

Stantec Consulting Services Inc.

4969 Centre Pointe Drive Suite 200, North Charleston SC 29418-6952

Phone: (843) 740-7700

Fax: (843) 740-7707

File: 178420817
Addendum No: 1
Date: June 15, 2018
Owner: City of Hanahan
Contract No. Hanahan Downtown Streetscape COH No. 051018

This addendum is to be read with and constitutes part of the tender document.

Instructions:

1. Amend your copy of the tender/quotation/proposal in accordance with the detail below
2. Acknowledge this addendum as 'Addendum 1' on the Bid form.

Details of the Addendum:

This Addendum is being issued for Hanahan Downtown Streetscape and should be acknowledged in the bid form.

The following changes have been made to the bidding and contract documents issued for bid on May 29th, 2018:

Pre-Bid Meeting: Meeting minutes for the pre-bid meeting held on June 14, 2018 are included in this Addendum

Plan Set: Changes to the plan set have been marked with revision clouds and include the following, but not limited to,

- Work noted to be done by CWS is now included in this contract
- Street Sweeping line item has been added
- Notes have been updated

Project Manual:

- Updated Bid Unit Price Sheet
- Updated Section 013200 – Construction Progress Documentation – addition of section 1.5 Rain Delays
- SCDOT Special Provision – Traffic Signal
- SCDOT Special Provision – Drainage
- SCDOT Special Provision – Traffic Control
- Section 329400 – Landscape Maintenance

Reference: Hanahan Downtown Streetscape COH No. 051018 – Addendum 1

Questions and Answers:

1. **How will addendums be issued?** Addendums will be issued through the City (Kitty Farias, Purchasing Agent) and posted on the City's website under this solicitation (<https://vrapp.vendorregistry.com/Bids/View/Bid/e90520a4-36ec-4bc2-82ab-2f024d966aa9>).
2. **Is there a DBE requirements?** No
3. **Is the City responsible for materials testing?** The City will hire a separate company to perform an independent review of materials testing for concrete and asphalt paving.
4. **Is road closure at night required since this is a SCDOT road?** No, but access to all businesses must be maintained. The only lane restrictions are for work on Remount Road: lane closures prohibited between 6 am through 7 pm.
5. **Are the quantities listed in the plan set for this project?** Yes, but it is the contractor's responsibility to confirm/verify all quantities.
6. **This is a base bid contract. What is the purpose of the unit pricing?** The unit pricing will be used for change orders and scope changes.
7. **Can items on the unit price sheet be left blank?** The unit price sheet was determined based on the quantities sheet in the bid drawing set, so all items should have a dollar amount associated with them.
8. **What is the specification for the mast arms?** Mast arms will be black, powder coated and galvanized per SCDOT pay item 6888167 Powder coating per Mast Arm over Galvanized.
9. **Explain further the scope of the 'One Year of Landscape Maintenance' on page 004100-2, Item 8.** This project does not include an irrigation system. To ensure the warranty specified in the project manual, please include a 12-month maintenance cost in your base bid. This line item has been added to the Unit Price Schedule and a Landscape Maintenance Specification has been added to the Project Manual.
10. **Is a construction permit required from SCDOT?** Stantec is obtaining permits from SCDOT, Berkeley County and SCDHEC. They will be provided at the preconstruction meeting. A business license with the City of Hanahan is required.
11. **Does the contract award have to be approved by Council?** No.
12. **Is there an engineer's estimate of cost?** An engineer's estimate of cost is unavailable.

Stantec Consulting Services Inc.

Jamie Hairfield PLA, ASLA
Landscape Architect

Phone: (843) 740-6334
Fax: (843) 740-7707
Jamie.Hairfield@stantec.com

Attachment: Pre-bid Meeting Agenda, Revised Drawing Sheets, Updated Unit Price Sheet and Construction Progress Documentation, SCDOT Special Provisions (Drainage, Signal, and Traffic Control), Landscape Maintenance Specification

c. C.C.

City of Hanahan Downtown Revitalization Pre-Bid Meeting

1255 Yeamans Hall Road
Hanahan, SC 29410
June 14, 2018

1. Introductions
2. This is a highly recommended pre-bid meeting, be sure you sign in on the sign in sheet up front.
3. Important Dates:
 - a. Bid Opening: **June 29, 2018, 2:00 PM**. Bid will be opened at 1255 Yeamans Hall Road, Council Chambers, this same room.
 - b. Last day for questions will be **June 21, 2018, 2:00 pm**.
 - i. All questions shall be e-mailed to Kitty Farias (kfarias@cityofhanahan.com). Questions over the phone will not be answered.
 - ii. Answers will be provided in an addendum.
 - c. Contract Award and Notice to Proceed: Anticipated Award Date – July 12th, 2018
4. Contract, Change Orders, Payment Applicatons: AIA format
5. Bid documents can be downloaded from the follow FTP site:
 - a. <https://projsftp.stantec.com/#/>
 - b. **Login name:** HDS1327
Password: 3482740
6. Refer to the bid documents page 7 of 27 for all bid submittal requirements. This is a base bid lump sum contract; however unit prices shall be submitted with each bid as laid out in the contract documents.
 - a. Contractor is responsible for verifying quantities and if there is a discrepancy, contractor is to note this on the bid form.
7. Project Introduction and Description
8. Anticipated Construction Time Frames: 210 days
 - a. Drainage and Paving – 120 days construction schedule
 - b. All other work – 210 days construction schedule.
 - c. Final Completion – 45 days from substantial completion
9. Coordination with Utilities –
 - a. SCE&G will be performing underground utility conversion simultaneously
 - b. Comcast, WOW, BCWS (sewer), SCE&G (gas) will perform their own relocations

10. Other Items:

- a. CWS work – all work noted ‘to be done by CWS’ will now be included in this contract. The note has been removed from plans and added to the bid sheet.
 - b. Rain Days - _For rain delays, the Contractor shall be entitled to a one-day extension of time for each day in any given month that the actual rain days measured at Charleston International Airport, or an otherwise mutually agreed upon location, exceed the NOAA average monthly rainfall for the month (rounded to the day). In order to qualify as a rain day, there must be at least one-hundredth of an inch precipitation on the date in question.
11. At least one Addendum will be issued which will contain the meeting minutes from the Pre-bid. Addendums will be sent out to all of those who signed the sign-in sheets. Addendums will also be posted on the City’s website. Be sure to acknowledge each Addendum on your bid form.
12. **Method of award:** The Contract will be awarded to the responsive, responsible Bidder submitting the lowest bid complying with the conditions of the Contract Documents.
13. Any Questions?



