latest revisions and all addenda thereof.

    2.2 The Model 2070LX Controller Unit shall be delivered in the following configuration:

    - Unit Chassis
    - Model 2070 – 1C CPU Card
    - Model 2070 – 2E+ Field I/O Card
    - Model 2070 – 3B Front Panel Interface
    - Model 2070 – 4A Power Supply
    - Model 2070 – 7A Serial Communication Module

    2.3 The Model 2070LX Controller Units supplied to this specification shall have the chassis openings for any unused Motherboard connector covered with the appropriate cover plates so that the entire rear of the controller is closed.

ITEM 680.321001NA - MODEL 2070LX CONTROLLER

2.4 The Model 2070LX Controller Units shall be supplied with 2X Wide Cover Plates installed over the chassis openings for connectors A1 and A2 so that the rear of the controller is completely enclosed.

CONSTRUCTION DETAILS

3. Installation

3.1 The Contractor shall install the Model 2070LX Controller Unit and all related hardware in the Model 336S, 336SX or 332 Cabinet at locations specified on the plans.

3.2 The County will provide the signal control software and the Contractor shall be required to program and test the Controller prior to installation in the field.

3.3 The Contractor shall program each Model 2070LX Controller Unit with a unique internet protocol (IP) address provided by the County and recorded in each equipment cabinet.

4. Documentation Requirements

4.1 One (1) complete set of operations and maintenance manuals shall be placed in each field cabinet and one (1) complete set shall be delivered to Nassau County. The manuals shall, as a minimum, include the following:

- Complete and accurate schematic diagrams.
- Complete installation procedures.
- Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
- Pictorial of components layout on circuit board.
- Complete maintenance and trouble-shooting procedures.
- Complete stage-by-stage explanation of circuit theory and operation.

5. Testing Requirements

5.1 Design Approval Tests shall include all functional and environmental tests specified in the most current version of the CALTRANS TEES Specifications.

A complete Quality Control (QC)/ final test report for the 2070LX shall be supplied with each unit. The test report shall indicate the name of the tester and shall be signed by a responsible manager. The QC procedure shall include the following:

- Acceptance of all supplied components.
- Physical and functional testing of all modules and items.
- A minimum 100-hour burn-in of all equipment

ITEM 680.321001NA - MODEL 2070LX CONTROLLER

METHOD OF MEASUREMENT

This work will be measured as the number of Model 2070LX Controllers satisfactorily furnished, installed, tested and made fully operational.

BASIS OF PAYMENT

The unit price bid shall include the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work. Payment for all documentation and testing specified herein shall be included under this contract item.

ITEM 680.336002NA - MODEL 336SX CABINET AND AUXILIARY EQUIPMENT
DESCRIPTION

This work shall consist of furnishing and installing a Model 336SX (Extra Stretch) Cabinet and Auxiliary Equipment in accordance with the contract documents and as directed by the Engineer.

MATERIALS

1. Controller Requirements

   1.1 All components and plug-in modules supplied under this item shall conform to the New York State Transportation Management Equipment Specifications for peripheral equipment. Model 2070LX controllers shall be on the latest Nassau County Qualified Products List and be approved by NCDPW. Model 2070LX controllers will be paid under a separate item.

2. Qualification

   1.1 All Model 336SX components supplied under this specification shall be listed on the CalTrans Qualified Product List (QPL) that is in effect on the issue date of this invitation. In the case of the modified 336SX Cabinet, the vendor's standard model shall be listed on the CalTrans QPL that is in effect on the issue date of this invitation. All auxiliary equipment shall be listed on the CalTrans QPL that is in effect on the issue date of this invitation. Equipment that is not defined by the CalTrans "Traffic Signal Control Equipment Specifications" (TSCES) or "Transportation Electrical Equipment Specifications" (TEES) that is in effect on the issue date of this invitation is not covered by this requirement. For each piece of equipment that is covered by this requirement, the vendor shall submit a notarized certification the equipment is listed on the QPL that was in effect as of the date of issue of this invitation. Failure to provide this certification shall cause the bid to be rejected as unresponsive. If during the course of the contract, any piece of equipment ceases to be listed on the current QPL, the County may, at its option, require the vendor to provide a suitable replacement that is listed on the current QPL at no additional cost.

3. Requirements

   3.1 All materials furnished, assembled, fabricated and installed shall be new, corrosion resistant and in strict accordance with the latest provisions set forth by the California Department of Transportation (CalTrans) Specifications.
   The specifications for the Model 336SX Cabinet and auxiliary equipment shall conform to the requirements in CalTrans documents TSCES and TEES, and to all addenda thereto current on the issue date of this invitation.

   3.2 This specification shall consist of a wired Model 336SX Cabinet with all auxiliary equipment, and cable harnesses required to control the site-specific project intersections and interface with the communications systems shown on the plans, as specified in these specifications, and as ordered by the Engineer. Model 2070LX Controller Units shall not be furnished under this item.

ITEM 680.336002NA - MODEL 336SX CABINET AND AUXILIARY EQUIPMENT

3.3 As a minimum, this item shall include, but not be limited to, the following equipment:

Model No.	Quantity	Description
336SX	1	Model 336 Extra Stretch Cabinet
2010 ECLip	1	Enhanced Conflict Monitor Unit with Red Monitoring Kit
200	*	Solid State Switchpack
204	2	Solid State Flasher
222	*	Dual Loop Vehicle Detector Module
242	*	Dual Isolation Module (DC)
430	*	Flash Transfer Relays
-	12	Flash Program Plugs (8 red, 2 yellow, 2 white)
-	10	2w/4k bleeding resistors for unused outputs
-	1	Mounting Bracket Assembly (Pole Mt. Only)
-	1	Aluminum Cover Plate for Cabinet Bottom (Pole Mt. Only)
-	1	Fiber Optic Distribution Panel
-	1	Exterior Surface Mount 30A Transfer Switch

* The contractor shall supply the appropriate quantity of the noted components in accordance with the signal design plans and cabinet wiring diagram.

3.4 Model 336SX Cabinet

3.4.1 Dimensions

The cabinet shall be a Model 336SX Extra Stretch type with a minimum height of 55", width of 24", and a depth of 22".

The unoccupied rack space of the Model 336SX Cabinet shall be provided at the bottom of the cabinet.

3.4.2 Traffic Signal Identification

The traffic signal number shall be painted on both sides of the cabinet as directed by the Engineer. It shall be painted in black with the letters 3" high in type "C" series.

3.4.3 Locks

The cabinet doors and transfer switch access door shall be equipped with a brass cylinder lock keyed for a Number Two Corbin Key, with a dust cover. Two (2) keys

for each cabinet shall be furnished and provided in the cabinet drawer. Cabinet shall be equipped with a removable handle that shall be provided with the cabinet.

3.4.4 Finish

All surfaces of the cabinet shall be bare, unpainted aluminum.

3.4.5 Police Door

The front door of the cabinet shall be equipped with an auxiliary police access door. The police access door shall include a Signal ON/OFF switch, Flash/Auto switch, and an Auto/Manual switch with hardwired police cord. One (1) police master key shall be provided in the cabinet drawer.

3.4.6 Cabinet Light

LED lamps shall be installed in the top of the front and rear of the cabinets. Switches shall be installed on the front and rear doors. Opening of either door shall illuminate both lights.

Each LED lamp and switch shall be equipped with noise suppression devices. Activation of the LED lamps and associated switches shall not cause any disruption of the Model 2070L Controller or any other electrical device in the cabinet. The vendor shall install sufficient RFI and surge suppression equipment to assure that operation of the LED lamps will not disrupt the operation of other equipment in the cabinet.

LED lamps and associated ballast transformers shall be rated for high output in cold environments, providing high light output in ambient temperature of -13˚ F.

The cabinet lamp circuit shall be fused. The fuse holder shall be easily accessible from the front the cabinet. It shall not be necessary to reach into the cavity above the 2070LX controller in order to access the fuse holder for the cabinet lamps.

3.4.7 Interconnect Terminal Block

Two twelve (12) position terminal blocks for interconnection shall be installed. The Contractor shall submit the proposed terminal block schematic and mounting location to the County for approval prior to installation in the cabinet. The cabinet shall be furnished with a plug-in Data/Signal 2 pair surge suppressor device, EDCO Model PC642 series, mounted on Socket PCB1B or approved equal. The voltage clamp value for the protector shall be selected to be appropriate for the communication equipment used in the cabinet.

3.4.8 Cabinet Drawer

An aluminum pullout drawer hinged at the top and having sliding tracts shall be provided in the cabinet. The drawer shall have the approximate dimensions of 1.75 inches in height, 13 inches deep and 16 inches wide and be capable of holding 40 pounds in weight when the drawer is extended. This drawer should be located between the Model 2070LX Controller and the power distribution assembly. Provide a top for the storage compartment that has a non-slip plastic laminate attached, which covers a minimum of 90% of the surface area of the top.

3.4.9 Door Alarm

A door ajar alarm switch shall be installed on front and back doors. Each switch shall be of heavy duty, spring- loaded design with single pole normally closed contacts. Each switch circuit shall be closed whenever the corresponding door is open at an angle of 15 degrees or more. The switches shall be installed so that they will not restrict removal of the cabinet rack assembly in any way. The door ajar switches shall only be used to support the door ajar alarm function; they shall not be used to support any other function (such as cabinet illumination or conflict monitor interlocking).

Each switch shall be wired to 2 point barrier style terminal block on the input side of the cabinet. One point of the terminal block shall also be connected to pin C1-75 of the controller's C1 connector. The other point of the terminal strip shall be connected to controller logic ground.

3.4.10 Input File Slot 14

Input File Slot 14 shall be disabled by means of jumping Channel 1 Out (F) to Channel 1 In (D), and Channel 2 In (W) to Channel 2 Out (J). The front opening of Input File Slot 14 shall be covered with a faceplate constructed of the same material as the input file housing.

3.4.11 Cabinet Filters

The cabinets shall have vents on both the front and back doors and metal water deflection panels mounted inside the vents. A disposable paper filter element shall be provided in lieu of a metal filter.

3.4.12 Surge Protection

The cabinet shall be furnished with a plug-in RFI filter and surge protection device, EDCO MODEL SHA 1250, mounted on the cabinet service panel assembly on Socket BEAU S-5412 SB or approved equal.

3.5 Conflict Monitor

3.5.1 The conflict monitor shall meet the requirements of the CalTrans specifications, plus the additional requirements as specified below:

3.5.2 The conflict monitor shall provide a guaranteed minimum flash time on power-up, brownout restore, and short AC Line interrupts to allow the 2070LX controller time to boot and set signal outputs.

3.5.3 The conflict monitor shall provide red monitoring and the Model 336SX Cabinet shall be adapted for red signal monitoring. All required cables, wiring and equipment for red signal monitoring shall be included under this item.

3.5.4 The conflict monitor display on the front panel shall clearly indicate the following tripped conditions: 24VDC Fail, Conflict, Watchdog Error, Switch or Dual Indication, Red Fail, and Yellow or Sequence Fail.

3.5.5 The conflict monitor shall have an Ethernet port installed on the front panel for communicating with a laptop computer, or for communications to a network switch. The conflict monitor shall be compatible with Siemens Se-PAC software. The software for communicating with the conflict monitor shall be provided.

3.5.6 The conflict monitor shall be capable of storing in non-volatile memory a minimum of 100 events. Each event shall be marked with the time and date of the event. These events consist of fault events, AC Line events, reset events, and configuration change events.

3.5.7 An Ethernet cable shall be provided with each conflict monitor furnished.

3.6 Model 200 Solid State Switchpack

3.6.1 The Model 200 Solid State Switchpack shall conform to the requirements in the latest Transportation Management Equipment Specifications and be on the NYSDOT Qualified Products List on the issue date of this invitation.

3.7 Model 204 Flasher Unit

3.7.1 The Model 204 Flasher Unit shall conform to the requirements in the latest Transportation Management Equipment Specifications and be on the NYSDOT Qualified Products List on the issue date of this invitation.

3.8 Model 222 Dual Channel Loop Vehicle Detector

3.8.1 The Model 222 Dual Channel Loop Vehicle Detector shall conform to the requirements in the latest Transportation Management Equipment Specifications and be on the NYSDOT Qualified Products List on the issue date of this invitation.

3.9 Model 242 Dual DC Isolation Module

3.9.1 The Model 242 Dual DC Isolation Module shall conform to the requirements in the latest Transportation Management Equipment Specifications and be on the NYSDOT Qualified Products List on the issue date of this invitation.

3.10 Model 430 Flash Transfer Relays

3.10.1 The Model 430 Flash Transfer Relays shall conform to the requirements in the latest Transportation Management Equipment Specifications and be on the NYSDOT Qualified Products List on the issue date of this invitation.

3.11 Fiber Optic Distribution Panel

3.11.1 Fiber optic distribution panels shall be provided in each cabinet specified for the termination and optical continuation of the fiber optic cables as required. The unit shall act as an interface between the fiber optic drop cable and the fiber optic patch cables located within the cabinet. In addition, the distribution panel shall facilitate the reassignment of the fibers within and testing of the optical fiber cable plant. The rack shall be configured in connector fields consisting of rack mounted bulkhead connectors. The fields shall contain a sufficient quantity of connectors to accommodate the maximum number of fibers entering the equipment cabinet. Each connector field shall consist of up to 12 type LC single mode connectors per row, with the connector fields clearly identified by function. The distribution panel shall be capable of mounting in the standard 19" rack assembly of the cabinet. The distribution panel shall have sufficient room for slack fiber and shall have multiple entrances. All connections to active optical transmission equipment within the cabinet shall be via this panel.

3.12 Exterior Surface Mount 30A Transfer Switch

3.12.1 The transfer switch will allow for easy switching between utility power and generator power and shall be a sealed unit surface mounted on the exterior lower portion of the cabinet. Transfer switch door shall be lockable, tamper proof, and weather proof in the closed position. Transfer switch housing shall be constructed with heavy duty 12 gauge rust and corrosion proof aluminum. Transfer switch interlock prevents generator and power utility from feeding the circuit concurrently. Transfer switch shall be wired from inside the traffic cabinet. Transfer switch generator connection shall be a male 30 Amp twist lock type flush mount connector. An LED indicator light illuminates when in generator mode and utility power is restored. A simple switch allows the user to choose between utility power and generator power. Approximate dimensions – 9" Wide X 4.25" High.

CONSTRUCTION DETAILS

4. Installation

4.1 Mounting

4.1.1 Base Mount

When base mounted, the Model 336SX Cabinet shall be mounted on a foundation with an "M" base adapter as prescribed by the plans or item sheet. The Contractor shall supply all bolts, nuts, lockwashers, mounting plates, and other material required to

secure the cabinet properly to the "M" Base Adapter and foundation in accordance with the Traffic Signal Standard Drawings.

4.1.2 The M Base Adaptor will be paid for under another Item when required.

4.1.3 Pole Mount

When pole mounted, the Model 336SX Cabinet shall be mounted on a pole as prescribed by the plans and as directed by the Engineer. Pole mounted cabinets shall be furnished with two (2) exterior pole mounting brackets and an aluminum plate to cover the opening on the bottom of the cabinet. The manufacturer shall reinforce the cabinet sidewalls/bracket mounting holes with metal plates of adequate size and strength, welded longitudinally across the inside depth of the cabinet. The cabinet shall provide sufficient resistance to flexing and shall withstand pole mounting without warping the cabinet when doors are opened or closed.

The installation shall include the drilling and welding of posts or poles and the fastening of supports. The Contractor shall supply all bolts, nuts, straps, condulets with screw on covers, nipples, lock washers, mounting plates, and other material required to secure the cabinet properly to the pole in accordance with the Traffic Signal Standard Drawings. The condulet shall be 3" or 4" in diameter as required and as directed by the Engineer.

4.2 The Contractor shall make all field cable connections in the cabinet with approved insulated solderless lugs. All cabinet wiring shall be neat and firm.