CITY OF HANAHAN

PROPOSED PLANS FOR BERKELEY COUNTY

S-8-24 (YEAMANS HALL ROAD) STREETScape IMPROVEMENTS

— CONSTRUCTION CHANGE —
SHEET PROVIDED AFTER LETTING

Hydraulic Design Reference for these plans is the:
2009
Edition of SCDOT's "Requirements for Hydraulic Design Studies"

Design Reference for these plans is the:
2001
AASHTO "A Policy on Geometric Design of Highways and Streets"

NPDES PERMIT INFORMATION

Disturbed Area = 1.0 Acre(s)
Project Area = 3.0 Acre(s)

Approximate Location of Roadway is

Begin
Latitude 32°54'00"
Longitude 80°00'39"

End
Latitude 32°54'18"
Longitude 80°00'24"

Hydraulic and NPDES Design provided by:
Stantec Consulting

Designs may be obtained from the SCDOT Regional Production Group

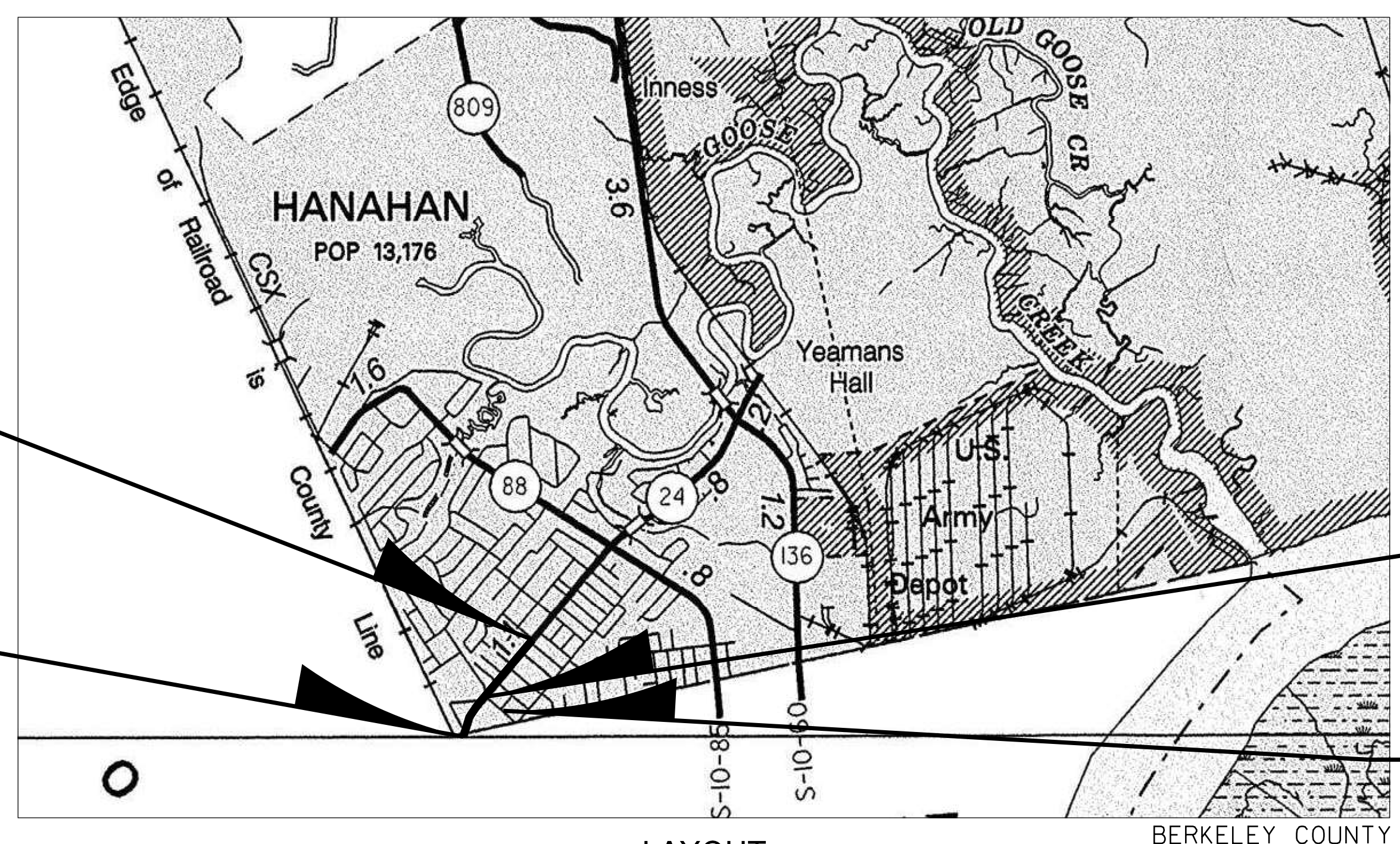
INDEX OF SHEETS		
SHEET NO.	DESCRIPTION	SHEET SUBTOTALS
1	TITLE SHEET	1
2	SUMMARY OF ESTIMATED QUANTITIES	1
2A	MOVING ITEMS, REMOVAL & DISPOSAL ITEMS, & NEW FENCES	1
3	TYPICAL SECTIONS	1
4	RAW DATA SHEET	1
4A-4B	PROPERTY STRIP MAP	2
5	GENERAL CONSTRUCTION NOTE	1
5A	SURVEY CONTROL & REFERENCE DATA SHEET	1
5B	CONSTRUCTION DETAIL	1
5C	ASPHALT PAVEMENT TEXTURING DETAIL	1
6-12	PLAN SHEETS	7
13-16	PROFILE SHEETS	4
D1-D8	DRAINAGE PLAN SHEETS	8
TC1-TC4	TRAFFIC CONTROL PLANS	4
PM1-PM2	PAVEMENT MARKING PLANS	2
SN1-SN2	SIGNING PLANS	2
TS1	TRAFFIC SIGNAL PLAN	1
EC1-EC4	EROSION CONTROL PLANS	4
U1-U10	UTILITY SHEETS	11
X1-X12	CROSS SECTIONS	12
L1-6	PLANTING PLANS & DETAILS	6
TOTAL		72

S-8-24 (YEAMANS HALL ROAD)
END CONSTRUCTION STA. 112+89.11

S-8-24 (YEAMANS HALL ROAD)
BEGIN CONSTRUCTION STA. 90+23.43

S-8-37 (CAROLYN STREET)
BEGIN CONSTRUCTION STA. 220+00.00

S-8-37 (CAROLYN STREET)
END CONSTRUCTION STA. 223+00.00



LAYOUT
SCALE 1 INCH = N.T.S. FEET

	S-8-24 (YEAMANS HALL ROAD)	S-8-137 (CAROLYN STREET)	TOTAL
NET LENGTH OF ROADWAY	0.429	0.057	0.486 MILES
NET LENGTH OF BRIDGES	0.000	0.000	0.000 MILES
NET LENGTH OF PROJECT	0.429	0.057	0.486 MILES
LENGTH OF EXCEPTIONS	0.000	0.000	0.000 MILES
GROSS LENGTH OF PROJECT	0.429	0.057	0.486 MILES

EQUALITIES IN STATIONING
NONE

NOTE: EXCEPT AS MAY OTHERWISE BE SPECIFIED ON THE PLANS OR IN THE SPECIAL PROVISIONS, ALL MATERIALS AND WORKMANSHIP ON THIS PROJECT SHALL CONFORM TO THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION (2007 EDITION) AND THE STANDARD DRAWINGS FOR ROAD CONSTRUCTION IN EFFECT AT THE TIME OF LETTING.