4.3 The controller and cabinet assembly with auxiliary equipment shall be tested in the field with the prescribed timing schedules for forty-eight (48) trouble-free hours prior to on-line activation.

5. Installation Details

5.1 The Contractor shall install the Model 2070LX Controller Unit and all related hardware in the Model 336SX Cabinets at locations specified on the plans.

5.2 The County will provide the signal control software and the Contractor shall be required to program and test the Controller prior to installation in the field.

5.3 After all cables entering the cabinet are installed and tested, the Contractor shall seal all conduits using duct seal and/or steel wool to deter rodent entry in the cabinet.

5.4 The cabinet doors shall be perpendicular and open away from the curb as specified on the plans. If the plans do not indicate this information, the Contractor shall confirm with the Engineer regarding the orientation of the cabinet.

5.5 All wiring connected to terminal blocks, flashers, relays, switches, radio interference suppressor, etc. shall be identified by use of insulated pre-printed tags over the wire

including, but not limited to, signal control wires, loop detector lead-in, etc. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

Cabinets shall be wired to accept and implement all of the features of the specified equipment.

6. Documentation Requirements

6.1 One (1) complete set of operation and maintenance manuals shall be placed in each field cabinet and ten (10) complete sets shall be delivered to the County. The manuals shall, as a minimum, include the following:

6.1.1 Complete cabinet and equipment layout drawings for all cabinet mounting configurations.
6.1.2 Complete cabinet wiring and harness drawings.
6.1.3 Complete installation procedures.
6.1.4 Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
6.1.5 Pictorial of components layout on circuit board.
6.1.6 Complete maintenance and trouble-shooting procedures.
6.1.7 Complete stage-by-stage explanation of circuit theory and operation.

6.2 The cabinet wiring diagram provided by the manufacturer shall reflect the C1 wiring/pin assignment in accordance with the C1 pin/assignment of the Siemens Se-PAC program.

6.3 The cabinet/equipment layout and cabinet wiring diagram shall be submitted for review and approval prior to actual cabinet fabrication.

7. Testing Requirements

At a minimum the following cabinet tests shall be performed on all cabinets, with a designated representative from the County. Test procedures shall be submitted for approval prior testing.

7.1 48 hour hot and cold for cabinet and controller - documented and certified.

7.2 Run STEP (Self Test Evaluation Program) on controller - documented and certified.

7.3 Run 336SX Cabinet test on cabinet. - documented and certified. It should test the following:

7.3.1 Input file wiring
7.3.2 Output file wiring
7.3.3 Timing of all possible conflict combinations
7.3.4 Watchdog error

7.4 Test proper brownout voltage calibration between conflict monitor and controller. Manufacturer to submit procedure for approval. Documentation and certification to be shipped with cabinet.

7.5 Perform conflict monitor unit (CMU) testing as follows:

7.5.1 Test all channel to channel conflicts
7.5.2 Test all voltage threshold levels
7.5.3 Test all auxiliary functions (watchdog, 24 VDC, program card ajar, etc.)
7.5.4 Test all enhanced (absence of red, sequence, etc.)
7.5.5 A printed record of each test to be provided; in particular all threshold voltages shall be documented.

METHOD OF MEASUREMENT

This work will be measured as the number of Model 336SX Cabinets and Auxiliary Equipment that are satisfactorily furnished and installed.

BASIS OF PAYMENT

The unit price bid to furnish and install a Model 336SX Cabinet and auxiliary equipment shall include the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work in accordance with the Contract Documents.

ITEM 680.51000010 - ALTER ELEVATION OF PULL BOXES

DESCRIPTION:
Under this item the Contractor shall alter the elevation of existing pull boxes in accordance with this specification, the details included in the contract plans, and the directions of the Engineer.

MATERIALS:

Existing pull box frames and covers shall be reused.

Concrete shall meet the material requirements for Portland Cement Concreteas outlined under Section 501 of the Standard Specifications. The Maintenance Repair/Misc. Items concrete in Table 2 of Materials Procedure MP 501-2 (Mix Design and Approval Procedure for Performance Engineered Mixtures – Structural Concrete) is acceptable.

CONSTRUCTION DETAILS:
The Contractor shall exercise care in removing and reinstalling pull box frames and covers so as not to damage any part thereof. Any component parts damaged by the Contractor shall be repaired or replaced at the Contractor's expense to the satisfaction of the Engineer.

Pull box walls shall be reconstructed as shown on the contract plans.

METHOD OF MEASUREMENT:
This work will be measured as the number of pull boxes altered in accordance with the plans, specifications, and directions of the Engineer.

BASIS OF PAYMENT:

The unit price bid for this item shall include the cost of all labor, equipment, and materials necessary to complete the work.

ITEM 680.51100010 - CLEAN EXISTING PULLBOX

DESCRIPTION:
The Contractor shall clean existing pullboxes as indicated on the plans or as directed by the Engineer.

MATERIALS:
Not applicable.

CONSTRUCTION DETAILS:
Existing pullboxes shall be cleaned to the base of its walls in a workmanlike manner and maintained clean as determined by the Engineer for the duration of the contract.

Existing pullboxes shall be dried by pumping, bailing, hauling or by any other method approved by the Engineer. Drying operations shall not cause soil erosion and shall be performed so as to avoid contamination of other new or existing facilities.

Material removed from the pullboxes shall be disposed of in accordance with provisions of Subsection 203-3.08, Disposal of Surplus Excavated Materials.

The Contractor shall execute care and protect all facilities within the pullboxes and the area adjacent to the work.

The Contractor shall replace in kind, any pullboxes or other facilities damaged by his operations at his own expense.

METHOD OF MEASUREMENT:
Cleaning existing pullboxes will be measured by the number of pullboxes actually cleaned and maintained in accordance with the Contract Documents and as directed by the Engineer.

BASIS OF PAYMENT:
The unit price bid to clean each existing pullbox shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made for only those existing pullboxes designated by the Engineer to be cleaned. Only one payment for each existing pullbox will be made regardless of the number of times it is cleaned. No payments will be made for pullboxes which are installed by the Contractor under this contract. No separate payments will be made for pullboxes damaged by the Contractor's operations.

06/26/97M

12/24/08E

ITEM 683.030300NA - HD CCTV TOP MOUNT IP CAMERA ASSEMBLY

DESCRIPTION

This work shall consist of furnishing and installing HD CCTV Top Mount IP Camera Assemblies in accordance with the contract documents and as directed by the Engineer.

MATERIALS

1. Product Description

- The camera system specified herein shall provide an integrated network IP camera positioning system (IPCPS) providing 720p/30 video with H.264/MJPEG compression and encoding for providing low bandwidth, low latency, high quality video images transported over standard ethernet infrastructures.
- The (IPCPS) shall integrate an HDTV standards 720p resolution @ 30 frames/sec day/night camera with integral 18x motorized zoom optics, an H.264/MJPEG ASIC based encoding engine and network communication circuitry, a wide dynamic range variable speed positioning drive, completely protected by an IP67/IP66 camera/positioner enclosure system.
- The H.264/MJPEG encoded video shall support 30 frames per second @ HDTV 720p resolution with support for uni-cast and multi-cast connections, using RTP/RTSP network layers.
- The (IPCPS) shall provide an integral web HTTP server allowing password protected administration/configuration capabilities along with full camera and positioning system control and viewing functions.
- The (IPCPS) camera manufacturer shall provide a software development kit (SDK) for allowing any 3rd party developers all necessary tools for integrating the (IPCPS) system into the users control system environment.
- The (IPCPS) shall provide hybrid capability delivering both ethernet and analog composite video and RS422 serial connections for external system connections and control.
- The (IPCPS) positioning drive system shall provide wide dynamic range speed capability of 0.1 to 80 degrees per second, with a 0.25 degree repeatability, 360 degree continuous pan rotation, and +90 to –90 degree tilt range as a minimum.
- The (IPCPS) shall include an advanced ID generation capability for indications of viewing direction, compass setting, azimuth/elevation position, location descriptors and user defined image/logo.
- The (IPCPS) shall be designed for use in harsh operational environments conforming to NEMA TS2 requirements for power, shock and vibration as well as IP66 and IP67 environmental standards.
- The (IPCPS) units shall be fully assembled, pressurized and tested at the original manufacturing facility and shipped as a complete unit, ready for installation and commissioning.

2. Quality Assurance

- Equipment: The HD CCTV Assembly shall have been satisfactorily used in projects of similar size and complexity for not less than two years.

3. Delivery, Storage and Handling

- Deliver materials in manufacturer's original, unopened, protective packaging.
- Store materials in a clean, dry space, protected from weather.
- Handle in a manner to prevent damage to finished surfaces.
- Where possible, maintain protective covering until installation is complete and remove such coverings as part of final clean up.
- Touch up damage to finishes to match adjacent surfaces, including recoating of galvanized or plated surfaces where damaged, cut, or drilled.

4. Product Specifications

The (IPCPS) shall meet or exceed the following design and performance specifications.

A. Camera Module

1. Image Sensor: Progressive Scan Ex-View ICX445AKA CCD
2. Image Size: Diagonal 6mm (1/3" type)
3. Image Resolution: 1280 horizontal; 720 vertical
4. Picture Elements (total) 1348 (H) x 976 (V)
5. Video Output: 16 Bit Digital YUV: 4.2.0
6. Day/Night Operation: Adjustable (Auto, Color and Mono Modes) via removable IR cut filter
7. Maximum Lens Aperture: f/1.6 (wide) to f/2.8 (tele)
8. Optical Zoom Range: 18X, 4.7mm to 84.6mm
9. Optical Zoom Speed: Two speeds, from approximately 3.5 seconds to 5 seconds full range
10. Horizontal Angle of View: Optical: 55.2° to 3.2
11. Minimum Focus Distance: 0.01m (w); 1.0m (t)
12. Auto Focus: Selectable Auto/Manual; Minimum Scene Illumination for Reliable Auto Focus shall be no more than 50% video output.
13. Manual Shutter: Selectable shutter speeds shall be from 1/30 to 1/10,000.
14. Auto Iris; Selectable auto/manual; Iris shall automatically adjust to compensate for changes in scene illumination to maintain constant video level output within sensitivity specifications.
15. Sensitivity: Scene Illumination; F1.6 @ 50% Video
    a. 1.8 Lux (0.18 fc) @ 1/30 shutter, color mode
    b. 0.1 Lux (0.01 fc) @ 1/30 shutter, mono mode

B. H.264/MJPEG Encoding Engine

The (IPCPS) system shall fully integrate within its positioning system enclosure the H.264/MJPEG encoding component with functions as specified below;

1. Video Encoding: H.264 (Main Profile/Level 3.1) and MJPEG standards
2. Video Streams: Two independently configurable streams; (2) H.264 streams or (1) H.264 and (1) MJPEG or (1) H.264 or MJPEG and 1 NTSC or PAL.

3. Video Stream Configuration Properties;
   a. Stream Settings
      1. Video Stream 1: H.264
      2. Video Stream 2: H.264 or MJPEG
   b. Image Resolution: 720p, D1, VGA, CIF
   c. Streaming Mode: CBR or VBRe. Image Settings: (GOP (M, N)), Quality Value
   d. Frame Rate: 30, 15, 7, 4, 2, 1

4. Data Rate: Adjustable from 64k to 8Mb/sec
5. Connection Types: Uni-cast, multi-unicast or multi-cast
6. IPCPS Video Latency: <150ms
7. Network Protocol Layers: RTP, RTSP, UDP, TCP, IP, HTTP, IGMPv2, ICMP, ARP as a minimum

C. Positioning Drive

1. Pan Movement; 360 degrees continuous rotation
2. Pan Speed; Variable from 0.1 to 80 degrees/second.
3. Pan Repeatability; +/- 0.25 degree precision
4. Pan Preset Speed; 180 degree movement < 2 Seconds
5. Tilt Movement; Minimum of +90 to –90 degrees
6. Tilt Speed; Variable from 0.1 to 40 degrees/second.
7. Tilt Repeatability; +/- 0.25 degree precision
8. Tilt Preset Speed; 180 degree movement < 2.5 Seconds
9. Positioning control shall allow variable pan/tilt speeds based on zoom position. This shall scale the maximum pan/tilt speed, while maintaining variable speed capability, throughout the zoom range of the camera.

D. Operational

1. Presets; Minimum of 64, with each preset consisting of a pan, tilt, zoom and focus coordinate and ID label.
   a. ID Label: Provide 1 line of up to 24 ASCII characters on video for Preset ID description. When a preset position is recalled the corresponding preset ID shall be displayed. The preset ID shall remain displayed until a pan, tilt, zoom or another preset command is received.

2. Preset Tours; Minimum 8 tours required, each tour shall consist of up to 32 pre-programmed presets, with individual dwell time property per preset per tour.
   a. Tours shall stop upon receipt of any pan/tilt positioning command.
   b. Tour data shall be stored in non-volatile memory and shall not be lost if a power failure occurs.

3. Scalable Zoom; Variable speed pan/tilt ranges based off of zoom position. This adds the capability of limiting the maximum pan/tilt speed, while maintaining variable speed capability, throughout the zoom range of the camera.

4. Updates: The (IPCPS) shall allow updates of firmware for new features via the ethernet network communication channel. An internal (IPCPS) web server shall be provided for performing this task.

5. The (IPCPS) system shall return to previous position and state of operation upon power loss and restoration.

E. On Screen Display

1. Location/Camera Site Message

   a. Single Line of up to 128 alpha-numeric characters
   b. Enable / Disable Mode
   c. Selectable X-Y Position

2. Logo Display

   a. Maximum logo size of up to 128x128 pixels
   b. Shall be a 24-BPP Bitmap
   c. Enable / Disable Mode
   d. Selectable X/Y Position
   e. Selectable Foreground Opacity Setting

3. Time/Date Display

   a. Enable / Disable (ON/OFF)
   b. Selectable X-Y Position
   c. Date: DD/MM/YY or MM/DD/YY
   d. Time Format: 24 Hour or AM/PM

4. Network Time Protocol (NTP) (CENTRAL TIME SERVER)

   a. Enable / Disable NTP
   b. NTP Server IP Address

` 5. Internal Temperature Display

   a. Metrics (US or Europe (Ft or M; °F or °C)

F. Maintenance Functions

The camera system shall support maintenance features as defined below;

1. The camera system shall support querying of camera parameters via the Ethernet connection. The camera parameters shall consist of the following items
   a. Serial number
   b. Software revision
   c. Assembly date
   d. Camera Model Number

2. Internal Temperature Monitoring and Reporting
3. Remote Software Upload/Updates via ethernet
4. Camera Device Auto Discovery of IP address
5. Camera System Auto Re-connect
6. Camera System Reset
7. Save and Restore camera system start-up configuration

G. IP Management

The (IPCPS) shall provide at minimum the following network configuration properties;

1. IP Configuration: DHCP or Static IP address entry
2. Net mask address entry
3. Gateway address entry
4. Domain name entry
5. DNS server entry

H. Power Input

The (IPCPS) system shall fully comply with and include independent laboratory test results confirming compliance with the following electrical operating conditions;

1. Power; <40 Watts (exclusive of PT Heater Option)
2. Operating Voltage; 89 to 135Vac +/-3hz. Shall comply with NEMA-TS2 para 2.1.2 and 2.1.3
3. The (IPCS) system shall NOT require any external to Camera System step-down power supply transformer/interface box for accepting the specified operating voltage. Products requiring this shall not acceptable.

I. Mechanical

1. Connectors; 18 Pin MS style PT06E-14-18S(SR) weatherproof non-corrosion type or equal
2. Weight; Maximum 18.5lbs
3. Dimensions; Maximum 6.7" D x 11.4" H x 13.30" W.
4. Construction; Powder Coated 6061 T6 aluminum; all internal and external parts corrosion protected, stainless steel fasteners. Faceplate shall be optically correct 0.230" thick glass.
5. Camera Mount; 6" Base plate with (4) 1/4-20 threaded holes 4.75 BC. Options for larger base plates with 7.00" BC shall be available.

J. Environmental

The (IPCPS) system shall fully comply with and include independent laboratory test results confirming compliance with the following environmental operating conditions;

1. Temperature; -29 F to 165 F tested across low and high voltage ranges per Nema-TS2 paragraphs 2.1.2 and 2.1.3.
2. Vibration; Per Nema-TS2 paragraphs 2.1.9, 2.2.3, 5-30Hz sweep @ 0.5g applied in each of 3 mutually perpendicular planes.
3. Shock; Per Nema-TS2 paragraphs 2.1.10, 2.2.4, 10g applied in each of 3 mutually perpendicular planes.

4. Water Spray; Per IEC 60529+A1, 1999, Para 14.2.6, Solid water stream delivered thru 12.5mm nozzle @ 25 gallons/minute @ 9ft for 3 minutes
5. External Icing; Per Nema-TS2 250-2003, paragraphs 5.6
6. Corrosion Protection; Per Nema 250-2003, paragraphs 5.10
7. Humidity; 0-100% N.C per MIL-E-5400T, paragraphs 3.2.24.4
8. Standards; IP66, IP67, ASTM-B117 Marine

K. Certifications

1. Safety; CE (24Vac)
2. Emissions; FCC Class A

CONSTRUCTION DETAILS

This item will consist of furnishing and installing a HD Closed Circuit Television (CCTV) Top Mount IP Camera Assembly at locations shown on the plans or as directed by the Engineer. The HD CCTV Top Mount Camera Assembly (CCTV Assembly) shall be installed on poles as shown in plans. Poles shall be existing or provided under other contract items. All materials, labor, workmanship, equipment, testing, documentation, and incidental items required to install and test a complete and operational Furnish and Install CCTV Top Mount Camera Assembly shall be supplied including but not limited to the following:

HD CCTV Top Mount IP Camera Assembly

- Camera with optical and digital zooms, automatic iris and daylight and nightlight sensitivity.
- Environmental enclosure
- Pan-tilt unit with preset
- Pole Top Camera Mount
- Camera / pan-tilt interface cable.

7. Examination

- Inspect all System equipment and accessories prior to installation. Replace anydamaged items.

- Ensure that the spaces where any electronic equipment is to be stored and/or installed is completely free from any foreign substances, such as concrete dust, water, or any other material that may otherwise be harmful to electronic equipment and connections. No allowances shall be made to the Contractor for equipment damage, or delays due to environmental/security damage.

8. Preparation

- The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

- The entity manufacturing the equipment shall provide on- site technical supervision and assistance during installation and interconnection of the system equipment installed by the Contractor. Said supervision is to insure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

- An on-site inspection will be made by the Engineer after the system equipment has been delivered,. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor will be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the Contractor shall install the system.

9. Installation Details:

- The Contractor shall install the specified HD CCTV assembly at locations shown on the plans and as directed by the Engineer. The equipment shall be installed on a pole at locations shown in the Contract Documents and Specifications. Particular care shall be given to the interconnection of all the components and the cabling, especially cabling through the conduit in the pole.

- All incidental parts which are necessary to complete the installation, but are not specified herein or on the plans, shall be provided as necessary to provide a complete and properly operating system. The Contractor shall prepare a shop drawing that details the complete Camera assembly and all components to be supplied.

- Install all System equipment in accordance with the manufacturers written instructions in the locations shown on the Contract Drawings.

- All control power and data communications wire shall be wired and harnessed within the equipment enclosures to meet the NEC requirements and utilize standard industry practices.

- All wiring shall be clearly labeled with function and wire identification number corresponding to the manufacturer's wiring diagrams and/or approved Shop Drawings.

- Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

- All wiring required to externally connect equipment lineups shall be installed by the electrical contractor.

- Contractor interconnection wiring requirements shall be clearly identified on the "AS-BUILT" system drawings.

10. Testing Requirements

The HD CCTV assembly shall be subjected to several levels of testing (post installation, and 30-day operational acceptance) as described in these Specifications. The Engineer reserves the right to inspect and/or factory test any completed assemblies prior to delivery of the material to the project site. Any deviation from these specifications that are identified during testing shall be corrected prior to shipment of the assembly to the project site.

A post installation test shall be performed for each completed Camera assembly. The test shall be conducted from the field equipment cabinet utilizing PC diagnostic to be supplied. The Contractor shall verify that the camera can be fully used and moved through the entire limit of Pan, Tilt, Zoom, and Focus.

The test shall also verify capabilities that all cabinet alarms (door open, temperature, etc) are operable, controllable and the appropriate status can be read via the control port of the control receiver driver. In addition, with the use of a monitor the video signal shall be demonstrated to be according to specification.

30-day operational acceptance shall be performed for the completed Camera system. The test shall be conducted from the field equipment cabinet and central operations. The Contractor shall verify that the camera can be fully used and moved through the entire limit of Pan, Tilt, Zoom, and Focus. The test shall also verify capabilities that all cabinet alarms (door open, temperature, etc) are operable, controllable and the appropriate status can be read via the control port of the camera controller module. In addition, with the use of a monitor the video signal shall be demonstrated to be according to specification.

Post-Installation Tests

After installation, a post installation test of the equipment shall show compliance with this Section and the manufacturers specifications. The Contractor shall submit the proposed testing procedure to the Engineer for approval two weeks prior to proposed start of test. Said testing shall continue until the results surpass the test criteria and are satisfactory to the Engineer. The Contractor shall perform any repairs, construction, or modifications as required complying with this Section without additional cost to the County.

The Contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the requirements of this Section, the manufacturers specifications and sequences of operation submitted. Correct any malfunctions as they occur, said malfunctions shall include, but not be limited to, equipment failure or failure of the system to comply with the requirements of this Section and to the manufacturers specifications.

The Contractor shall submit a test report detailing compliance with the requirements of post- installation testing.

After satisfactory completion of post installation testing and after construction is complete, a 30-day operational test shall commence on the entire CCTV surveillance system.

30-Day Operational Test

The 30-day operational test shall commence with the approval of the engineer after post installation testing of all components and the complete CCTV surveillance system is operational.

The Contractor shall submit the proposed testing procedure to the Engineer for approval two weeks prior to proposed start of test. Said testing shall continue until the results surpass the test criteria and are satisfactory to the Engineer. The Contractor shall perform any repairs, construction, or modifications as required complying with this Section without additional cost to the County.

Testing shall be performed to verify compliance with the requirements of this Section and the manufacturer's specifications and shall be performed in accordance with the approved testing plan. Correct any malfunctions as they occur, said malfunctions shall include, but not be limited to, equipment failure or failure of the System to comply with the requirements of this Section and to the manufacturers specifications.

Malfunctions shall stop the 30-day operational test for repair of the equipments. After corrections have

been made, the 30-day operational test shall restart a new 30-day period and shall continue until the results are satisfactory to the Engineer for a period of 30 consecutive days.

Maintain a log during all operational testing. Include a narrative description of corrective measures required and items required or replaced.

11. Documentation Requirements

- Five (5) complete sets of operation and maintenance manuals shall be provided. The manuals shall include detail and complete information as follows:
- Equipment operation
- Installation procedures
- Accurate schematic diagrams
- Performance specification (functional, electrical, mechanical, and environmental)
- Accurate troubleshooting, diagnostic and maintenance procedures
- Parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA
- Communications protocol
- One copy of the final pole mounted cabinet-wiring diagram shall be placed in the cabinet and one reproducible and two copies delivered to the Engineer.

- Training Requirements

- Prior to installation of any specified equipment, the Contractor's personnel shall have received training from the vendor/supplier on installation, operations, testing, maintenance, and repair procedures of all equipment.
- In addition, training shall be provided for up to 10 individuals designated by the Engineer. The training shall include all material and manuals required for each individual. The training shall be as follows:

- Engineering Training - A minimum of 8 hours of training for up to ten (10) engineering and operations personnel shall be provided. The training shall include both classroom and hands on CCTV equipment assembly operation and all equipment capabilities including interface to the TMC and the Video Switching and Control Equipment.

Maintenance Training - A minimum of 8 hours of training for ten (10) maintenance personnel shall be provided. The training shall include both classroom and hands on equipment operation and maintenance. It shall include the CCTV equipment theory of operation, operation instructions, circuit description, and troubleshooting, preventative maintenance, including interface to the TMC and Video Switching and Control Equipment for diagnostics

METHOD OF MEASUREMENT

This work will be measured as the number of HD CCTV Top Mount IP Camera Assemblies satisfactorily furnished and installed.

ITEM 683.030300NA - HD CCTV TOP MOUNT IP CAMERA ASSEMBLY

BASIS OF PAYMENT

The unit bid shall include the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work including camera assemblies, camera enclosure, controller module, composite Video and camera control cable, integrations, testing, training, cable. All miscellaneous hardware required for the installation of the unit, including but not limited to coaxial cables, fiber optic jump cables, control and power cabling, connectors, terminations, and mounting hardware, between the video and communication equipment. Payment for all documentation, testing, and test equipment used for the testing of the HD CCTV Top Mount IP Camera Assembly shall be included in this item.

ITEM 683.090100NA – 8 PORT HARDENED 10/100 ETHERNET SWITCH WITH ONE DUAL PURPOSE 10/100/1000 OR SFP PORT

DESCRIPTION

This work shall consist of furnishing and installing An 8 Port Hardened 10/100 Ethernet Switch with one Dual Purpose 10/100/1000 or SFP Port in accordance with the contract documents and as directed by the Engineer.

MATERIALS

1. Requirements

1.1. All materials furnished, assembled, fabricated and installed shall be new, corrosion resistant and in strict accordance with the requirements set forth in this specification.

1.2. This specification shall consist of an Ethernet Switch, as specified in these specifications. The switch shall provide Ethernet connectivity from the field cabinets to the NCDPW Traffic Management Center or any other designated locations as specified by the Engineer.

The Ethernet Switch shall be fully-compatible with all of the software management functions of the existing central switch and Cisco Works, the existing Traffic Management Center Network Management Software.

The Ethernet Switch must be registered and licensed to Nassau County Department of Public Works, Traffic Management Center..

1.3. The switch shall have (8) 10/100 baseTX (RJ-45) Ports, and (1) Dual Purpose 10/100/1000 or SFP Port.

2. Dimensions

2.1. The Ethernet Switch shall be rack-mountable in a standard 19 inch rack in accordance with EIA-310D and shall not exceed external dimensions of 1.73” (H) x 10.6” (W) x 6.4” (D).

2.2. The Ethernet Switch shall comply with the following standards:

2.2.1. RMON I and II standards
2.2.2. SNMPv1, v2c, and v3
2.2.3. IEEE 802.1d Spanning Tree Protocol
2.2.4. IEEE 802.1p CoS classification
2.2.5. IEEE 802.1q VLAN
2.2.6. IEEE 802.1w Rapid Convergence Spanning Tree Protocol
2.2.7. IEEE 802.1x Port Access Authentication
2.2.8. IEEE 802.3ad Link Aggregation Control Protocol (LACP)
2.2.9. IEEE 802.3af PoE
2.2.10. IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
2.2.11. IEEE 802.3 10BASE-T
2.2.12. IEEE 802.3u 100BASE-T/TX
2.2.13. IEEE 802.3ab 1000BASE-T
2.2.14. IEEE 802.3z 1000BASE-X

3. Regulatory Agency Approvals

3.1.1. Safety certifications: UL 1950/CSA 22.2 No. 950
3.1.2. IEC 950-EN 60950
3.1.3. AS/NZS 3260, TS001
3.1.4. CE Marking

4. Electromagnetic Emissions Certifications

4.1.1. FCC Part 15 Class A
4.1.2. EN 55022: 1998 Class A (CISPR22 Class A)
4.1.3. EN 55024: 1998 (CISPR24)
4.1.4. VCCI Class A
4.1.5. AS/NZS 3548 Class A
4.1.6. CE Marking
4.1.7. CNS 13438
4.1.8. BSMI Class A
4.1.9. MIC

5. Environmentally Hardened

5.1. The Contractor shall provide an Ethernet Switch that is environmentally hardened and capable of operating in the following conditions: temperatures ranging from 32° F to 113° F, relative humidity from 10 to 85% (noncondensing) and altitudes up to 10,000 feet.

6. Power

6.1. The Ethernet Switch shall contain an internal power supply that shall support input voltages between 100 and 240 VAC. The supplied AC power cord shall be used to connect the AC power conductor to an AC duplex outlet within the cabinet. If the Ethernet Switch is installed at location where an AC duplex outlet is not readily available, the Contractor shall coordinate with the Engineer in order to modify the AC power cord, or provide other power cabling that the Contractor shall utilize, in order to make appropriate connections to the available AC power.

The Ethernet Switch shall permit input voltages ranging from 100 through 127 Volts AC (RMS) at 60 Hz, or permit voltages from 200 through 240 Volts AC (RMS) at 50 Hz. The Ethernet Switch shall have a DC input voltage of +12 V at 13 amps.

7. Communications Aspects and Switching Attributes

The Ethernet Switch shall provide acceptable levels of Quality of Service (QoS) and provide switching capabilities appropriate for interfacing with the equipment within the field cabinet. In specific:

7.1.1. The Ethernet Switch shall support the metering/policing of incoming packets to restrict incoming traffic flows to a certain rate: The Ethernet Switches shall support four (4) egress queues per port to enable differentiated management of up to four (4) types of traffic. The Ethernet Switch shall support a minimum of 128 aggregate or individual ingress policers and 8 aggregate ingress policers on each Gigabit Ethernet port.

7.1.2. The Ethernet switch shall support auto-sensing on each non-GBIC port to detect the

speed of the attached device and automatically configures the port to 10, 100 or 1000 Mbps operation, easing the deployment of the switch in mixed 10, 100, 1000 BASE-T environments.

7.1.3. The Ethernet Switch shall be equipped with multifunction LED's per port for port status, half-duplex or full-duplex, 10BASE-T/100/BASE-T/10000BASE-T. LED's for system redundant power supply and bandwidth usage shall also be available.

7.1.4. The Ethernet Switch shall support SNMP protocol and telnet for remote monitoring and troubleshooting. The Ethernet Switch shall support Remote Monitoring (RMON) software agent for RMON groups, where data history, statistics, alarms, events can be collected for traffic management, monitoring and analysis.

7.1.5. The Ethernet Switch shall support Switched Port Analyzer (SPAN) port to monitor the traffic going through a single or multiple ports.

7.1.6. The Ethernet Switch shall support Remote Switched Port Analyzer (RSPAN), where the network administrator can monitor the port switch traffic from any other switch in the same network.

7.1.7. The Ethernet Switch shall support Network Timing Protocol (NTP) to provide an accurate and consistent time stamp on all switches within the network.

7.1.8. The Ethernet Switch shall support Trivial File Transfer Protocol (TFTP) for software upgrade and configuration deployment.

7.1.9. The Ethernet Switch shall support filtering of incoming traffic based on the following:

- Layer2, Source Media Access Controller (MAC) Address, Destination MAC address
- Layer3, Source IP Address, Destination IP address
- Layer4, TCP source or destination port number, UDP source or destination port number.

7.1.10. The Ethernet Switch shall support the 802.x1 standard that allows users to be authenticated, regardless of which LAN port is being accessed. The Ethernet Switch shall support 802.x1 with VLAN assignment in order to permit dynamic VLAN assignment for a specific user, regardless of where the user is connected. In addition, the Ethernet Switch shall support time-based ACL's in order to allow the implementation of security settings during specific periods of the day, or days of the week.

7.1.11. The Ethernet Switch shall support IGMP Filtering providing multicast authentication by filtering out non-subscribers and limits the number of concurrent multicast streams available per port.

7.1.12. The Ethernet Switch shall support Intrusion Detection System (IDS) to allow the IDS to take action when an intruder is detected.

7.1.13. The Ethernet Switch shall support Secure Socket Shell (SSH), Kerberos, and

SNMPv3 providing network security by encrypting administrator traffic during Telnet and SNMP sessions.