3 DAYS BEFORE DIGGING IN SOUTH CAROLINA
CALL 811
SOUTH CAROLINA 811 (SC811)
www.SC811.COM
ALL UTILITIES MAY NOT BE A MEMBER OF SC811

RAILROAD INVOLVEMENT?
YES / NO

TRAFFIC DATA S-8-24

2018	ADT	7,500
2038	ADT	9,100
TRUCKS		2 %

CONSULTING ENGINEERING FIRM

Stantec
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North Charleston, SC 29418
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ENGINEER OF RECORD

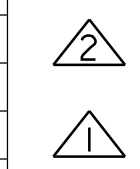
FOR CONSTRUCTION: Justin Ite 6/14/18
DATE

SUMMARY OF ESTIMATED QUANTITIES

COUNTY	ROUTE NAME	ROUTE NO.	SHEET NO.
BERKELEY	YEAMANS HALL ROAD	S-8-24	2

SECTION	ITEM	QUANTITY	UNIT
1031000	MOBILIZATION	1.000	LS
1032010	BONDS AND INSURANCE	1.000	LS
1050800	CONSTRUCTION STAKES, LINES & GRADES	1.000	EA
1071000	TRAFFIC CONTROL	1.000	LS
2012000	CLEARING & GRUBBING WITHIN ROADWAY	1.000	LS
2031000	UNCLASSIFIED EXCAVATION	700.000	CY
2033000	BORROW EXCAVATION	1,200.000	CY
3100310	HOT MIX ASPHALT BASE COURSE - TYPE A	275.000	TON
4011004	LIQUID ASPHALT BINDER PG64-22	80.000	TON
4013990	MILLING EXISTING ASPHALT PAVEMENT (VARIABLE)	10,240.000	SY
4020320	HOT MIX ASPHALT INTERMEDIATE COURSE TYPE B	85.000	TON
4030320	HOT MIX ASPHALT SURFACE COURSE TYPE B	1,110.000	TON
4039030	IMPRINTED ASPHALT WITH SURFACE COATING	24.000	SY
6021120	PERMANENT CONSTRUCTION SIGNS (GROUND MOUNTED)	496.000	SF
609105A	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 4" WHITE BROKEN LINES	340.000	LF
609115A	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 4" WHITE SOLID LINES	5,700.000	LF
609115B	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 4" YELLOW SOLID LINES	11,000.000	LF
609125A	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 8" WHITE SOLID LINES	2,580.000	LF
609135A	PAVEMENT MARKINGS(TEMPORARY-PAINT)-24" WHITE SOLID LINES	440.000	LF
609135B	PAVEMENT MARKINGS(TEMPORARY-PAINT)-24" YELLOW SOLID LINES	150.000	LF
609160A	PAVEMENT MARKINGS(TEMPORARY-PAINT)-WHITE SINGLE ARROW	10.000	EA
609180A	PAVEMENT MARKINGS(TEMPORARY-PAINT)-WHITE WORD "ONLY"	6.000	EA
6271005	4" WHITE BROKEN LINES(GAPS EXCL.)THERMOPLASTIC- 90 MIL.	170.000	EA
6271010	4" WHITE SOLID LINES (PVT. EDGE LINES) THERMO. - 90 MIL.	2,850.000	LF
6271015	8" WHITE SOLID LINES THERMOPLASTIC - 125 MIL.	1,290.000	LF
6271025	24" WHITE SOLID LINES (STOP/DIAG LINES)-THERMO -125 MIL.	220.000	LF
6271030	WHITE SINGLE ARROWS (LT, STRGHT, RT) THERMO -125 MIL.	5.000	EA
6271035	WHITE WORD MESSAGE "ONLY" -THERMOPLASTIC - 125 MIL.	3.000	EA
6271074	4" YELLOW SOLID LINES(PVT.EDGE LINES) THERMO-90 MIL.	5,500.000	LF
6271080	24" YELLOW SOLID LINES - THERMOPLASTIC - 125 MIL.	75.000	LF
6300005	PERMANENT CLEAR PAVEMENT MARKERS- MONO-DIR - 4"x4"	10.000	EA
6301100	PERMANENT YELLOW PAVEMENT MARKERS BI-DIR - 4"x4"	45.000	EA
6510105	FLAT SHEET, TYPE III, FIXED SZ & MSG. SIGN	58.750	SF
6510108	FLAT SHEET, TYPE VIII OR IX, SIZE DETERMINED BY MSG. - OVERHEAD	12.500	SF
6513020	FURNISH & INSTALL MOUNTING ASSEMBLY FOR FLAT SHEET SIGN ERCTD ON MAST ARM	2.000	EA
6531210	U-SECTION POST FOR SIGN SUPPORTS - 3P	130.000	LF
6750275	FURNISH & INSTALL 1.0" SCHEDULE 80 PVC CONDUIT	100.000	LF
6750278	FURNISH & INSTALL 2.0" SCHEDULE 80 PVC CONDUIT	585.000	LF
675027C	FURNISH & INSTALL 3.0" SCHEDULE 80 PVC CONDUIT	440.000	LF
675027Z	FURNISH ADDITIONAL CONDUIT WITHIN DIRECTIONAL BORE	205.000	LF
6760060	FURNISH & INSTALL 2" SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)	350.000	LF
6770388	NO. 14 COPPER WIRE, 4 CONDUCTOR - BLACK	860.000	LF
6770389	NO. 14 COPPER WIRE, 4 CONDUCTOR - GRAY	1,000.000	LF
6770393	NO. 14 COPPER WIRE, 8 CONDUCTOR (BLACK)	530.000	LF
6770394	NO. 14 COPPER WIRE, 8 CONDUCTOR (GRAY)	480.000	LF
6770413	NO. 14 COPPER WIRE, 1-CONDUCTOR FOR LOOP WIRE	1,468.000	LF
6780495	SAWCUT FOR LOOP DETECTOR	632.000	LF
6800508	FURNISH & INSTALL 12"x12"x12"D.ELEC. FLUSH UNDERGRD ENCLOSURE-(STR.POLY.CONC)HD	1.000	EA
6800518	FURNISH & INSTALL 13"x24"x18"D.ELEC. FLUSH UNDERGRD ENCLOSURE-(STR.POLY.CONC)HD	12.000	EA
680052C	FURNISH & INSTALL 17"x30"x24"D.ELEC. FLUSH UNDERGRD ENCLOSURE-(STR.POLY.CONC)HD	1.000	EA
6825484	FURNISH AND INSTALL 10' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	6.000	EA
6845511	FURNISH AND INSTALL CONTROLLER AND 332/336 CABINET ASSEMBLY - BASE MOUNTED	1.000	EA
6865723	FURNISH AND INSTALL 12" 3 SECTION SIGNAL HEAD	9.000	EA
6865783	FURNISH & INSTALL 1-WAY-1SECT.(COUNTDOWN HAND/MAN EMBLEM)PED SIG HEAD	6.000	EA
6865797	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE STATION ASSEMBLY (9"x15") AND SIGN (R-10-3E)	6.000	EA
6865831	FURNISH & INSTALL VEHICLE TRAFFIC SIGNAL HEAD MOUNTING ASSEMBLY FOR MAST ARM	9.000	EA
6865834	FURNISH & INSTALL BACKPLATE W/ RETROREFL BORDERS FOR TRAFFIC SIGNAL	9.000	EA
6885990	REMOVAL, SALVAGE,& DISP OF EXISTING TRAF. SIGNAL EQUIPMENT	NEC	LS
6885992	TEMPORARY ADJUSTMENT OF TRAFFIC SIGNAL EQUIPMENT	1.000	EA