7.1.14. The Ethernet Switch shall support 802.x1 with port security authentication using access lists. In addition, the Ethernet Switch shall support MAC address notification allowing the administrator to be notified of new users as they are added or removed from the network.

7.1.15. The Ethernet Switch shall support QoS classification of incoming packets for QoS flows based on Layer 2–4 fields: Layer 2 fields (or a combination) for classifying incoming packets to define QoS flows: source MAC address, destination MAC address, and 16-bit Ethertype. Layer 3 and 4 fields (or a combination) for classifying incoming packets to define QoS flows: source IP address, destination IP address, TCP source or destination port number, and UDP source or destination port number.

7.1.16. The Ethernet Switch shall offer the ability to limit data flows based on MAC source/destination address, IP source/destination address, TCP/UDP port numbers, or any combination of these fields. The switch shall also offer the ability to manage data flows asynchronously upstream and downstream from the end station or on the uplink.

7.1.17. The Ethernet Switch shall support Layer3 routing including Multiplayer Switching (MLS) for inter-VLAN routing. In addition, the Ethernet Switch shall support local proxy ARP working in conjunction with private VLAN edge to minimize broadcasts and maximize available bandwidth.

7.1.18. The Ethernet Switch shall support Spanning-Tree protocol on both the RJ45 ports and the SFP Port in order to provide path redundancy while preventing undesirable loops in the network

7.1.19. The Ethernet Switch shall support Port Aggregation Protocol (PAgP) in order to automate the creation of Fast EtherChannel or EtherChannel groups, thus enabling linking to another switch, router, or server.

7.1.20. The Ethernet Switch shall support multicast VLAN Registration (MVR) as required for the deployment of multicast traffic across an Ethernet network. The MVR allows a subscriber on a port to subscribe and unsubscribe to a multicast stream on the network-wide multicast VLAN.

7.1.21. The Ethernet Switch shall support the Internet Group Management Protocol (IGMP). IGMP is utilized in order to permit the Ethernet Switch to receive all IGMP conversation between hosts and routers. When the Ethernet Switch detects an "IGMP join" request from a host for a given multicast group, the

7.1.22. The Ethernet switch shall provide full IPv4 dynamic routing.

7.1.23. Ethernet switch is to add the host's port number to the group destination address (GDA) list for that group. When the Ethernet Switch detects an "IGMP leave" request, it is to remove the host's port from the content-addressable memory (CAM) table entry.

7.1.24. The Ethernet Switch shall support distance Vector Multicast Routing Protocol (DVMRP) tunneling for interconnecting two multicast-enabled networks across nonmulticast networks.

7.1.25. The Ethernet Switch shall support IP multicast routing to enable the network to receive the multicast feed requested and for switches not participating in the multicast to be pruned support for The Protocol Independent Multicast (PIM) sparse mode (PIMSM), PIM dense mode (PIM-DM), and PIM sparse-dense mode.

7.1.26. The Ethernet Switch shall support high-performance IP routing, supporting fallback bridging for forwarding of non-IP traffic between two or more VLAN's.

7.1.27. The Ethernet Switch shall support switch port Auto-recovery (or "errDisable") automatically attempts to re-enable a link that becomes disabled due to a network error.

7.1.28. The Ethernet switch shall support bandwidth aggregation per port, per destination and origin, using the MAC or IP addresses. It also shall aggregate the bandwidth per-port for multicast and unicast to control and prevent faulty end stations to degrade the overall system performance The Ethernet Switch is to be capable of sharing a minimum of 64 MB DRAM and 16 MB Flash memory among all ports.

7.1.29. The Ethernet Switch shall support a minimum of 12000 configurable MAC addresses.

7.1.30. The Ethernet Switch shall be compatible with Cisco Works management software

7.1.31. The Ethernet Switch must utilize Cisco Discovery Protocol.

8. Cables and Connectors

8.1. The Ethernet Switch shall utilize the following cables and connectors:

8.1.1. 10BASE-T ports: RJ-45 connectors; two pair Category 3, 4, 5e, 6 or 7 unshielded q twisted pair UTP cabling.

8.1.2. 100BASE-T ports: RJ-45 connectors; two pair Category 5e, 6 or 7 unshielded q twisted pair UTP cabling.

8.1.3. 1000BASE-T ports: RJ-45 connectors; two-pair Category 5e, 6 or 7 UTP cabling.

8.1.4. SFP Gigabit Ports: Single mode fiber optic cable with ST connectors

8.1.5. Management console port: 8-pin RJ-45 connector, RJ-45-to-RJ-45 rollover cable with RJ-45-to-DB9 adapter for PC connections; for terminal connections, RJ- 45-to-DB25 female data-terminal-equipment (DTE) adapter.

8.1.6. Each Ethernet switch provided shall include Two (2) 10/100 Ethernet LX Single Mode Fiber SFP Modules capable of transmitting data over a distance of 6.2 miles. In the event that the Ethernet switches require an SFP Module that will transmit in excess of 6.2 miles, an SFP module with a longer transmit capacity will be substituted at no additional charge. SFP modules provided must be compatible with

the existing Cisco switches and network software in the County Traffic management Center.

CONSTRUCTION DETAILS

9. Installation

9.1. The Contractor shall furnish and install the Ethernet Switches at the designated locations as specified by the Engineer. The Contractor shall install the switches in full compliance with the manufacturer's recommendations.

9.2. The Contractor shall mount the rack-mountable Ethernet onto the rack within the equipment cabinet, at each location.

9.3. The Contractor shall be responsible to integrate the Ethernet Switch with the other devices within the cabinet that communicate utilizing Ethernet Protocol.

9.4. The Contractor shall reserve two (2) Ethernet Ports on the Ethernet Switch for connecting the NCDPW maintenance computers.

9.5. The physical layout of the Ethernet Switch and its cables, in relation to the other equipment within the cabinet shall be acceptable to the Engineer.

9.6. The Contractor shall maintain all furnished equipment and software in good working condition and shall provide replacement, at no additional cost to the County, due to breakdown, damage, or theft within ten (10) working days.

10. Documentation

10.1. Three (3) advanced copies of equipment manuals furnished by the manufacturer shall be submitted to the Engineer for review at least ten (10) days prior to the scheduled start of the 30 day operational test. The manuals shall include the following:

10.1.1. Complete installation and operation procedures

10.1.2. Complete performance specifications (functional, electrical, mechanical and environmental) of the unit

10.1.3. Complete schematic diagrams

10.1.4. Complete maintenance and troubleshooting procedures

11. 30 Day Operational Test

11.1. The 30 day operational test shall commence with the approval of the engineer after all the communications equipment in a zone or local fiber ring has been installed and operational.

11.2. The contractor shall submit the proposed testing procedure to the engineer for approval two weeks prior to the proposed test start date.

11.3. The contractor shall perform any repairs, construction or modifications as required in order to comply with the acceptance test at no additional cost to the County.

11.4. Any malfunctions that occur shall stop the 30 day test. Upon completion of the necessary repairs, a new 30 day test period shall commence.

11.5. The contractor shall be responsible to maintain a log during the test period documenting any repairs or modifications made during the test period.

METHOD OF MEASUREMENT

This work will be measured as the number of 8 Port Hardened Ethernet Switches satisfactorily furnished and installed in accordance with the plans and as specified herein.

BASIS OF PAYMENT

The unit price bid shall include the cost of furnishing, installing, and integrating the Ethernet Switch with all equipment, software and cabling within the equipment cabinet and with existing switches and network software in the County Traffic management Center.

ITEM 683.090600NA - 10/100 MBPS OPTICAL ETHERNET CONVERTER, SHELF MOUNT
ITEM 683.090700NA - 10/100 MBPS OPTICAL ETHERNET CONVERTER, RACK MOUNT
ITEM 683.090800NA - 1000 MBPS OPTICAL ETHERNET CONVERTER, RACK MOUNT

DESCRIPTION

This work shall consist of furnishing and installing Optical Ethernet Converters of the type designated in the contract documents and as directed by the Engineer.

MATERIALS

1. Requirements

1.1. All materials furnished, assembled, fabricated and installed shall be new, corrosion resistant and in strict accordance with the provisions set forth in this specification.

1.2. This specification shall consist of:

- 10/100 Mbps Optical Ethernet Converters used to transmit and receive Ethernet data over fiber between the communication hubs and the field control equipment.
- 10/100/1000 Mbps Optical Ethernet Converters used to transmit and receive Ethernet data over fiber between the communication hubs and NCDPW Traffic Management Center equipment.
- Shelf-mount Optical Ethernet Converters shall be installed in the field at traffic signal equipment cabinets and rack-mount Optical Ethernet Converters shall be installed in the field at hub cabinets as designated on the plans or as ordered by the Engineer.
- One (1) 10/100 Ethernet LX Single Mode fiber SFP Module with LC connector shall be furnished with each 10/100 Mbps unit provided.
- Two (2) 10/100/1000 Ethernet LX Single Mode fiber SFP Modules with LC connectors capable of transmitting over a distance of 10 km shall be furnished with each 1000 mbps unit provided. In the event that the 1000 Mbps units require an SFP Module that will transmit in excess of 6.2 miles, an SFP module with a longer transmit capacity will be substituted at no additional charge.
- All SFP Modules furnished and installed shall be compatible with the existing Cisco switches and network software in the County Traffic management Center.

1.3. The equipment furnished as part of these items shall meet the following requirements:

- Be from the same manufacturer
- Not require manual adjustment
- Transmit Ethernet 10/100 Mbps (10/100 Mbps units) and 10/100/1000mbps (1000Mbps units) data over two (2) single mode fibers that exist or are furnished as part of this contract.

1.4. Optical:

- Optical port 100 BASE -FX (10/100 Mbps units)
- Optical port: 1000 BASE-FX (1000 Mbps units)
- Fiber type: Single mode
- Optical transmitter: Laser
- Optical Wavelength: 1310nm
- Link loss budget range: minimum 0 to 15 dB (10/100 Mbps units)
- Link loss budget range: minimum 0 to 10 dB (1000 Mbps units)
- Dynamic range 0 to 15 dB w/o external attenuators (10/100 Mbps units)
- Dynamic range 0 to 10 dB w/o external attenuators (1000 Mbps units)
- Connector: LC
- A loss of optical link contact closure shall be provided for remote alarm sensing

1.5. Data:

- Data rate 10/100 Mbps Auto-sensing (10/100 Mbps units)
- Data rate 10/100/1000 Mbps Auto-sensing (1000 Mbps units)
- BER $< 10^{-9}$
- Data Interface: Ethernet (IEEE 802.3)
- Ethernet connector: RJ-45

1.6. Indicators:

- Led indicators shall be provided to indicate the following:
  - Data transmit/ receive status
  - Power-on

1.7. Environmental:

- The Optical Ethernet Converters shall meet the environmental requirements for operating and storage ambient Temperature, Mechanical Shock, Vibration, Humidity with Condensation, High-Line/Low-Line Voltage Conditions, and Transient Voltage Protection of NEMA TS-1/TS-2 and the CALTRANS specification for Traffic Signal Control Equipment.

1.8. Electrical Requirements:

- Voltage 115 -120 VAC. An adapter may be used to provide the required power to the stand-alone data transceivers. A power supply shall be contained in the rack.
- Current: 200 mA max (10/100 Mbps units)
- Current: 600 mA max (1000 Mbps units)

- Re-settable circuit breakers or fuses shall be provided to protect the equipment. The protection may be provided either as part of the cabinet wiring or on the equipment.
- All equipment shall be hot swappable.

1.9. Mechanical:

- Shelf-Mount
  - The shelf-mount Ethernet converters shall be suitable for mounting on a shelf or attached to a wall/ rack cage rail of the cabinet and shall have the following maximum dimensions: 7" x 6" x 1".
- Rack Mount
  - The rack shall be fully wired to accommodate a minimum of ten (10) Ethernet Converters. All power to the converters shall be distributed through the rack.
  - The slots shall be assigned in accordance with the plans or as directed by the Engineer. The rack shall comply with EIA 19 mounting spacing.
  - The maximum dimensions of the rack shall be as follows: 19" wide x 7" high by 5.25" deep.

CONSTRUCTION DETAILS

The Contractor shall install the shelf and rack mounted Optical Ethernet Converters in the equipment cabinets designated on the plans. The converters shall be connected to the fiber optic cable through the fiber optic patch panel furnished as part of the cabinet items and fiber optic patch cables.

2. Documentation Requirements:

2.1. Manuals

- Six (6) advance copies of equipment manuals furnished by the manufacturer shall be submitted to the Engineer for review at least ten-days prior to the scheduled start of the first Operational Stand-Alone Test. The Engineer will verify the manufacturer's equipment manual as part of the test and integration process. The equipment manual incorporating the Engineer's corrections and comments shall be integrated by the Contractor into the operations and maintenance manual. The manuals shall, as a minimum, include the following:
  - Complete and accurate schematic diagrams
  - Complete installation and operation procedures
  - Complete performance specifications (functional, electrical, mechanical and environmental) of the unit.

- Complete list of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC/ RETMA or EIA.
- Complete maintenance and troubleshooting procedures.

3. Stand Alone Test

3.1. After installation of the equipment in the field and prior to integration of the equipment into the system, the Contractor shall perform a 30 day operational test in the field for each of the optical Ethernet converters installed.

3.2. The test shall demonstrate as a minimum the ability of the converter to transmit and receive Ethernet data between the field equipment and hubs or the hubs and central as appropriate. As part of the operational test the optical transmit and receive levels shall be recorded for each converter.

3.3. If the Stand Alone Test fails, the equipment shall be repaired or replaced and the test shall be rerun for that site. If a component has been modified as a result of a failure, that component shall be replaced in all like units and the test shall be rerun for each unit.

METHOD OF MEASUREMENT

This work will be measured as the number of Optical Ethernet Converters satisfactorily furnished, installed, made fully operational, and tested in accordance with the contract documents, specifications, and as directed by the Engineer.

BASIS OF PAYMENT

The unit price bid to furnish and install an Optical Ethernet Converter shall include the cost of furnishing all labor, materials, tools, documentation, testing, 19 inch rack equipment, Ethernet and fiber optic cables and equipment necessary to satisfactorily complete the work in accordance with the Contract Documents.

ITEM 683.115100NA – WI-FI TRAVEL TIME READER

DESCRIPTION:

This work shall consist of furnishing and installing long range, wide angle Wi-Fi detectors capable of measuring vehicle travel flows by measuring Wi-Fi MAC (Media Access Control) addresses. The system will be used to measure and collect high quality travel times, in real-time, from the traffic stream by matching MAC addresses at two or more locations across a network.

MATERIALS:

The Wi-Fi receiver shall consist of the following equipment furnished as part of this item:

1. Wi-Fi Radio receiver, Antenna with cable and all mounting hardware
2. MAC Address Controller Unit with all required interface cabling and software

The receivers will typically be installed on traffic signal span poles, mast arms, control cabinets or as shown on the plans. The antenna/radio shall sense MAC addresses and signal strength from Wi-Fi devices in the configured detection zone. The MAC Address Controller unit shall be powered from and installed into the input card file in a traffic signal control cabinet. MAC Address Controller Unit shall forward the MAC addresses to the existing Nassau County Traffic Management Foundation control server. This will allow Foundation to generate travel times and other performance statistics using the data from multiple Wi-Fi receivers across the County's traffic communications network. The MAC Address Controller will be connected directly to the Ethernet switch in the traffic signal control cabinet.