SECTION	ITEM	QUANTITY	UNIT
6888167	POWDERCOATING PER MAST ARM OVER GALVANIZED	2.000	EA
6888177	DESIGN, FURNISH & INSTALL STEEL POLE WITH TWIN MAST ARMS INCLUDING FOUNDATION	1.000	EA
6888179	DESIGN, FURNISH & INSTALL STEEL POLE WITH MAST ARM INCLUDING FOUNDATION	1.000	EA
6888194	POWDERCOATING OPTION FOR 10' ALUMINUM PEDESTAL POLE	6.000	EA
7143615	15" SMOOTH WALL PIPE	87.000	LF
7143618	18" SMOOTH WALL PIPE	607.000	LF
7143624	24" SMOOTH WALL PIPE	255.000	LF
7149999	CLEANING EXISTING PIPE	1,400.000	LF
7191005	CATCH BASIN - TYPE 1	2.000	EA
7191605	CATCH BASIN - TYPE 16	15.000	EA
7191615	CATCH BASIN - TYPE 16 - SPECIAL	2.000	EA
7192011	DROP INLET (24" X 24") WITH STANDARD 4' X 4' BOX	2.000	EA
7192020	DROP INLET (24" X 36")	17.000	EA
7192021	DROP INLET (24" X 36") WITH STANDARD 4' X 4' BOX	1.000	EA
7192107	MANHOLE WITH STANDARD 4' X 4' BOX	5.000	EA
7197130	ADJUST DROP INLET ADJUST D.I.	4.000	EA
7197150	ADJUST JUNCTION BOX	1.000	EA
7198310	JUNCTION BOX - CONVERT DROP INLET 24" X 24"	8.000	EA
7203110	CONCRETE CURB AND GUTTER (1'-6") VERTICAL FACE	940.000	LF
7203210	CONCRETE CURB AND GUTTER (2'-0") VERTICAL FACE	1,240.000	LF
7204100	CONCRETE SIDEWALK (4" UNIFORM)	1,400.000	SY
7204600	CONCRETE SIDEWALK (6" UNIFORM)	100.000	SY
7204900	DETECTABLE WARNING MATERIAL	430.000	SF
7205000	CONCRETE DRIVEWAY(6" UNIFORM)	80.000	SY
7207000	CONCRETE FLUME	3.000	EA
7207002	CONCRETE FLUME UNDER SIDEWALK	3.000	EA
7209000	PEDESTRIAN RAMP CONSTRUCTION	180.000	SY
8081000	MOVING ITEM NO. 1	1.000	LS
8091010	RIGHT OF WAY MARKER (REBAR AND CAP)	9.000	EA
8091050	RIGHT OF WAY PLAT	1.000	LS
8109050	SELECTIVE WATERING	54,300.000	GAL
8109901	MOWING	3.000	ACRE
8152004	INLET STRUCTURE FILTER - TYPE F (WEIGHTED)	660.000	LF
8152006	INLET STRUCTURE FILTER - TYPE F (NON-WEIGHTED)	160.000	LF
8153000	SILT FENCE	660.000	LF
8153090	REPLACE/REPAIR SILT FENCE	66.000	LF
8154050	REMOVAL OF SILT RETAINED BY SILT FENCE	165.000	LF
8156200	CLEANING INLET STRUCTURE FILTERS	60.000	EA
8152619	INLET STRUCTURE FILTER - TYPE A	360.000	LF
9991000	STREET SWEEPING	3.000	EA
9999995	WATER MAIN VERTICAL OFFSET	6.000	EA
9999996	ADJUST WATER VALVE	8.000	EA
9999997	ADJUST WATER METER	4.000	EA
9999998	RELOCATE FIRE HYDRANT	1.000	EA
9999999	FIRE HYDRANT ASSEMBLY	1.000	LS



User: aboyd
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6/18/2018

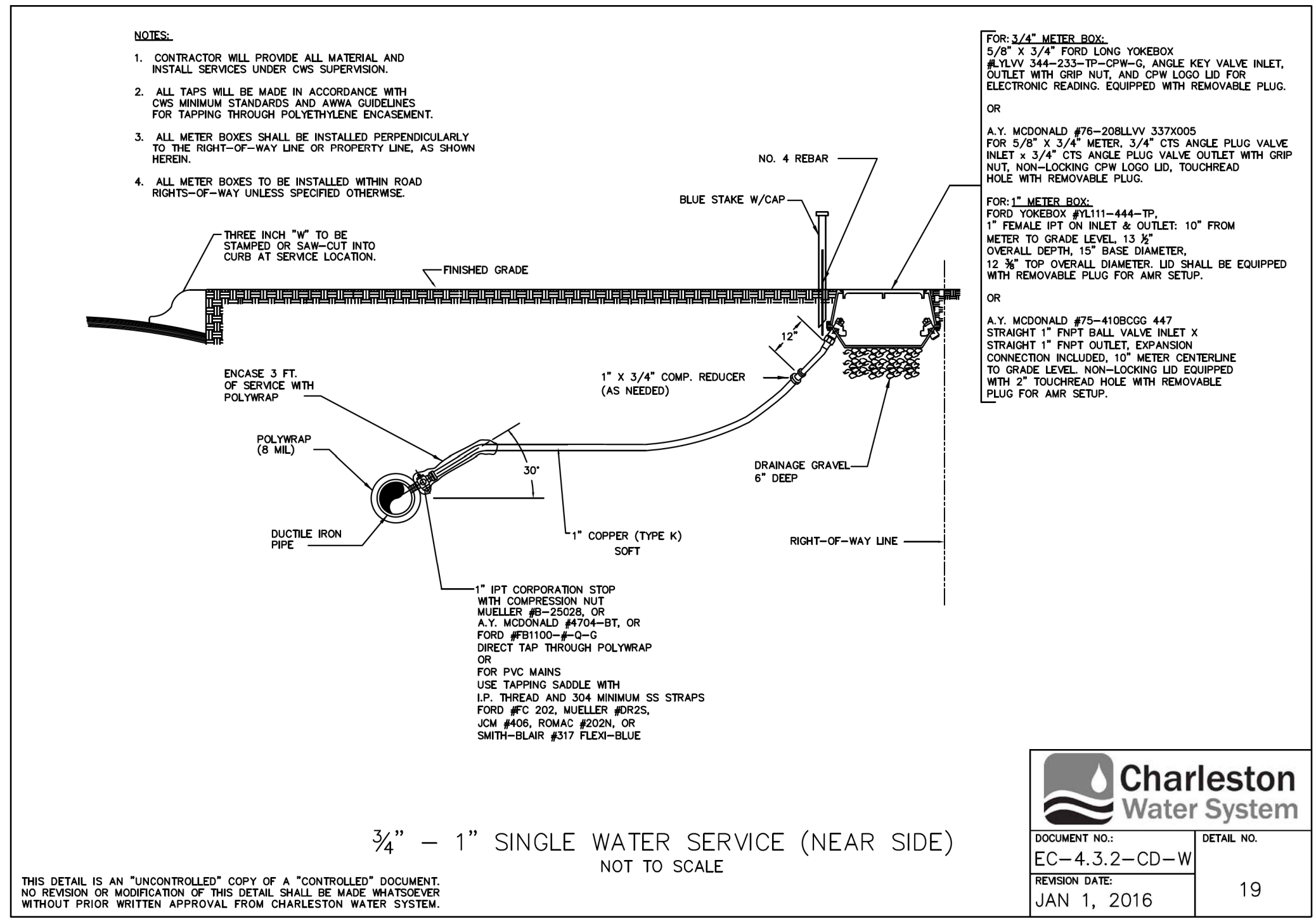
— CONSTRUCTION CHANGE —
SHEET PROVIDED AFTER LETTING

PLANS PREPARED BY:
 Stantec
Stantec Consulting Services Inc.
4969 Centre Pointe Drive Suite 200
North Charleston, SC 29418
www.stantec.com



4					
3					
2	ATB	6/14/18	ADDED STREET SWEEP PAY ITEM		
1	ATB	6/8/18	ADDED WATER PAY ITEMS		
REV. NO.	BY	DATE	DESCRIPTION OF REVISION		
TOPO.		DATE	PLAN SCALE 1" =		
DWG.		DATE	PROF SCALE 1" =	HORIZ	
R/W		DATE	SCALE 1" =	VERT	