Wi-Fi field equipment must transmit raw, un-encrypted MAC address information back to the Nassau County Traffic Management Center over the County's existing Ethernet based traffic communications network. This will be completed through TCP/IP socket connections initiated from the TMC servers. Configurable MAC address store and forward ability with a buffer of at least 15 minutes for use during communication outages will be provided. Wi-Fi equipment installed must either have direct communications with the County's existing Foundation management system, or with a central server that will communicate with the field Wi-Fi devices and then with the County's existing Foundation system. NTCIP or the latest National Standard communications protocol must be utilized when communicating across the Nassau Traffic network. If direct communications with the County's existing Foundation servers is not feasible, then a primary and backup server must be provided and installed at the Nassau County Traffic Management Center. This server will communicate directly with the field Wi-Fi readers, and the existing Foundation servers to provide MAC address data, communication statistics and device configuration interfaces. The server must be provided with software that will manage Wi-Fi reader maintenance, operations and communications status providing both GUI and Foundation interfaces. Whether communicating directly with the Foundation servers, or using another server, the Foundation Server must receive raw, unencrypted MAC address information including signal strength and multiple reads per address when obtained in the field in order for the system

to work.

Any servers, hardware or software provided as part of this specification must include a royalty-free, perpetual license for use by Nassau County. No off site hardware will be permitted and no annual or continual operational fees or licenses will be paid. Any server hardware, as well as the operating systems installed on it, must be standard to the IT industry and commonly available to the County. This will be a closed loop system with all the necessary software and hardware within Nassau County.

All material furnished, assembled, fabricated or installed shall be new, corrosion resistant and in strict accordance with all the details shown in the Contract Documents and in this Special Specification.

The radio, antenna and controller unit shall meet the following minimum system requirements:

Protocols

- IEEE 802.11 g
- IEEE 802.11 b

Frequency Band

- 2400 to 2483.5 MHz (ISM Unlicensed Band)
- A minimum of 10 frequency channels
- Channel Bandwidth – 20 MHz (11 g), 22 MHz (11 b)

Data Rate

- Selectable from 54 to 1 Mbps auto fall back

Antenna Gain

- 9 dBi

Antenna Type

- Omni-directional

Receive Sensitivity

- -87 dBm at 54 Mbps
- -93 dBm at 11 Mbps

ITEM 683.115100NA – WI-FI TRAVEL TIME READER

Interfaces (Minimum)

- 10/100Base-T network access via RJ45
- (2) USB 2.0
- TCP/IP 10/100Base-T Ethernet for local configuration IP

Connectivity

- HTTP, PPP, PPTP, SSH

Input Voltage

- 22-26 VDC, 9-15 VDC

Power Consumption

- 2.4 W typical

Antenna Dimensions

- 20” L x 1” D
- 2.5 lbs – with all required mounting hardware

Operating Temperature

- -29ºF to +165ºF

CONSTRUCTION DETAILS:

The Contractor shall install the Wi-Fi Travel Time Receivers at locations designated on the plans and perform the initial programming and set up of the Wi-Fi reader. Any required control or configuration software shall be provided under this item. The equipment required to connect the Wi-Fi readers to the existing Nassau County Traffic communications network or to a separate communications network will be included under separate contract items.

The Contractor shall submit his proposed antenna mounting scheme to the Engineer for approval prior to installation. In general, the antenna shall be mounted to the specified signal pole, mast arm or cabinet at a height recommended by the Engineer for optimal sensing. The antenna cable shall be routed into the existing signal controller cabinet, HUB or auxiliary cabinet in accordance with the installation detail plans.

ITEM 683.115100NA – WI-FI TRAVEL TIME READER

Documentation Requirements

Six (6) advance copies of equipment manuals furnished by the manufacturer shall be submitted to the Engineer for review at least ten-days prior to the scheduled start of the first Operational Stand-Alone Test. The Engineer will verify the manufacturer's equipment manual as part of the test and integration process. The equipment manual incorporating the Engineer's corrections and comments shall be integrated by the Contractor into the operations and maintenance manual as described in the General Requirements. The manuals shall, as a minimum, include the following:

a. Complete and accurate schematic diagrams

b. Complete installation and operation procedures

c. Complete performance specifications (functional, electrical, mechanical and environmental) of the unit.

d. Complete list of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC/ RETMA or EIA.

e. Complete maintenance and troubleshooting procedures.

f. Complete documentation of all software interfaces including those used for transmitting MAC address data, maintenance information and device configuration.

g. Testing Requirements

After installation of the equipment in the field and prior to integration of the equipment into the system, the Contractor shall perform an Operational Test in the field for each of the Wi-Fi Travel Time Receivers installed. The test shall demonstrate as a minimum the ability of the receiver to sense MAC addresses at each field location as designated on the plans under conditions of (1), a range of vehicle speeds from stationary to 20% above the posted speed, and (2), various vehicle densities typical of the installed location. Once integrated with the County's existing Foundation system, a 30-day operational test will be performed. The test must demonstrate continued and un-uninterrupted transfer of MAC address info from field equipment to the Traffic Management Center.

If the Operational Test fails, the equipment shall be repaired and the test shall be rerun for that site. If a component has been modified as a result of a failure, that component shall be replaced in all like units and the test shall be rerun for each unit.

METHOD OF MEASUREMENT:

The Wi-Fi Travel Time Receivers will be measured for payment as the number of each specified in the Contract Documents satisfactorily installed.

BASIS OF PAYMENT:

The unit price bid for each Ethernet Switch shall include the cost of furnishing all labor, materials and tools and equipment necessary to complete the work and to make the Wi-Fi Travel Time Receiver fully operational and tested. Payment for the antenna, antenna cable, conduit between the antenna and the controller cabinet and all required mounting hardware and materials shall be included under this item.

Payment for all documentation, control software, testing and test equipment shall be included under this item.

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ITEM 683.921072NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
ITEM 683.921144NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 144 FIBERS
ITEM 683.921288NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 288 FIBERS
ITEM 683.921500NA - FIBER OPTIC DROP CABLE

DESCRIPTION:

This work shall consist of the furnishing and installation of fiber optic cables, passive components and miscellaneous equipment required for a complete cable plant in accordance with the contract documents and as directed by the Engineer.

MATERIALS:

Equipment to be installed as part of these bid items include the following:

1. Single Mode Fiber Optic Cable
2. Fiber Optic Cable Connectors and Splices
3. Fiber Optic Splice Trays
4. Fiber Optic Splice Cases
5. Fiber Optic Breakout Kits

Other passive components that are required to form a complete communication system include (1) terminators and (2) moisture and water sealants and cable caps for below grade applications. The components supplied shall be commercially available components whose specifications indicate state-of-the-art capability for the application.

1. Single-mode Fiber Optic Trunk Cable

The single-mode fiber optic cable shall incorporate a water swellable tape and be of a loose buffer tube cable design as specified herein. The fiber optic cable shall be all dielectric suitable for conduit and aerial installation in an outside cable plant environment and for indoor cabling environments when installed in accordance with the current NEC and local building code requirements. All cable shall consist of the number of fibers specified in the contract documents.
The cable shall meet the requirements of the United States Department of Agriculture Rural Utility Service (RUS) 7 CFR1755.900 and the requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1999 at a minimum, and shall be new, unused and of current design and manufacture. The cable manufacturer shall have a minimum of three years experience in manufacturing fiber optic cable of similar design.

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Optical Requirements

The fiber shall meet the requirements of EIA/TIA-492CAAA "Detail Specification for Class Iva Dispersion-Unshifted Single-Mode Optical Fibers".

Attenuation: The nominal attenuation shall not exceed 0.4 dB/km at a wavelength of 1310 nm and 0.3 dB/km at a wavelength of 1550 nm. Fiber attenuation shall be uniform with no discontinuities greater than 0.1 dB. The attenuation at 1383 + 3 nm shall not exceed 2.1 dB/km. The attenuation measurements shall be in accordance with EIA/TIA Standards FOTP-20, 59, 61 and 78. The average change in attenuation at extreme operational temperatures (-40º F to 158º F) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm. The change in attenuation measurements shall in accordance with EIA/TIA Standard FOTP-3.

Cutoff Wavelength: Not to exceed 1250 nm. Mode-Field Diameter:

9.30 ± 0.50 μm at 1310 nm.

10.50 ±1.00 μm at 1550 nm.

Zero Dispersion Wavelength: 1312 nm ±10 nm.

Zero Dispersion Slope: Not to exceed 0.092 ps/(nm^2×km). Polarization Mode Dispersion: Not to exceed 0.5 ps/(km)1/2

Dispersion: Less than 3.5 ps/(nm*km) for 1285 nm through 1330 nm and less than 18 ps/(nm*km) at 1550 nm as measured in accordance with EIA/TIA Standard FOTP-169.

Mechanical Requirements

Fibers

All optical fibers shall be Corning glass fibers or approved equivalent. All fibers within a given cable shall be from the same manufacturer and shall contain no factory splices. Each fiber shall conform to the following minimum requirements:

- Typical Core Diameter: 8.3 μm (0.327mil)
- Cladding Diameter: 25.0+1.0 μm (1 mil to 0.04mil)

- Core-to-Cladding Offset: Not to exceed 0.5 μm(0.02 mil)
- Cladding Non-Circularity: Not to exceed 1.0 % Color Coating

Each fiber shall have a color coating applied to it by the manufacturer. The coating shall not affect the optical characteristics of the fiber. The basic color configuration shall be as follows, in accordance with EIA/TIA-598-A:

1. Blue	4. Brown	7.Red	10. Violet
2. Orange	5. Slate	8.Black	11. Rose
3. Green	6. White	9.Yellow	12. Aqua

The nominal colored fiber diameter shall be 250 μm. (10 mil). Primary Coating

Each fiber shall have a dual layered, UV acrylate coating applied to it by the manufacturer. The coating shall be mechanically strippable without damaging the fiber. The coating diameter shall be 245+10 μm(10 mil±0.4 mil).

Central Strength Member: The strength member shall consist of a dielectric, glass-reinforced plastic rod. Buffering

All fibers shall be enclosed in non-conductive loose buffer tubes. Each buffer tube shall contain up to twelve (12) fibers. The Contractor shall submit the fiber count per buffer tube and the buffer tube count configuration to the Engineer for approval. The fiber shall not adhere to the inside of the buffer tube. Each buffer tube containing fibers shall be color coded in a similar scheme as the fiber color. The basic color configuration shall be as follows, in accordance with EIA/TIA-598-A:

1. Blue	4. Brown	7. Red	10. Violet
2. Orange	5. Slate	8. Black	11. Rose
3. Green	6. White	9. Yellow	12. Aqua

In basic color configuration is repeated with the inclusion of a black tracer for buffer tubes 13 through 24.

In buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together. Buffer tubes shall be of dual-layer construction.

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The buffer tubes shall be dry tube. Gel filled tubes will not be accepted.

Filler Rods: Filler rods shall be used to fill all unused buffer tubes or shall be used instead of unused buffer tubes. The filler rod shall be a solid polyethylene material and shall be natural in color. The filler rods shall maintain the concentricity of the cable cross section where required.

Stranding: The buffer tubes shall be stranded around the central strength member using the reverse oscillarion (S-Z) stranding process. Water swellable yarns shall be applied longitudinally along the central member during stranding.

Water Swellable Tape: A water swellable tape shall be applied longitudinally over the stranded tubes/fillers. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter.

Tensile Strength Provisions: Aramid yarn shall be helically stranded evenly around the cable core to provide tensile strength. The yarn shall enable the cable to withstand a maximum pulling force of 607 lbs during installation and 200 lbs long term installed without changing the characteristics of the optical fibers. Each length of cable shall have sufficient strength to be installed in continuous lengths as specified on the plans.

Outer Jacket: A medium density polyethylene (or approved equal) outer jacket shall be applied over the entire cable assembly. The outer jacket shall have a minimum nominal jacket thickness of 1/16 inch. The polyethylene shall contain carbon black and shall not promote the growth of fungus. Jacketing material shall be applied directly over the strength members and the water swellable tape. The outer jacket shall contain no metallic elements and shall be of a consistent thickness.

The MDPE jacketed material shall be as defined in ASTM D1248, Type II, Class C and Grades J4, E7 and E8. The jacket shall be marked in contrasting color at 2 feet intervals with the following information: NCDPW TRAFFIC FIBER OPTIC CABLE - XXX – YYZZ where XXX shall equal the number of optical fibers in the cable and YYZZ shall be the month and year that the cable was manufactured. The height of the markings shall be approximately 3/32 inch.

In addition, the outer jacket shall have sequential meter markings as approved by the Engineer. The actual length of the cable shall be within -0% +1% of the length markings.

Outer jacket shall be ORANGE in color for underground applications.

Outer jacket shall be BLACK in color for aerial applications.

Ripcord: The cable shall contain a ripcord under the sheath to facilitate cable preparation.

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Bend Radius: The cable shall be capable of withstanding a minimum bending radius of ten (10) times its outer diameter during operation and fifteen (15) times its outer diameter during installation without changing the characteristics of the optical fibers.

Diameter: The outer diameter of the cable shall be less than 19/32 inch for cables containing 72 fibers or less and 13/16 for cables containing between 72 fibers and 288 fibers.

Other Requirements

Manufacturer's Certification: The cable manufacturer shall certify that each reel of cable furnished, meets or exceeds the following specifications:

Fluid Penetration: When a one meter static head of water or equivalent continuous pressure is applied at one end of a one meter length of filled cable for one hour, no water shall leak through the open cable end. The water penetration testing shall be performed in accordance with EIA/TIA Standard FOTP-82.

Filling Compound Flow: When tested in accordance with EIA/TIA Standard FOTP-81, the cable shall exhibit no flow (drip or leak) of filling or flooding compound at 158° F.

Compressive Strength: When tested in accordance with EIA/TIA Standard FOTP-41, the cable shall withstand a minimum compressive load of 126 lb/inch applied uniformly over the length of the sample and applied at the rate of 0.1 inch per minute. The load shall be maintained for a period of 1 minute and then decreased to 63 lb/in. The 63lb/in load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 63 lb/in load. The change in attenuation shall not exceed 0.15 dB at 885lb/in.

Tensile Loading and Bending: When tested in accordance with EIA/TIA Standard FOTP-33, using a maximum mandrel and sheave diameter of 22 inch, the cable shall withstand a rated tensile load of 600 lbs and a residual load of 30% of the rated installation load. The axial fiber strain shall be $\leq$ 20% of the fiber proof level after completion of 10 minutes of conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm.

Impact Resistance: When tested in accordance with EIA/TIA Standard FOTP-25 except that the number of cycles shall be two at three locations along a one-meter cable length and the impact energy shall be at least 3.24lb/ ft (in accordance with ICEA S-87-640), the change in attenuation shall not exceed 0.15 dB at 1550 nm.

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Cable Flex: When tested in accordance with EIA/TIA Standard FOTP-104, the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The fibers shall not experience an attenuation change greater than 0.15 dB at 1550 nm. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.

Temperature Cycling: When tested in accordance with EIA/TIA Standard FOTP-3, the change in attenuation at extreme temperatures (-40°F to +158° F) shall not exceed 0.15 dB/km at 1550 nm.

Low or High Temperature Bending: When tested in accordance with EIA/TIA Standard FOTP-37, the cable shall withstand four full turns around a mandrel of # 20 times the cable diameter for four hours at test temperatures of -22°F and +140°F. Neither the inner our outer surfaces of the jacket shall exhibit visible cracks, splits, tears or other openings. The fibers shall not exhibit a change in attenuation greater than 0.30 dB/km at 1550 nm.

Cable Twist: When tested in accordance with EIA/TIA Standard FOTP-85, a length of cable no longer than 6½ft shall withstand 10 cycles of mechanical twisting. The fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.

2. **Fiber Optic Drop Cable**

Fiber optic drop cables shall be installed in conduit, between the mainline fiber optic backbone cable and equipment cabinets patch panels as shown on the plans. They shall be spliced to the appropriate fiber within approved splice cases in pullboxes adjacent to equipment cabinets as specified.

Optical Requirements: The fiber optic drop cables shall have identical optical characteristics as the single-mode fiber optic trunk cable specified above.

Material Requirements

The drop cable shall have the identical physical configuration as the single-mode fiber optic trunk cable specified above. The fiber optic drop cable shall contain twelve (12) or more fibers. The number of fibers per drop cable shall be selected to allow for a minimum of 50% spare for the drop location.

The drop cable shall be able to withstand a minimum of 100 lbs of pulling force during installation.

The Contractor shall submit the drop cable buffer tube count configuration and fiber count per buffer tube to the engineer for approval.

The individual fibers in each drop cable shall be unterminated on one end and have a factory installed SM

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LC Duplex connectors on the other end. The unterminated end shall be fusion spliced to the appropriate mainline fiber in a splice case and the terminated end shall interface with the cabinet distribution rack specified under a separate contract item. The manufacturer shall factory test the cable assembly with connectors and provide results to the Engineer for approval prior to field installation.

The drop cable shall be of sufficient length to be installed as shown on the plans, with a minimum of 20 ft of slack provided on either end.

The Contractor shall follow the drop cable manufacturer's recommendation in the installation of the drop cables, including the individual breakout fibers.

3. **Fiber Optic Connectors**:

Fiber optic connectors shall be factory installed. Field installation of connectors shall only be permitted with the express consent of the Engineer and will be considered on a case by case basis. The connectors shall meet the following requirements:

- Type SM LC Duplex
- Uses ceramic ferrules
- Fiber secured within the ferrule with epoxy, as specified by the connector or epoxy manufacturer.
- Operating temperature: -4°F to +158°F
- Insertion loss: 0.5 dB maximum
- Return loss: 55 dB minimum

4. **Splice Cases**

The Contractor shall furnish and install fiber optic splice cases in locations where splices require protection. The typical location where they will be required is in pullboxes where the fiber optic trunk cable will be spliced to fiber optic drop cables. The splice cases shall meet the following minimum requirements:

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- The case shall be constructed of a rigid, high strength plastic material. The case shall be waterproof with the appropriate gaskets and protection to provide moisture integrity. When installed, the case shall be capable of withstanding severe conditions of moisture, vibration, impact, cable stress and temperature extremes.

- The case shall be capable of holding the type of splice trays specified herein, for fusion splices. The case shall have the capability of holding trays from various manufacturers. The basic case shall have the capacity to hold three (3) splice trays with 24 splices per tray.

- The basic case shall have the input/output capacity for 6 cables.

- The case shall be re-enterable without disturbing the fibers or the fiber splices. No special tools shall be required for installation of maintenance of the case. All hardware and miscellaneous parts shall be standard industry equipment.

- The splice case shall be mountable to standard U-shaped sign channels using stainless steel hardware, or manufacturer approved hardware. Mounting shall be as shown on the details.

- Nominal dimensions of the basic case shall be 22 inch long by 9 inch wide by 9 inch high. The basic case shall weigh 20 lbs maximum.

- The splice case shall have a termination block to terminate the central strength members of the fiber optic cables.

- The case shall be able to accommodate the total cables and number of cable trays and number of splices equal to or greater than the fiber count of the largest cable within the splice case or as called for in the plans.

- Splices cases shall be installed with un-used splice trays for future expansion.

5. **Splice Trays**

The Contractor shall furnish and install fiber optic splice trays to organize and store splices within splice cases. The trays shall be compatible with the fiber optic splices and splice cases specified herein and shall meet the following minimum requirements:

- The tray shall have the capacity for 24 splices. It shall be compatible with the fusion splices specified herein but shall also be adaptable to hold mechanical splices.

- The tray shall accommodate up to 8 loose tube buffers. No cable ties are to be used. The loose tube buffers shall be secured with a tube guide or channel snap.

- The tray shall accommodate both 250 micron and 900 micron fiber.

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- Slack fiber within the tray shall be placed in an oval shape along an inside wall of the tray.

- The fiber optic splice trays shall be stackable within the splice case. Any tray within a stack shall be accessible without disassembly of any of the other trays.

- The nominal dimensions of the splice tray shall be 16 inch long by 4 ½ inch wide by ½ inch high.

- Each tube shall be labeled within the splice case for easy identification.

6. **Fiber Optic Breakout Kits**

The fiber optic breakout kits contain all the tools and materials necessary to complete the installation of the fiber optic backbone and drop cables. It shall include, as a minimum, the following equipment:

- Pulling eyes with protective covering for the installation of preterminated fiber optic drop cable.

- Fiber optic installer test equipment, fusion splicers, test cables, connector adapters, inspection tools, attenuators, tracers, continuity checkers, consumables and all ancillary equipment.

Quality Assurance Provision

All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 ksi.

All optical fibers shall be attenuation tested. The attenuation of each fiber shall be provided to the Engineer with each reel of cable furnished.

The fiber optic cable shall conform to the following requirements:

Environmental Requirements

The cable shall function within specifications over the following temperature ranges:

- Shipping/Storage: -58°F to 158°F
- Installation: -22°F to 158°F
- Operation: -40°F to 158°F

CONSTRUCTION DETAILS:

All fiber optic cable will be installed in innerduct, steel conduit, lashed to or messenger cable, or over-lashed to existing cables as indicated in these contract documents or otherwise

directed by the Engineer. All fibers in the fiber optic cable shall be spliced and/or terminated in designated field cabinets or pullboxes only.

Prior to the installation of the fiber optic cable the Contractor shall submit his proposed cable plant design to the Engineer for approval. No cable shall be installed until the proposed cable plant design submission is approved by the Engineer. The cable plant design shall include the following:

- Catalog cuts and shop drawings for all cable, connectors, splice equipment, splice enclosures, splice trays and cable installation and test equipment.

- Preliminary locations of all proposed splices.

- Proposed pullbox locations where hand assists or intermediate assist winches will be required during installation.

- Proof of the experience requirements as defined in this special specification.

- Cable manufacturer's recommended cable installation techniques, both in conduit and overlashed to messenger or existing cable, such that the optical and mechanical properties of the cables are not degraded at the time of installation. The proposed recommendations shall include the following:

- Cable manufacture's approved pulling lubricant for use on the cable and method of application.

- No other lubricants will be permitted.

- Installation set-up including size and types of rollers, feeder guides, tension gauge make and model number, attachment of pulling jig to jacket and direction of pull.

- Method to overlash the cables to existing cables including spacing of drip loops, lashing material, slack cable storage.

- Maximum pulling tensions, which shall specify both pulling from the cable=s conductors and for pulling from the cable=s outer jacket.

- Minimum bend radii, which shall specify a radius both loaded and unloaded.

- Method to install multiple cables.

The cable plant design shall be submitted at the Milestone specified in the Special Note of the Contract Documents.

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Experience Requirements

Personnel involved in the installation, splicing and testing of the fiber optic cable shall meet the following requirements:

- A minimum of seven (7) years experience in the installation of fiber optic cables, including fusion splicing, terminating and testing single mode fibers.

- Five (5) installed systems where fiber optic cables are installed in outdoor conduits and aerial plants and the systems are in continuous satisfactory operation for at least two (2) years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the fiber optic systems.

- One (1) fiber optic cable system (which may be one of the five in the preceding paragraph) which the Contractor can arrange for inspection and demonstration to NCDPW representatives and the Engineer. Test records for the system including cable and splice loss shall be furnished for examination by the Engineer. A system splice enclosure and a patch panel selected at random by the Engineer shall be opened by the Contractor for inspection of workmanship. All inspection activities shall be approved in writing by the system owner prior to actual field inspection.

- Splicers shall have been trained and certified by the manufacturer of the fiber splice material to be used, in fiber optic splicing procedures. Proof of this training must be submitted to the Engineer for approval.

- Installers shall have been trained and certified by the manufacturer of the fiber optic cable to be used, in fiber optic cable installation and handling procedures. Proof of this training must be submitted to the Engineer for approval.

- Personnel involved in testing shall have been trained and certified by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures. Proof of this training must be submitted to the Engineer for approval.

Slack Cable Storage

Slack cable shall be stored underground on approved racks in fiber optic pullboxes, at grade in equipment cabinets, and overhead on pairs of approved cable snowshoes. Quantity of slack cable to be stored shall be as indicated in the contract documents and as approved by the Engineer.

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ITEM 683.921036NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 36 FIBERS
ITEM 683.921048NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 48 FIBERS
ITEM 683.921060NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 60 FIBERS
ITEM 683.921072NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 72 FIBERS
ITEM 683.921144NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 144 FIBERS
ITEM 683.921288NA - SINGLE MODE FIBER OPTIC TRUNK CABLE, 288 FIBERS
ITEM 683.921500NA - FIBER OPTIC DROP CABLE

Splicing Requirements

All optical fibers shall be spliced to provide continuous runs. Splices shall be allowed only at locations designated in the approved cable plant layout or as approved by the Engineer. All splices shall be performed in a controlled, clean environment such as a Contractor designated splicing truck/or van.

The splices shall meet the following requirements:

a. All splices shall use the fusion technique. Fusion splicing equipment shall be provided by the Contractor and shall be cleaned, calibrated and specifically adjusted to the fiber and environmental conditions at the start of each shift. Splice enclosures, tools and procedures, shall be approved by the cable manufacturer as being compatible with the cable type being delivered.

b. Only buffered tubes containing fibers to be spliced shall be opened. The other tubes shall be neatly looped and stored in the enclosure.

c. Each spliced fiber shall be packaged in a protective sleeving or housing. Bare fibers shall be completely re-coated with a protective RTV, gel or similar substance, prior to application of the sleeve or housing, so as to protect the fiber from scoring, dirt or microbending.

d. Rack mounted organizer trays shall be used to hold the spliced fibers, with each fiber neatly secured to the tray.

e. Splice loss shall not exceed a mean of 0.1 dB per link. A link is defined as the fiber optic path between two active components. No splice loss shall exceed 0.15 dB. If a splice is measured to exceed 0.15 dB during the splicing process, it shall be remade until its loss falls below 0.15 dB or the Engineer waives the 0.15 dB requirement. Each attempt shall be recorded for purposes of acceptance. If the mean exceeds 0.1 dB in any link, splices in the link shall be remade until the mean loss does not exceed 0.1 dB

f. All splice losses shall be recorded in tabular form and submitted to the Engineer in paper and electronic formats for approval. If an optical time domain reflectometer (OTDR) is used to record splice loss, chart recordings of the "signature" shall be submitted with the splice data with a record of all OTDR settings and the OTDR locations written on the trace.

Installation

Fiber optic cable shall be installed in accordance with the approved manufacturer=s recommendations. In addition, the following requirements shall be met:

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a. The number of pullboxes and their locations shall be as shown on the Contract Documents. The Contractor may be required to install the cable one pullbox at a time. The direction of the cable pull shall be determined by the Contractor and shall require the approval of the Engineer.

b. A minimum of 30 ft of cable slack, or as approved by the Engineer, shall be provided in pullboxes containing splices or otherwise designated on the Contract Documents or as directed by the Engineer. Additional slack, as indicated on the approved cable installation plan, may be provided for closure preparation and splicing.

c. No fiber optic cable shall be pulled through more than one 90-degree bend unless so indicated on the approved Contract Documents or specifically approved by the Engineer.

d. The cable shall not be pulled over edges or corners, over or around obstructions, or through unnecessary curves or bends.

e. The cable shall be looped in and out of cabinets and pull boxes to provide adequate slack and the least amount of stress on the fibers. The Contractor shall ensure that the cable is not damaged during storage or installation.

f. Fiber optic cable ends shall be kept sealed at all times during installation, using a method recommended by the cable manufacturer and approved by the Engineer. The cable end shall remain sealed until the Contractor terminates the fiber cables. Cables that are not immediately terminated shall have a minimum of 6 ½ ft of slack.

g. When using lubricants, the Contractor shall adhere to the cable manufacturer's requirements for the proper amount, application tools and method, and removal of the lubricant from the exposed cable.

h. Optical fiber cable shall be installed in continuous lengths without intermediate splices throughout the project except where splices are indicated on the Contract Documents or approved by the Engineer. Splices shall only be in reenterable splice enclosures mounted in pullboxes, junction boxes and underground vaults.

i. The fiber optic drop cable shall be spliced to either the backbone or distribution cable at the locations indicated in the Contract Documents or as directed by the Engineer.

j. The maximum pulling tensions and minimum bending radii shall not be violated at any time during installation. The Contractor shall consult with the Engineer concerning existing conduit, pull boxes, and risers, which could force the violation of the minimum bending radius for the fiber optic cable. The Contractor shall obtain approval from the Engineer if modifications to these existing facilities are required. Violation of these parameters shall be cause for rejection of the installed cable.

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k. Prior to any installation of cable, the Contractor shall clean existing conduit in accordance with the requirements of these special provisions.

l. Prior to over-lashing cable, the Contractor shall inspect the existing aerial cable plant and report any deficiencies that may hinder the proper installation of the new cable to the Engineer who will determine, what, if any, action should be taken.

m. Slack cable and innerduct where pulled through a pullbox shall be racked to the pullbox wall.

n. For aerial applications, snap-on cable markers shall be furnished and installed at each pole attachment. Cable marker design and color shall be approved by the engineer.

Splicing Requirements

a. All optical fibers shall be spliced to provide continuous runs.

b. Prior to splicing the Contractor shall test each fiber of the installed cable for continuity, anomalies (events above 0.3 dB) and attenuation using an Optical Time Domain Reflectometer (OTDR) at wavelengths of 1310 nm and 1550 nm.

c. Only the fibers designated for splicing shall be spliced. All other fibers shall be routed through the splice enclosure with at least 1 ft of slack left within the enclosure. Only buffer tubes containing fibers to be spliced shall be opened.

d. Splices shall be made only at locations designated in the approved cable plant layout or as approved by the Engineer.

Termination Requirements

The connector loss for complete connection to the terminal equipment shall not exceed a mean of 0.5 dB. No connector losses above 1.0 dB shall be permitted.

Unused optical fibers shall be properly protected with sealed end caps.

Documentation Requirements

Five (5) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

- Complete and accurate as-built schematic diagrams showing the fiber optic cable plant and locations of all splices.

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- Complete performance data of the cable plant showing the losses at each splice joint and each terminal connector.
- Installation, splicing, terminating and testing procedures.
- Complete parts list including names of vendors.
- Complete maintenance and trouble-shooting procedures.
- One (1) month prior to installation, five (5) copies of the Contractors Installation Practices shall be submitted for approval. This shall include practices, list of installation equipment, and splicing and test equipment. Field quality control procedures shall be detailed as well as procedures for corrective action.

Testing Requirements

The following tests shall be conducted. All tests shall conducted in accordance with approved test procedures. The Contractor shall submit test procedures and forms in paper and electronic formats for approval to the Engineer.

Existing Fiber Cable Verification Test: Prior to splicing fibers installed under this contract to existing fibers (where designated in the plans), the Contractor shall verify the loss characteristics of the existing fiber. Any anomalies shall be reported to the Engineer.

Pre-Installation Tests

The fiber optic cable shall be inspected and tested at the site storage area prior to installation.

Proper fiber cladding and fiber tube colors shall be verified by visual inspection. Any difference discovered from approved fiber optic cable plant layout or approved catalogue cut sheets for the cable shall be grounds for rejection of the cable.

Each optical fiber in the cable shall be tested from one end with an OTDR compatible with wavelength and fiber type. Testing shall check for continuity, length, anomalies, and approximate attenuation at both 1310nm and 1550nm wavelengths. Each measurement shall be recorded with color, location and type of fiber measure. In the event that a meaningful measurement cannot be made from one end, it shall be performed from the opposite end of that fiber.

Post-Installation Tests

Pre-splice and Post-splice testing shall be performed as follows:

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Pre-Splice Testing

After installation and prior to splicing or terminating each optical fiber in the cable shall be tested again for the loss characteristics at both 1310nm and 1550nm wavelengths. Both directions of operation of the fiber shall be tested.