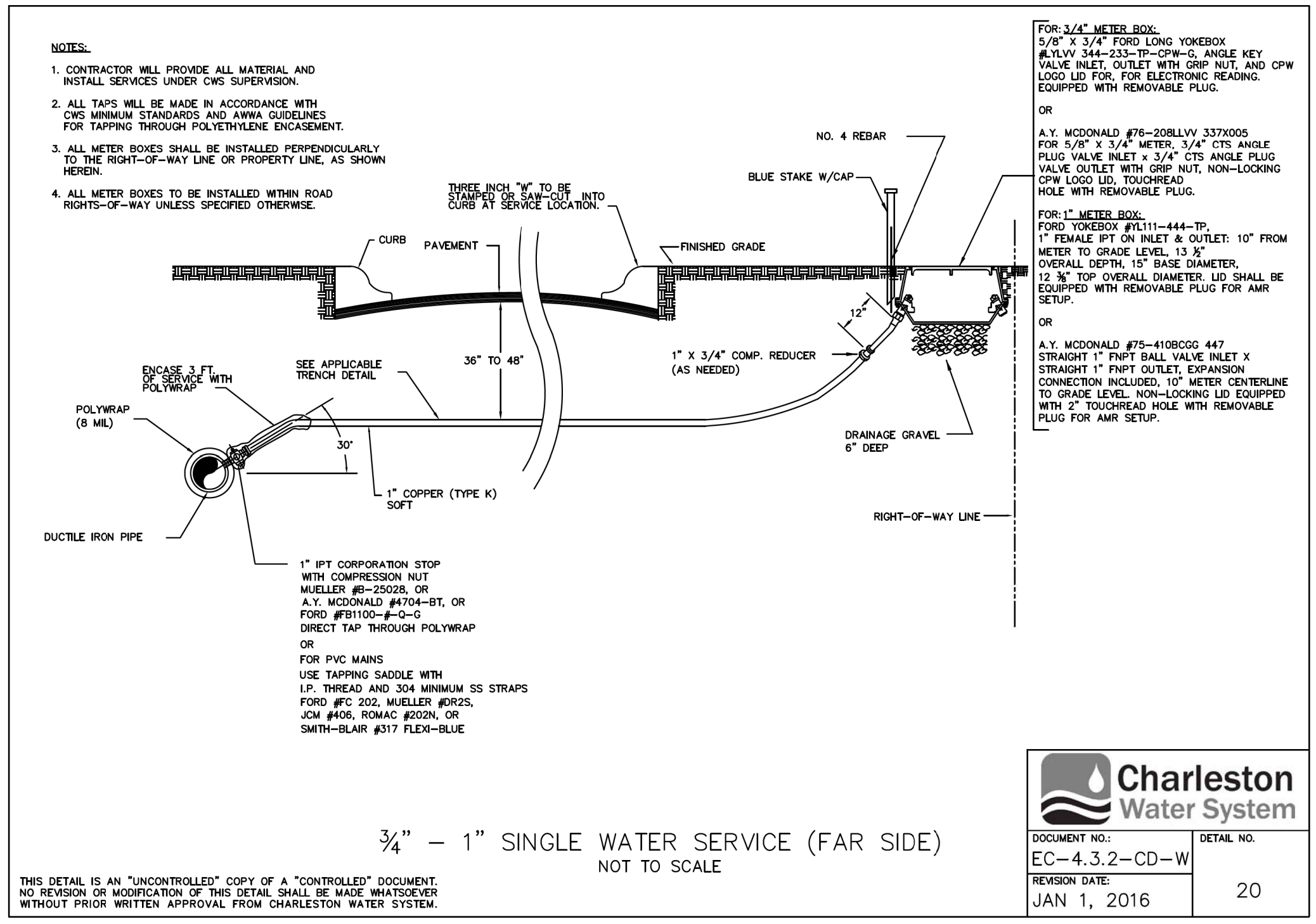
CITY OF HANAHAN
 BERKELEY COUNTY
 YEAMANS HALL ROAD IMPROVEMENTS
 SUMMARY OF ESTIMATED QUANTITIES
 SCALE: N/A RTE. S-8-24