Post-splice Testing

After each splice and connector installation, each optical fiber span including all black/spare fibers shall undergo the following tests after installation of all connectors and splices. A span is defined as a continuous length of fiber including all splices and connectors:

- Using an OTDR test each span at 1310 nm and 1550 for fiber attenuation, continuity, length, and anomalies. Each optical fiber shall meet the following acceptance criteria:

- Attenuation: Not to exceed 0.4 dB/km + 0.1 dB/splice + 0.5 dB/connector. The number of splices and cable attenuation shall be based upon the approved cable plant layout.

- Anomalies: No event shall exceed 0.3 dB. If any event is detected that value, the contractor shall repair or replace that section of cable.

- Using an optical source and a power meter measure the attenuation from both ends. The measured attenuation shall be meet the criteria defined for the attenuation using the OTDR.

All cable that fails to meet the aforementioned requirements shall be replaced.

The Contractor shall submit to the Engineer a tabulated list of fibers and the actual end-to-end measured values from the above tests and all traces and loss length printouts.

Each fiber shall be listed according to the color code and span. This test data shall be the basis of acceptance for the fiber.

For optical fibers spliced to existing fibers this test shall be repeated between the control center and the field termination after the new and existing fibers have been spliced together. If a fiber fails to meet the loss characteristics for the spliced section fiber, the Contractor shall determine whether the excessive loss is the result of an anomaly in the new section of fiber, splice or existing section of fiber. The Contractor will not be responsible for repairing the existing fiber. The Contractor shall, however, be responsible for the new section of fiber and the splice between the two sections.

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METHOD OF MEASUREMENT:

The fiber optic cable will be measured for payment as the number of linear feet of each size actually furnished and installed in accordance with the contract documents.

BASIS OF PAYMENT:

The unit price bid per foot for Single Mode Fiber Optic Trunk Cable and Fiber Optic Drop Cable shall include the cost of furnishing all labor, material, tools and equipment and testing of the fiber optic cable to complete the work. The cost of furnishing and installing all passive components shall be incidental to and included in the pay item for fiber optic cable. All splicing, including set-up and individual terminations and connectors shall also be included in the pay item for fiber optic cable. All cable racks, snowshoes and other miscellaneous hardware necessary for slack cable storage shall also be included in the pay item for fiber optic cable.

Progress payment will be made as follows:

- Sixty percent of the bid price of the completed cable plant will be paid upon completion of installation and satisfactory completion of the post-installation tests.

- Twenty-five percent of the bid price will be paid upon satisfactory completion of all subsystem tests as described in the Special Provisions.

- Fifteen percent of the bid price will be paid upon satisfactory completion of Final System Acceptance.

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ITEM 685.0720XX10 - EPOXY REFLECTORIZED PAVEMENT MARKINGS 20 MILS THICK (WET NIGHT VISIBILITY SPHERES)

DESCRIPTION:

Under this work the contractor shall furnish and apply epoxy reflectorized pavement markings in accordance with these specifications, the Contract Documents, the NYSMUTCD, or as ordered by the Engineer. Items for Special Markings include stop bars and crosswalks.

Yield line symbols are isosceles triangles with height equaling 1.5 times the base dimension:
A small yield line symbol shall have a base dimension of one foot.
A large yield line symbol shall have a base dimension of two feet.
Yield line symbols are to be installed with the Apex of the triangle oriented towards oncoming traffic.

The epoxy marking material shall be hot-applied by spray methods onto bituminous and portland cement concrete pavement surfaces at the thickness and width shown on the Contract Documents. Following a simultaneous application of Standard Glass Beads (Type 2) and Wet/Night Visibility Beads (Type 1), the cured epoxy marking shall be an adherent reflectorized stripe that will provide wet night retro-reflectivity.

MATERIALS REQUIREMENTS:

Epoxy Paint	727-03
Glass Beads for Pavement Markings	727-05

Reflective Glass Spheres

Retro-reflective beads shall be a double drop system of glass spheres consisting of Standard Beads (Type 2) and Wet/Night Visibility Beads (Type 1) as defined in §727-05 Glass Beads for Pavement Markings.

EPOXY APPLICATING EQUIPMENT

In general, a mobile applicator shall be a truck mounted, self-contained pavement marking machine, specifically designed to apply epoxy resin materials and reflective glass spheres in continuous line patterns. The applicating equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. In addition, the truck mounted unit shall be provided with accessories to allow for the marking of cross hatching and other special patterns as directed by the Engineer.

At any time throughout the duration of the project, the Contractor shall provide free access to his epoxy applicating equipment for inspection by the Engineer or his authorized representative.

The Engineer may approve the use of a portable applicator in lieu of mobile truck mounted accessories for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized epoxy markings in accordance with these specifications.

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Mobile applicating equipment shall be capable of installing up to 19 miles of epoxy reflectorized pavement markings in an eight hour day and shall include the following features:

1. Individual tanks for the storage of Part A and Part B of the epoxy resin.

2. Individual tanks for the storage of Standard (Type 2) and Wet/Night Visibility (Type 1) glass spheres. Each tank shall have a minimum capacity of 3000 lbs.

3. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.

4. Individual dispensers for the simultaneous application of Standard (Type 2) and Wet/Night Visibility (Type 1) glass spheres. Each dispenser shall be capable of applying spheres at a minimum rate of 10 lbs/gal of epoxy resin composition.

5. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.

6. All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of epoxy reflectorized pavement markings in a simultaneous sequence of operations as described in Construction Details, D. Application of Epoxy Reflectorized Pavement Markings.

CONSTRUCTION DETAILS

A. General

All pavement markings shall be placed as shown on the Contract Documents and in accordance with the New York State, Manual of Uniform Traffic Control Devices (MUTCD).

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Engineer.

At least five (5) days prior to starting striping, the Contractor shall provide the Engineer with the epoxy manufacturer's written instructions for use. These instructions shall include, but not be limited to, material mixing ratios and application temperatures.

When pavement markings are applied under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

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The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

When necessary the Contractor shall establish marking line points at 30 foot intervals throughout the length of the pavement or as directed by the Engineer.

B. Atmospheric Conditions

Epoxy pavement markings shall only be applied during conditions of dry weather and on substantially dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 50°F and the ambient temperature shall be a minimum of 50°F and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

C. Surface Preparation

The Contractor shall clean the pavement and existing durable markings to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the epoxy markings application.

At the time of application all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new portland cement concrete surfaces and existing painted pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and paid for in accordance with §635 Cleaning and Preparation of Pavement Surfaces for Pavement Markings.

D. Application of Epoxy Reflectorized Pavement Markings

Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated in the Contract Documents.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions are acceptable to the Engineer.

Pavement markings shall be applied by the following simultaneous operation:

1. The pavement surface is air-blasted to remove dirt and residues.

2. The epoxy resin, mixed and heated in accordance with the manufacturer's

recommendations, is uniformly hot-sprayed onto the pavement surface at the minimum specified thickness.

3. Standard (Type 2) and Wet/Night Visibilty (Type 1) reflective glass spheres are injected into or dropped onto the liquid epoxy marking. Standard beads (Type 2) shall be applied first immediately followed by the application of Wet/Night Visibilty beads (Type 1). Each type shall be applied at a minimum rate of 10 lbs/gal of epoxy resin (minimum total application = 20 lbs/gal).

E. Defective Epoxy Pavement Markings

Epoxy reflectorized pavement markings, which after application and curing are determined by the Engineer to be defective and not in conformance with this specification, shall be repaired. Repair of defective markings shall be the responsibility of the Contractor and shall be performed to the satisfaction of the Engineer as follows:

1. Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention.

   Repair Method. Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains.

   Immediately after surface preparation remove loose particles and foreign debris by brooming or blasting with compressed air.

   Repair shall be made by restriping over the cleaned surface in accordance with the requirements of this specification and at the full thickness indicated on the Contract Documents.

2. Uncured or discolored epoxy*; insufficient bond (to pavement surface or existing durable marking).

   Repair Method. The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor's expense.

   The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending three feet in any direction.

   After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

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*Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with the requirements of §727-03 Epoxy Paint; or applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Engineer.

Discoloration shall be defined as localized areas or patches of brown, grayish or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Other defects not noted above, but determined by the Engineer to need repair, shall be repaired or replaced as directed by and to the satisfaction of the Engineer.

All work in conjunction with the repair or replacement of defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

METHOD OF MEASUREMENT

Pavement striping (regular lines, cross hatching and special markings) will be measured in feet along the centerline of the pavement stripe and will be based on a 4 inch wide stripe. Measurement for striping with a width greater than the basic 4 inches, as shown on the plans or directed by the Engineer, will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

BASIS OF PAYMENT

The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

No payment will be made for the repair or replacement of defective epoxy reflectorized pavement markings.

PAY ITEM NO.	***DESCRIPTION***	***PAY UNIT***
685.07150110	White Epoxy Reflectorized Pavement Stripes – 15 mils	Foot

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	(Wet Night Visibility Spheres)	
685.07150210	White Epoxy Reflectorized Pavement Letters - 15 mils (Wet Night Visibility Spheres)	Each
685.07150310	White Epoxy Reflectorized Pavement Symbols – 15 mils (Wet Night Visibility Spheres)	Each
685.07150410	White Epoxy Reflectorized Cross Hatching -15 mils Thick (Wet Night Visibility Spheres)	Foot
685.07150510	White Epoxy Reflectorized Pavement Stripes (Special Markings) 15 mils Thick (Wet Night Visibility Spheres)	Foot
685.07150610	Yellow Epoxy Reflectorized Pavement Stripes – 15 mils (Wet Night Visibility Spheres)	Foot
685.07150710	Yellow Epoxy Reflectorized Pavement Stripes (Cross Hatching) 15 mils Thick (Wet Night Visibility Spheres)	Foot
685.07150810	White Epoxy Reflectorized Pavement Yield Line Symbols - Small - 15 mils (Wet Night Visibility Spheres)	Each
685.07150910	White Epoxy Reflectorized Pavement Yield Line Symbols - Large - 15 mils (Wet Night Visibility Spheres)	Each
685.07200110	White Epoxy Reflectorized Pavement Stripes – 20 mils (Wet Night Visibility Spheres)	Foot
685.07200210	White Epoxy Reflectorized Pavement Letters – 20 mils (Wet Night Visibility Spheres)	Each
685.07200310	White Epoxy Reflectorized Pavement Symbols – 20 mils (Wet Night Visibility Spheres)	Each
685.07200410	White Epoxy Reflectorized Pavement Stripes (Cross Hatching) 20 mils Thick (Wet Night Visibility Spheres)	Foot
685.07200510	White Epoxy Reflectorized Pavement Stripes (Special Markings) 20 mils Thick (Wet Night Visibility Spheres)	Foot

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685.07200610	Yellow Epoxy Reflectorized Pavement Stripes – 20 mils (Wet Night Visibility Spheres)	Foot
685.07200710	Yellow Epoxy Reflectorized Pavement Stripes (Cross Hatching) 20 mils Thick (Wet Night Visibility Spheres)	Foot
685.07200810	White Epoxy Reflectorized Pavement Yield Line Symbols - Small - 20 mils (Wet Night Visibility Spheres)	Each
685.07200910	White Epoxy Reflectorized Pavement Yield Line Symbols - Large - 20 mils (Wet Night Visibility Spheres)	Each

ITEM 685.1X010009 - EPOXY PAINT WITH WET-NIGHT REFLECTIVE ELEMENTS, 20 MILS (RE-APPLICATION INTO A GROOVE)

DESCRIPTION

Apply epoxy pavement markings within existing grooves with a combination of wet-night reflective elements and standard glass beads in accordance to this specification, the contract documents, the MUTCD with the NYS supplement and as directed by the Engineer.

MATERIALS

White and Yellow Epoxy Reflectorized Pavement Markings	727-03
Glass Beads for Pavement Markings	727-05

Wet-Night Reflective Elements. The Wet-Night Reflective Elements shall be composed of microcrystalline ceramic beads and designed to be applied to epoxy pavement marking paint. The ceramic elements shall have a minimum index of refraction of 2.30 when tested using the liquid oil immersion method. The ceramic beads shall be either clear or yellow tinted as required. For white stripes, 3M Series 70E ceramic beads or approved equal shall be used. For yellow stripes, 3M Series 71E ceramic beads or approved equal shall be used.

Packaging and Shipment. Shipped and packaged in accordance with commercially accepted standards. Clearly display the name of the product, the name and address of the manufacturer, the quantity of material, the date of manufacture, and the date of expiration or the shelf life, on each container or on the shipping invoice.

Basis of Approval. Approvals will be based upon independent lab analysis and field testing in accordance to this specification and Department directives. The Contractor shall submit independent lab analysis to Director of Materials and arrange for field testing through the General Engineering Section of the Materials Bureau. If the product passes the requirements of this specification, it will be added to the Department's Approved List.

Basis of Acceptance. Epoxy Paint and Glass Beads for Pavement markings will be accepted on the basis of the appearance of the product on the Department's Approved List. Wet-Night Reflective Elements will be accepted based on manufacturer's certification that the product meets the requirements of this specification.

Epoxy Paint Application Equipment. In general, a mobile applicator shall be a truck mounted, self–contained pavement marking machine, specifically designed to apply epoxy resin materials and reflective glass spheres in continuous and skip–line patterns. The applicating equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc. In addition, the truck mounted unit shall be provided with accessories to allow for the marking of legends, symbols, crosswalks, and other special patterns

At any time throughout the duration of the project, the Contractor shall provide free access to his/hers epoxy applicating equipment for inspection by the Engineer or his authorized representative.

ITEM 685.1X010009 - EPOXY PAINT WITH WET-NIGHT REFLECTIVE ELEMENTS, 20 MILS (RE-APPLICATION INTO A GROOVE)

The Engineer may approve the use of a portable applicator in lieu of mobile truck mounted accessories for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized epoxy markings in accordance with these specifications. The applicating equipment shall be capable of installing a minimum of 100,000 feet of epoxy reflectorized pavement markings in an eight hour day and shall include the following features:

1. Individual tanks for the storage of Part A and Part B of the epoxy resin.
2. Individual tanks for the storage of Standard Glass beads for epoxy paint and Wet-Night Reflective Elements. Each tank shall have a minimum capacity of 3000 lbs.
3. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.
4. Individual dispensers for the simultaneous application of Standard Glass Beads for epoxy paint and Wet-Night Reflective Elements. Each dispenser shall be capable of applying spheres at a minimum rate of 10 lbs/gal of epoxy resin composition.
5. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.
6. All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of epoxy reflectorized pavement markings in a simultaneous sequence of operations as described in Construction Details of this specification.

Supply the Engineer with two accurate, easily readable gauges with which to verify groove depth. The gauges shall be delivered no less than one week prior to the anticipated beginning of grooving operations. Gauges shall be accompanied by manufacturer's instructions for their use, if such instructions are necessary for proper understanding of the gauge's function.

CONSTRUCTION DETAILS

General

Before any pavement marking work is begun, contractor shall submit a schedule of operations for the approval of the Engineer.

At least five (5) days prior to the start or work, the Contractor shall provide the Engineer with the manufacturer's written instructions for:

- Applying epoxy paint with wet-night reflective elements including but not be limited to, material mixing ratios and application temperatures

The Contractor shall provide and retain an on site manufacturer's representative to provide guidance regarding construction methods, and oversight of wet-night reflective elements application. The services of the manufacturer's representative shall be retained by the Contractor until the release by the Engineer.

ITEM 685.1X010009 - EPOXY PAINT WITH WET-NIGHT REFLECTIVE ELEMENTS, 20 MILS (RE-APPLICATION INTO A GROOVE)

When pavement markings operations are carried out under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set as per manufacturer's procedures.

Epoxy Paint Application

Pavement markings shall be applied in the general direction of traffic. Applications against the direction of traffic flow shall not be allowed.