Charleston Water System

DOCUMENT NO.: EC-4.3.2-CD-W
 REVISION DATE: JAN 1, 2016

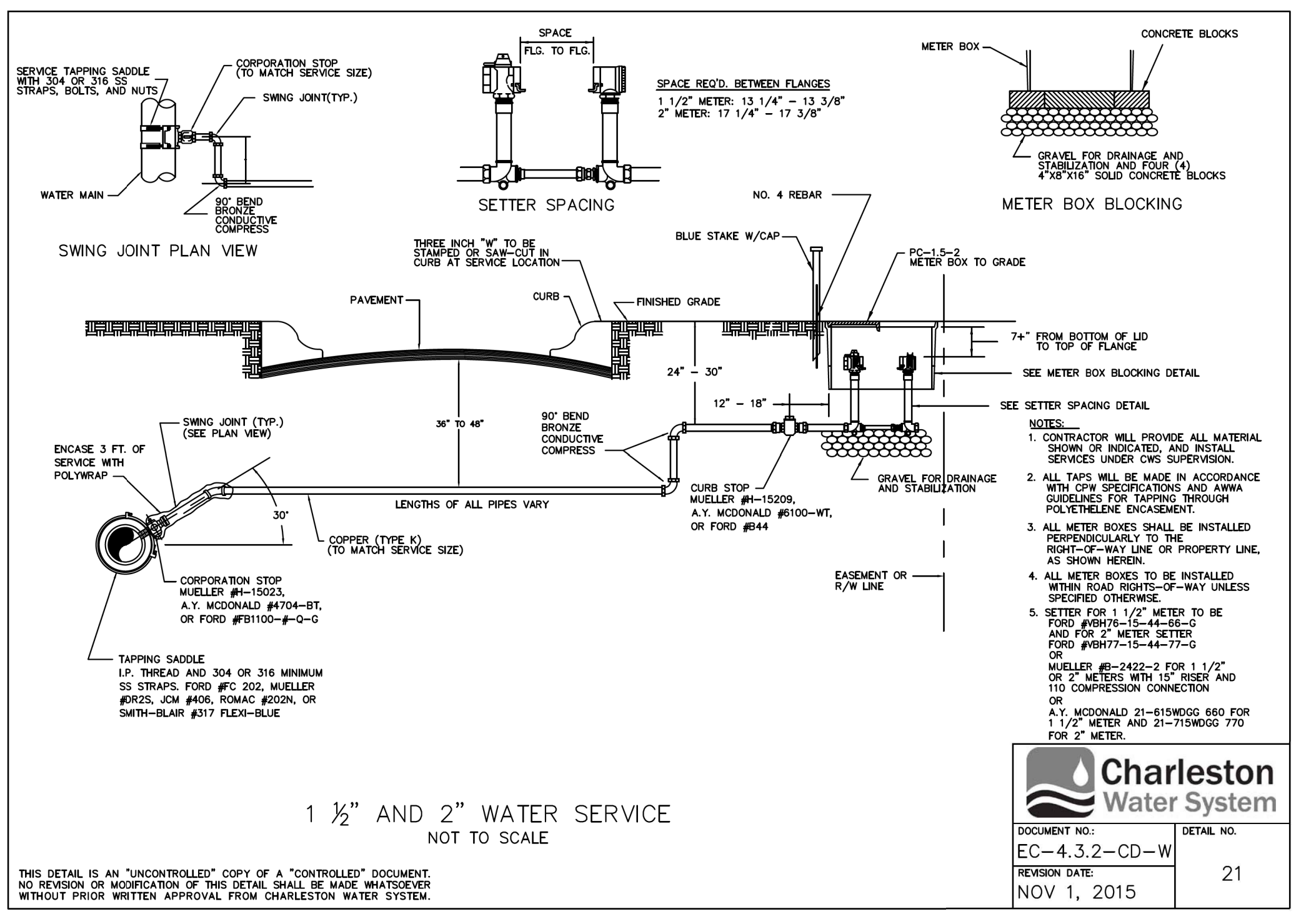
DETAIL NO.:
 19



Charleston Water System

DOCUMENT NO.: EC-4.3.2-CD-W
 REVISION DATE: JAN 1, 2016

DETAIL NO.:
 20



Charleston Water System

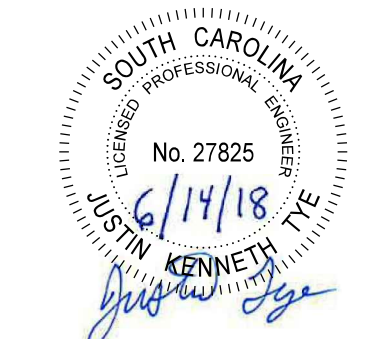
DOCUMENT NO.: EC-4.3.2-CD-W
 REVISION DATE: NOV 1, 2015

DETAIL NO.:
 21

— CONSTRUCTION CHANGE —
 SHEET PROVIDED AFTER LETTING

User: aboyd
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 6/18/2016

PLANS PREPARED BY:
Stantec
 Stantec Consulting Services Inc.
 4969 Centre Pointe Drive Suite 200
 North Charleston, SC 29418
 www.stantec.com



4			
3			
2			
1	ATB	6/8/18	ADDED VERTICAL WATER MAIN OFFSET DETAIL
REV. NO.	BY	DATE	DESCRIPTION OF REVISION
TOPO.	DATE	PLAN SCALE 1" =	
DWG.	DATE	PROF SCALE 1" =	HORIZ
R/W	DATE	SCALE 1" =	VERT

CITY OF HANAHAN

BERKELEY COUNTY
 YEAMANS HALL ROAD IMPROVEMENTS
 UTILITY DETAILS

SCALE: N/A
 RTE. YEAMANS HALL ROAD

**EXHIBIT A – (Mandatory Bid Submittal Form)
 UNIT PRICE SCHEDULE**

When changes in the work are ordered by the Owner, and such changes involve the following items, the following unit prices will be used to calculate adjustments to the Contract Sum. These unit prices shall be for the work as specified, including all labor, materials, equipment, accessories, shipping, preparation, insurance, testing, overhead, profit, applicable taxes, permits, fees, warranties and all other associated costs for the finished and completed work. All unit prices for utility conduits shall include sweeps, bends, couplings, caps, fittings, etc. which shall be included in the unit price per linear foot. Unit prices for undercut soils shall include material in place, surveyed and compacted pursuant to the Contract Documents.

Submit unit price and proposal amount for the following items. This list may not include all components necessary to provide a completed product, therefore any applicable items necessary to provide a completed product should be considered in your unit price response.

In case of errors in the extension of prices, unit price governs. In case of error in summations, corrected bid amounts will be totaled and will govern.

Contractor shall be responsible for all necessary electric and water hookups.

Contractor shall make quantity take-offs using drawings to determine quantities to his satisfaction, reporting promptly any discrepancies which may affect bidding.

This is not a comprehensive list of items included in the contract documents, and represents only a portion of the project total.

UNIT PRICE SCHEDULE. (SEE THE FOLLOWING)

Prices provided below.

SECTION	ITEM	UNIT	UNIT PRICE (\$)
1031000	MOBILIZATION	LS	
1032010	BONDS AND INSURANCE	LS	
1050800	CONSTRUCTION STAKES, LINES & GRADES	EA	
1071000	TRAFFIC CONTROL	LS	
2012000	CLEARING & GRUBBING WITHIN ROADWAY	LS	
2031000	UNCLASSIFIED EXCAVATION	CY	
2033000	BORROW EXCAVATION	CY	
3100310	HOT MIX ASPHALT BASE COURSE - TYPE A	TON	
4011004	LIQUID ASPHALT BINDER PG64-22	TON	
4013990	MILLING EXISTING ASPHALT PAVEMENT (VARIABLE)	SY	
4020320	HOT MIX ASPHALT INTERMEDIATE COURSE TYPE B	TON	
4030320	HOT MIX ASPHALT SURFACE COURSE TYPE B	TON	
4039030	IMPRINTED ASPHALT WITH SURFACE COATING	SY	
6021120	PERMANENT CONSTRUCTION SIGNS (GROUND MOUNTED)	SF	
609105A	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 4" WHITE BROKEN LINES	LF	
609115A	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 4" WHITE SOLID LINES	LF	
609115B	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 4" YELLOW SOLID LINES	LF	
609125A	PAVEMENT MARKINGS(TEMPORARY-PAINT)- 8" WHITE SOLID LINES	LF	

609135A	PAVEMENT MARKINGS(TEMPORARY-PAINT)-24" WHITE SOLID LINES	LF	
609135B	PAVEMENT MARKINGS(TEMPORARY-PAINT)-24" YELLOW SOLID LINES	LF	
609160A	PAVEMENT MARKINGS(TEMPORARY-PAINT)-WHITE SINGLE ARROW	EA	
609180A	PAVEMENT MARKINGS(TEMPORARY-PAINT)-WHITE WORD 'ONLY'	EA	
6271005	4" WHITE BROKEN LINES(GAPS EXCL.)THERMOPLASTIC- 90 MIL.	LF	
6271010	4" WHITE SOLID LINES (PVT. EDGE LINES) THERMO.- 90 MIL.	LF	
6271015	8" WHITE SOLID LINES THERMOPLASTIC - 125 MIL.	LF	
6271025	24" WHITE SOLID LINES (STOP/DIAG LINES)-THERMO.-125 MIL	LF	
6271030	WHITE SINGLE ARROWS (LT, STRGHT, RT) THERMO.-125 MIL.	EA	
6271035	WHITE WORD MESSAGE "ONLY" -THERMOPLASTIC - 125 MIL.	EA	
6271074	4" YELLOW SOLID LINES(PVT.EDGE LINES) THERMO-90 MIL.	LF	
6271080	24" YELLOW SOLID LINES - THERMOPLASTIC - 125 MIL.	LF	
6300005	PERMANENT CLEAR PAVEMENT MARKERS- MONO-DIR.- 4"X4"	EA	
6301100	PERMANENT YELLOW PAVEMENT MARKERS BI-DIR.- 4"X4"	EA	
6510105	FLAT SHEET, TYPE III, FIXED SZ. & MSG. SIGN	SF	
6510108	FLAT SHEET, TYPE VIII OR IX, SIZE DETERMINED BY MSG. - OVERHEAD	SF	
6513020	FURNISH & INSTALL MOUNTING ASSEMBLY FOR FLAT SHEET SIGN ERCTD ON MAST ARM	EA	
6531210	U-SECTION POST FOR SIGN SUPPORTS - 3P	LF	
6750275	FURNISH & INSTALL 1.0" SCHEDULE 80 PVC CONDUIT	LF	
6750278	FURNISH & INSTALL 2.0" SCHEDULE 80 PVC CONDUIT	LF	
675027C	FURNISH & INSTALL 3.0" SCHEDULE 80 PVC CONDUIT	LF	
675027Z	FURNISH ADDITIONAL CONDUIT WITHIN DIRECTIONAL BORE	LF	
6760060	FURNISH & INSTALL 2" SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)	LF	
6770388	NO. 14 COPPER WIRE, 4 CONDUCTOR - BLACK	LF	
6770389	NO. 14 COPPER WIRE, 4 CONDUCTOR - GRAY	LF	
6770393	NO. 14 COPPER WIRE, 8 CONDUCTOR (BLACK)	LF	
6770394	NO. 14 COPPER WIRE, 8 CONDUCTOR (GRAY)	LF	
6770413	NO. 14 COPPER WIRE, 1-CONDUCTOR FOR LOOP WIRE	LF	
6780495	SAWCUT FOR LOOP DETECTOR	LF	
6800508	FURNISH & INSTALL 12"X12"X12"D.ELEC. FLUSH UNDERGRD.ENCLOSURE-(STR.POLY.CONC)HD	EA	
6800518	FURNISH & INSTALL 13"X24"X18"D.ELEC. FLUSH UNDERGRD.ENCLOSURE-(STR.POLY.CONC)HD	EA	
680052C	FURNISH & INSTALL 17"X30"X24"D.ELEC. FLUSH UNDERGRD.ENCLOSURE-(STR.POLY.CONC)HD	EA	
6825484	FURNISH AND INSTALL 10' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA	
6845511	FURNISH AND INSTALL CONTROLLER AND 332/336 CABINET ASSEMBLY - BASE MOUNTED	EA	
6865723	FURNISH AND INSTALL 12" 3 SECTION SIGNAL HEAD	EA	
6865783	FURNISH & INSTALL 1-WAY-1SECT.(COUNTDOWN HAND/MAN EMBLEM)PED.SIG.HEAD	EA	
6865797	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE STATION ASSEMBLY (9"x15") AND SIGN (R-10-3E)	EA	
6865831	FURNISH & INSTALL VEHICLE TRAFFIC SIGNAL HEAD MOUNTING ASSEMBLY FOR MAST ARM	EA	
6865834	FURNISH & INSTALL BACKPLATE W/ RETROREFL.BORDERS FOR TRAFFIC SIGNAL	EA	
6885990	REMOVAL, SALVAGE,& DISP.OF EXISTING TRAF. SIGNAL EQUIPMENT	LS	
6885992	TEMPORARY ADJUSTMENT OF TRAFFIC SIGNAL EQUIPMENT	EA	
6888167	POWDERCOATING PER MAST ARM OVER GALVANIZED	EA	
6888177	DESIGN, FURNISH & INSTALL STEEL POLE WITH TWIN MAST ARMS	EA	

	INCLUDING FOUNDATION		
6888179	DESIGN, FURNISH & INSTALL STEEL POLE WITH MAST ARM INCLUDING FOUNDATION	EA	
6888194	POWDERCOATING OPTION FOR 10' ALUMINUM PEDESTAL POLE	EA	
7143615	15" SMOOTH WALL PIPE	LF	
7143618	18" SMOOTH WALL PIPE	LF	
7143624	24" SMOOTH WALL PIPE	LF	
7149999	CLEANING EXISTING PIPE	LF	
7191005	CATCH BASIN - TYPE 1	EA	
7191605	CATCH BASIN - TYPE 16	EA	
7191615	CATCH BASIN - TYPE 16 - SPECIAL	EA	
7192011	DROP INLET (24" X 24") WITH STANDARD 4' X 4' BOX	EA	
7192020	DROP INLET (24" X 36")	EA	
7192021	DROP INLET (24" X 36") WITH STANDARD 4' X 4' BOX	EA	
7192107	MANHOLE WITH STANDARD 4' X 4' BOX	EA	
7197130	ADJUST DROP INLET ADJUST D.I.	EA	
7197150	ADJUST JUNCTION BOX	EA	
7198310	JUNCTION BOX - CONVERT DROP INLET 24" X 24"	EA	
7203110	CONCRETE CURB AND GUTTER (1'-6") VERTICAL FACE	LF	
7203210	CONCRETE CURB AND GUTTER (2'-0") VERTICAL FACE	LF	
7204100	CONCRETE SIDEWALK (4" UNIFORM)	SY	
7204600	CONCRETE SIDEWALK (6" UNIFORM)	SY	
7204900	DETECTABLE WARNING MATERIAL	SF	
7205000	CONCRETE DRIVEWAY(6" UNIFORM)	SY	
7207000	CONCRETE FLUME	EA	
7207002	CONCRETE FLUME UNDER SIDEWALK	EA	
7209000	PEDESTRIAN RAMP CONSTRUCTION	SY	
8081000	MOVING ITEM NO. 1	LS	
8091010	RIGHT OF WAY MARKER (REBAR AND CAP)	EA	
8091050	RIGHT OF WAY PLAT	LS	
8109050	SELECTIVE WATERING	GAL	
8109901	MOWING	ACRE	
8152004	INLET STRUCTURE FILTER - TYPE F (WEIGHTED)	LF	
8152006	INLET STRUCTURE FILTER - TYPE F (NON-WEIGHTED)	LF	
8153000	SILT FENCE	LF	
8153090	REPLACE/REPAIR SILT FENCE	LF	
8154050	REMOVAL OF SILT RETAINED BY SILT FENCE	LF	
8156200	CLEANING INLET STRUCTURE FILTERS	EA	
8152619	INLET STRUCTURE FILTER - TYPE A	LF	
99910000	STREET SWEEPING	EA	
9999995	WATER MAIN VERTICAL OFFSET	EA	
9999996	WATER VALVE ADJUSTMENT	EA	
9999997	WATER METER ADJUSTMENT	EA	
9999998	FIRE HYDRANT RELOCATION	EA	
9999999	FIRE HYDRANT ASSEMBLY	LS	
001	LAGERSTROEMIA X `MIAMI` / CRAPE MYRTLE - 30 gal.	EA	
002	QUERCUS PHELLOS `HIGHTOWER` / WILLOW OAK - 3" cal.	EA	
003	SABAL PALMETTO / CABBAGE PALMETTO - 12'-14' HT.	EA	
004	ABELIA X GRANDIFLORA `KALEIDOSCOPE` / GLOSSY ABELIA - 3 gal.	EA	
005	AZALEA X `AUTUMN ANGEL` / AUTUMN ANGEL AZALEA - 3 gal.	EA	
006	FICUS PUMILA / CREEPING FIG - 1 gal.	EA	
007	MUHLENBERGIA CAPILLARIS / PINK MUHLY - 3 gal.	EA	
008	PENNISETUM ALOPECUROIDES `LITTLE BUNNY` / LITTLE BUNNY FOUNTAIN GRASS - 3 gal.	EA	

009	PITOSPORUM TOBIRA `WHEELER'S DWARF` / DWARF PITOSPORUM - 3 gal.	EA	
010	PODOCARPUS MACROPHYLLUS `DWARF PRINGLES` / DWARF PODOCARPUS - 7 gal.	EA	
011	CERATOSTIGMA PLUMBAGINOIDES / DWARF PLUMBAGO - 1 gal.	EA	
012	CYNODON DACTYLON / BERMUDA GRASS - sod	SF	
013	ECHINACEA PURPUREA / PURPLE CONEFLOWER - 1 gal.	EA	
014	LIRIOPE MUSCARI `SUPER BLUE` / BIG BLUE LILYTURF - 1 gal.	EA	
015	LOROPETALUM CHINENSE `PURPLE PIXIE` / PURPLE PIXIE LOROPETALUM - 3 gal.	EA	
016	ROSA X `MEIDRIFORA` / CORAL DRIFT ROSE - 1 gal.	EA	
017	RUDBECKIA HIRTA / BLACK-EYED SUSAN - 1 gal.	EA	
018	TRACHELOSPERMUM ASIATICUM `ASIATIC` / ASIATIC JASMINE - 1 gal.	EA	
019	PINESTRAW	BALE	
020	TOPSOIL	CY	
021	BRICK WALL	LF	
022	LANDSCAPE MAINTENANCE	MONTHLY	

**SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Field condition reports.

1.3 SUBMITTALS

- A. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- B. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 RAIN DELAYS

Rain Day: For rain delays, the Contractor shall be entitled to a one day extension of time for each day in any given month that the actual rain days measured at the Charleston International Airport, or an otherwise mutually agreed upon location, exceed the NOAA average monthly rainfall for the month (rounded to the day). In order to qualify as a rain day, there must be at least one-hundredth of an inch precipitation on the date in question.