Atmospheric Conditions. Epoxy pavement markings shall only be applied during conditions of dry weather and on thoroughly dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 50^{o}F and the ambient temperature shall be a minimum of 50^{o}F and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

Surface Preparation. The Contractor shall clean all surfaces of the groove by air blasting to remove all loose residues. Include power brooming or manual brooming, if necessary, to remove all loose residue from the groove. Make sure all pavement surfaces are free of oil, dirt, dust, grease, salt, and similar foreign materials at the time of application. The cost of cleaning these contaminants shall be included in the bid price of this item. If water blasting is used, allow the surface to thoroughly dry to the satisfaction of the Engineer, before application of any epoxy paint.

Application of Epoxy Reflectorized Pavement Markings

Epoxy reflectorized pavement markings shall be applied within the grooves as centered as possible, at the width, thickness, and pattern designated in the Contract Documents.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions are acceptable to the Engineer.

Pavement markings shall be applied by the following simultaneous operation:

1. The pavement surface is air-blasted to remove dirt and residues.
2. The epoxy resin, mixed and heated in accordance with the manufacturer's recommendations, is uniformly hot-sprayed onto the pavement surface at the minimum specified thickness. Epoxy paint shall be applied at the wet film thickness specified in the contract documents.
3. Standard Glass Beads for epoxy paint and Wet-Night Reflective Elements are injected into or dropped onto the liquid epoxy marking. The glass beads and wet-night reflective elements shall be applied to the hot epoxy paint using a double drop system, in the amount per unit length of stripe as recommended by the wet-night element manufacturer.

4. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

Defective Epoxy Pavement Markings

Repair defective markings, as determined by the Engineer and at no additional cost to the State, as follows:

1. Repair Method for insufficient film thickness, line width, glass bead coverage and/or inadequate glass bead retention:

   Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains as determined by the Engineer.

   Remove loose particles and foreign debris by brooming or blasting with compressed air just prior to reapplication of markings in accordance with this specification.

2. Repair Method for uncured or discolored epoxy and/or insufficient bond to pavement surface or existing durable marking:

   Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with the requirements of §727-03 Epoxy Paint or applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Engineer.

   Discoloration shall be defined as localized areas or patches of brown, grayish or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

   The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor's expense.

   The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending one meter in any direction.

   After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

ITEM 685.1X010009 - EPOXY PAINT WITH WET-NIGHT REFLECTIVE ELEMENTS, 20 MILS (RE-APPLICATION INTO A GROOVE)

Other defects not noted above, but determined by the Engineer to need repair, shall be repaired or replaced as directed by and to the satisfaction of the Engineer. All work in conjunction with the repair or replacement of defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

METHOD OF MEASUREMENT

Epoxy paint striping will be measured in feet along the centerline of the pavement stripe and will be based on a 4-in wide stripe. Measurement for striping with a width greater than the basic 4 inches, as shown on the plans or directed by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

BASIS OF PAYMENT

The unit bid price, shall include all labor, materials, and equipment to complete the work including the cost of cleaning and waste disposal associated with the preparation, installation and application of epoxy paint with standard glass beads and wet-night reflective elements.

The work will be paid under:

Item No.	Description	Pay Unit
X = 6 - 8		
685.16010009	White, Epoxy Paint With White Wet-Night Reflective Elements - 20 mils (Re-application Into A Groove)	Foot
685.17010009	Yellow, Epoxy Paint With Yellow Wet-Night Reflective Elements -20 mils (Re-Application Into A Groove)	Foot
685.18010009	White, Epoxy Paint With White Wet-Night Reflective Elements - 20 mils (Hand-Work Re-application Into A Groove)	Foot
685.19010009	Yellow, Epoxy Paint With Yellow Wet-Night Reflective Elements - 20 mils (Hand-Work Re-Application Into A Groove)	Foot

ITEM 685.1X0Y0014 - EPOXY PAINT WITH GROOVED-IN WET-NIGHT REFLECTIVE BEADS, 20 MILS (GROOVED PAVEMENT METHOD)

DESCRIPTION

Under this work the contractor shall install grooves at locations where long-line pavement markings will be applied on pavements, at locations given in the contract documents and as directed by the Engineer, in accordance with this specification. Apply epoxy pavement markings within the grooves with a combination of Grooved-In Wet-Night Reflective Beads and standard glass beads in accordance with this specification, the contract documents, the MUTCD with the NYS supplement and as directed by the Engineer.

MATERIALS

White and Yellow Epoxy Reflectorized Pavement Markings	§727-03
Glass Beads for Pavement Markings (Standard Glass Beads)	§727-05

Grooved-In Wet-Night Reflective Beads: Unique from the Approved List's Large Wet-Night Visibility Spheres, Grooved-In Wet-Night Reflective Beads are designed to be applied on grooved-in pavement markings.

The Grooved-In Wet-Night Reflective Beads must meet the following requirements:

- Composed of highly reflective particles having a structural center core surrounded by high refractive index microcrystalline ceramic beads or glass sphere beads and designed to be applied to epoxy pavement marking paint.
- Refractive index of 2.30 minimum when tested using the liquid oil immersion method.
- Either white or yellow tinted as required.
- Appearance in Table 1, below or approved equal.

TABLE 1

Product Name	Manufacturer Location
3M Series 70E-White 3M Series 71E-Yellow	3M Traffic Control Materials Division Brownwood, TX

Packaging and Shipment. Shipped and packaged in accordance with commercially accepted standards. Clearly display the name of the product, the name and address of the manufacturer, the quantity of material, the date of manufacture, and the date of expiration or the shelf life, on each container or on the shipping invoice.

ITEM 685.1X0Y0014 - EPOXY PAINT WITH GROOVED-IN WET-NIGHT REFLECTIVE BEADS, 20 MILS (GROOVED PAVEMENT METHOD)

Basis of Approval. Approvals will be based upon independent lab analysis and field testing in accordance with this specification and Department directives. Submit independent lab analysis to Director of Materials and arrange for field testing through the Materials Bureau. If the product passes the requirements of this specification, it will be added to the Department's Approved List.

Basis of Acceptance. Grooved-In Wet-Night Reflective Beads will be accepted based on appearance on Table 1, above and the manufacturer's certification that the product meets the requirements of this specification.

Grooving Equipment:
Equipment used for grinding in grooves shall meet the following minimum requirements:

- Free-floating cutting or grinding head providing a consistent groove depth over irregular pavement surfaces.
- Diamond blades or heads only.
- Capable of producing a final pavement surface that has perpendicular vertical sides and a smooth, flat bottom free of ridges.

Epoxy Paint Application Equipment:
In accordance with §685-3.02 Epoxy Applicating Equipment in addition to the following:

1. Individual tanks for the storage of Standard Glass beads for epoxy paint and Grooved-in wet-night reflective beads. Each tank shall have a minimum capacity of 3000 lbs.
2. Individual dispensers for the simultaneous application of Standard Glass Beads for epoxy paint and Grooved-In Wet-Night Reflective Beads.
3. Each dispenser shall be capable of applying spheres at a minimum rate of 10 lbs/gal of epoxy resin composition.

Supply the Engineer with two accurate, easily readable gauges with which to verify groove depth. The gauges shall be delivered no less than one week prior to the anticipated beginning of grooving operations. Gauges shall be accompanied by manufacturer's instructions for their use, if such instructions are necessary for proper understanding of the gauge's function.

CONSTRUCTION DETAILS

General: Before any pavement marking work is begun, contractor shall submit a schedule of operations for the approval of the Engineer. At least five (5) days prior to the start of work, the Contractor shall provide the Engineer with the manufacturer's written instructions for:

- Grinding pavement
- Applying epoxy paint with grooved-in wet-night reflective beads including but not be limited to, material mixing ratios and application temperatures.

ITEM 685.1X0Y0014 - EPOXY PAINT WITH GROOVED-IN WET-NIGHT REFLECTIVE BEADS, 20 MILS (GROOVED PAVEMENT METHOD)

Provide and retain an on-site manufacturer's representative to provide guidance regarding the grooving equipment, construction methods, and oversight of grooved-in wet-night reflective beads application. The services of the manufacturer's representative shall be retained by the Contractor until the release by the Engineer.

When grinding and pavement marking operations are carried out under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set as per manufacturer's procedures.

Grooving Operation

Do not grind grooves over longitudinal pavement joints. Locate the grooves at least 4 to 5 in. away from longitudinal pavement joints when possible.

Install wet-reflective epoxy in such a manner as to prevent damage to the surrounding pavement or pavement joints. Repair all damaged pavement surfaces that result from improper installation, or installation of grooves in unauthorized areas. Remove and repair damaged pavement surfaces to meet the pavement condition prior to grinding areas at no additional cost to the State. Groove edge lines, skip lines and double center lines at the locations specified in the contract documents.

Install a groove of the following dimensions, into the pavement:

Groove Width: Pavement Marking Width plus 1 inch.
5 in. width for 4 in. markings
7 in. width for 6 in. markings
Depth: 0.100 in. ± 0.010 in.

Grind segments in broken lines and dotted lines to provide the specified depth along the entire length of the marking.

Conduct pavement cutting operations and pavement cleaning work in such a manner as to minimize airborne dust and similar debris and prevent a hazard to workers, motor vehicle operation, or nuisance to property.

Verify the specified groove depth at the start of the grooving operation and periodically throughout the operation. Regrind areas where any groove depth measurement does not meet the minimum specified depth. Grooves that exceed the specified maximum shall be repaired to the satisfaction of the Engineer at no additional cost to the State. This may include relaying a full width section of pavement as deemed necessary by the Engineer.

When necessary, establish marking line points at thirty (30) ft intervals throughout the length of the pavement or as directed by the Engineer.

ITEM 685.1X0Y0014 - EPOXY PAINT WITH GROOVED-IN WET-NIGHT REFLECTIVE BEADS, 20 MILS (GROOVED PAVEMENT METHOD)

Wet Saw Blade Operation:
When water is used to cool the saw blades, flush the groove with high pressure water immediately following the cut to avoid build-up and hardening of the slurry in the groove. Allow the surface to dry, to satisfaction of the Engineer, before application of any pavement markings. If the Engineer determines that the groove surfaces have become contaminated during the dry time, it must be cleaned again as per this specification.

Dry Saw Blade Operation:
After grooving with dry saw blades, immediately vacuum all debris and dust from the recess. Collect all debris resulting from the pavement cutting operation, by vacuuming the pavement cut and adjacent pavement surface.

Disposal of Waste Material:
Remove and collect debris resulting from the grooving/grinding operation prior to opening the roadway to traffic and prior to the application of a surface preparation adhesive. Dispose of collected debris in accordance with §107-10 *Managing Surplus Material and Waste*.

Allow the surface to dry before application of any pavement markings when using water or other lubricants for grinding or cleaning the grooves, allow the surface to dry to the satisfaction of the Engineer before application of any pavement markings. If the Engineer determines that the groove surfaces become contaminated during the dry time, it must be cleaned again as per this specification.

Epoxy Paint Application

Pavement markings shall be applied in the general direction of traffic. Applications against the direction of traffic flow shall not be allowed.

Atmospheric Conditions

Epoxy pavement markings shall only be applied during conditions of dry weather and on thoroughly dry pavement surfaces. At the time of installation, the pavement surface temperature shall be a minimum of 45ºF and the ambient temperature shall be a minimum of 45ºF and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

Surface Preparation

The Contractor shall clean all surfaces of the groove by air blasting to remove all loose residues. Include power brooming or manual brooming, if necessary, to remove all loose residue from the groove. Make sure all pavement surfaces are free of oil, dirt, dust, grease, salt, and similar foreign materials at the time of application. The cost of cleaning these contaminants shall be included in

the bid price of this item. If water blasting is used, allow the surface to thoroughly dry to the satisfaction of the Engineer, before application of any epoxy paint.

Application of Epoxy Reflectorized Pavement Markings

Epoxy reflectorized pavement markings shall be applied within the grooves as centered as possible, at the width, thickness, and pattern designated in the Contract Documents.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions are acceptable to the Engineer.

Pavement markings shall be applied by the following simultaneous operation:

1. The pavement surface is air-blasted to remove dirt and residues.

2. The epoxy resin, mixed and heated in accordance with the manufacturer's recommendations, is uniformly hot sprayed onto the pavement surface at the minimum specified thickness. Epoxy paint shall be applied at the wet film thickness specified in the contract documents.

3. Standard Glass Beads for epoxy paint and grooved-in wet-night reflective beads are injected into or dropped onto the liquid epoxy marking. The glass beads and grooved-in wet-night reflective beads shall be applied to the hot epoxy paint using a double drop system, in the amount per unit length of stripe as recommended by the grooved-in wet-night reflective bead manufacturer.

4. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

Defective Epoxy Pavement Markings

Repair defective markings, as determined by the Engineer and at no additional cost to the State, as follows:

1. *Repair Method for insufficient film thickness, line width, glass bead coverage and/or inadequate glass bead retention:*

   Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains as determined by the Engineer.

   Remove loose particles and foreign debris by brooming or blasting with compressed air

just prior to reapplication of markings in accordance with this specification.

2. Repair Method for u*ncured or discolored epoxy and/or insufficient bond to pavement surface or existing durable marking:*

   Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with the requirements of §727-03 Epoxy Paint or applied material that fails to cure (dry) within a reasonable time under actual field conditions, as defined by the Engineer.

   Discoloration shall be defined as localized areas or patches of brown, grayish or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

   The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor's expense.

   The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending one meter in any direction.

   After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

Other defects not noted above, but determined by the Engineer to need repair, shall be repaired or replaced as directed by and to the satisfaction of the Engineer. All work in conjunction with the repair or replacement of defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

METHOD OF MEASUREMENT

The Engineer will measure the length in feet of grooves satisfactorily installed. The Engineer will measure grooves with a plan width greater than the standard 4 in. using the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

Epoxy paint striping will be measured in feet along the centerline of the pavement stripe and will be based on a 4-in wide stripe. Measurement for striping with a width greater than the basic 4 inches, as shown on the plans or directed by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

ITEM 685.1X0Y0014 - EPOXY PAINT WITH GROOVED-IN WET-NIGHT REFLECTIVE BEADS, 20 MILS (GROOVED PAVEMENT METHOD)

BASIS OF PAYMENT

The unit bid price, shall include all labor, materials, and equipment to complete the work including the cost of grooving, cleaning and waste disposal associated with the preparation, installation and application of epoxy paint with standard glass beads and grooved-in wet-night reflective beads. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid.

No additional payment will be made for the number of linear feet of gaps between dashed lines.

The work will be paid under:

Item No.	Item	Pay Unit
685.16010014	White, Epoxy Paint With White Grooved-In Wet-Night Reflective Beads- 20 mils (Grooved Pavement Method)	Foot
685.17010014	Yellow, Epoxy Paint With Yellow Grooved-In Wet-Night Reflective Beads -20 mils (Grooved Pavement Method)	Foot
685.16020014	White, Epoxy Paint With White Grooved-In Wet-Night Reflective Beads - 20 mils (Hand Work - Grooved Pavement Method)	Foot
685.17020014	Yellow, Epoxy Paint With Yellow Grooved-In Wet-Night Reflective Beads -20 mils (Hand Work - Grooved Pavement Method)	Foot

(On Construction firms letterhead)

Date Issued: _____

Dear Resident:

We are sorry to inconvenience you, but in order to proceed with construction for _____ we must close and/or limit your access to your driveway. As work progresses, you will be notified on a daily basis when and how your particular residence will be affected. We assure you that every effort will be made to minimize the impact to you relative to this construction.

Our current schedule calls for the project related work to be performed in your area during the week of _____. A copy of this letter with specific dates and time for this work will be delivered at least twenty-four (24) hours in advance in order that you will have sufficient opportunity to plan for accessibility to your vehicles.

If additional information is necessary, you may contact any of the representatives listed below.

Thank you for your patience.

Contractor	_____	Phone:	_____
Inspector	_____	Phone:	_____
Project Manager	_____	Phone:	_____

_____

(On Construction firms letterhead)

Date Issued: _____

CONSTRUCTION NOTIFICATION
24 HOUR NOTICE

Date & Type of Construction: _____
How will residence be affected: _____
Approximate time of Construction: _____

Driveway access (will) (will not) be permitted.