The rain gauge (Charleston International Airport), or an otherwise mutually agreed upon location, shall be used as the determinate for daily rain measurement. The Contractor shall submit any request for rain days by the tenth day of the following month. Rain and weather delay extensions of time are non-compensable delays and the Contractor shall be entitled to no additional compensation as consequence of rain and weather related extensions hereunder.

PART 1 PRODUCTS

1.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

1.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 15 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.3 REPORTS

- A. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information on AIA Form G716. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 EXECUTION

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and

activity durations.

3. As the work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in performance of construction activities.

END OF SECTION 013200

(1) **SECTION 714: SMOOTH WALL PIPE:**

REFERENCE:

SCDOT Supplemental Technical Specification SC-M-714

DESCRIPTION:

When bid items for smooth wall pipe are listed in the EBS file and/or proposal, the SCDOT will allow the use of reinforced concrete pipe, spiral ribbed aluminum pipe or high density polyethylene pipe in accordance with the specifications found in SC-M-714 (latest edition), the Standard Drawings, and this Special Provision. The plans may indicate reinforced concrete pipe only and are hereby superseded by this Special Provision.

MATERIALS:

Smooth wall pipe is either Reinforced Concrete Pipe (RCP: 714-205-XX), Spiral Ribbed Aluminum Pipe (SRAP: 714-605-XX), or High Density Polyethylene pipe (HDPE: 714-705-XX) as described in SCDOT Supplemental Technical Specification SC-M-714 and in the SCDOT Standard Drawings. Use smooth wall pipe culvert from manufacturers listed on Qualified Product Lists 30, 68, or 69. No value engineering application is required in order to use alternate pipe.

For the following counties: Berkeley, Beaufort, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper, provide pipe joints meeting AASHTO M 315 for RCP or passing the 13 psi pressure test as indicated on the QPL for SRAP or HDPE. Take care to properly lubricate and equalize pipe gaskets as indicated in the **SCDOT Standard Drawings** and **SC-M-714** to prevent gaskets from “rolling” during installation. For all other counties, provide pipe joints meeting AASHTO M 198, M 315, or passing the minimum 10 psi pressure test unless specific pipe joints are indicated in the plans or special provisions.

No other pipe type will be accepted as an alternate.

CONSTRUCTION REQUIREMENTS:

Use only pipe that conforms to the minimum and maximum fill height limitations indicated on the appropriate standard drawing. Unless indicated otherwise in the plans, determine pipe fill height based on the following formula:

Fill Height = Elevation (top of curb or max grade above pipe) – Elevation (pipe crown)

For all locations where new pipe is being attached to an existing system, use one of the following options:

1. Any existing pipe may be extended using any acceptable alternate pipe type by using a drainage structure at the interface between the different pipe types. The drainage structure* may consist of standard junction boxes, manholes, catch basins, drop inlets, or circular drainage structures detailed on **SCDOT Standard Drawings**. For larger diameter pipe, custom drainage structures may be required. Field cut existing pipe to remove damaged joint (if applicable) and install new drainage structure at the field cut interface. Always fully clean existing pipe and pipe joints before installing joint sealant or gaskets and attaching new pipe.
2. For locations where existing pipe properties cannot be directly matched, use a custom designed interface* (concrete collar, proprietary mastic wrap, custom coupling band, etc.) appropriate to interface the existing pipe to the new pipe of the same type. Submit interface drawings and design for review by the Engineer of Record and the Design Standards Engineer. Always fully clean existing pipe and pipe joints before installing joint sealant or

gaskets and attaching new pipe. Replace existing pipe that has joint damage before connecting new pipe to the system.

3. Any existing pipe may be extended using new pipe with the same joint profile and wall properties of the existing pipe. Always fully clean existing pipe and pipe joints before installing joint sealant or gaskets and attaching new pipe. Verify* the following parameters before ordering new pipe:
 - a. For RCP to RCP, confirm wall thickness, joint profile shape, and compatibility with existing manufacturer's pipe. Replace existing pipe that has joint damage before connecting new pipe to the system.
 - b. For SRAP to SRAP, replace existing pipe that has joint damage before connecting new pipe to the system.
 - c. For HDPE to HDPE, confirm the manufacturer of the existing pipe and the joint compatibility with the new pipe. Provide a new gasket when connecting to existing spigot end of HDPE pipe. Replace existing pipe that has joint damage before connecting new pipe to the system.
 - d. For CAAP to CAAP, confirm the type and size of end corrugations of the pipe. When existing pipe has full helical corrugations, provide new connecting pipe with one end fully helical and fully helical coupling band. When end corrugation size does not match the corrugation size shown on SCDOT Standard Drawings, provide a drainage structure (described above) at the interface. Replace existing pipe that has joint damage before connecting new pipe to the system. Do not install CAAP as smooth wall pipe; however, use these requirements when plans specify installing new CAAP.

The **RCE** will verify that connections between existing pipe and new installed pipe have been handled with one of the options listed above. Repair or replace all existing to new joint interfaces that do not meet the requirements above at no additional cost to **SCDOT**.

In all installations, provide the RCE with a complete pipe table indicating the following: Plan Pay Item, Plan Pipe Description, Plan Quantity, Installed Pipe (diameter, type, class/gage), Installed Quantity, and description of interface used to join new pipe to existing pipe for each occurrence.

In cases where 2 or more different pipe types are installed, provide a copy of the proposed installation layout on the drainage/plan sheets to the RCE indicating which pipe is installed at each location.

MEASUREMENT:

Measure smooth wall pipe in accordance with methods specified in SC-M-714 for the pipe material installed.

*No measurement will be made for drainage structure, designed interface, or field verification performed at each interface between existing pipe and new pipe unless drainage structure/interface is specified in the plans.

PAYMENT:

Payment will be made for smooth wall pipe regardless of the type of material installed. Payment for smooth wall pipe is as specified in SC-M-714 for the pipe material installed.

*Include all costs for work related to connecting new pipe to existing pipe in the unit bid price of the new pipe. This connection work includes: drainage structure at the interface, custom designed interface, field verification of existing pipe and compatibility with new pipe, new gaskets, new joint sealant, new coupling bands, removal, and disposal of damaged sections of existing pipe.

ITEM NO.	DESCRIPTION	UNIT
7143XXX	X" SMOOTH WALL PIPE	LF

7143XXX	X"x X" SMOOTH WALL PIPE CUL.TEE	EA
714XXX	X" x X" SMOOTH WALL PIPE CUL.WYE	EA
7144XXX	X" SMOOTH WALL PIPE X DEG BEND	EA
7144XXX	SMOOTH WALL PIPE INCR.- X" TO X"	EA

(2) **SECTION 714: PIPE END TREATMENTS (2/5/2010)**
REFERENCE: SCDOT Supplemental Technical Specification SC-M-714

DESCRIPTION:

For exposed pipe culvert ends, provide an end treatment in accordance with this special provision.

MATERIALS:

Rigid pipe culvert is Reinforced Concrete Pipe (RCP: 714-205-00). Flexible pipe culvert is either Spiral Ribbed Aluminum Pipe (SRAP: 714-610-00), High Density Polyethylene pipe (HDPE: 714-705-00), or Corrugated Aluminum Alloy Pipe (CAAP: 714-605-00).

Use minimum Class B riprap for pipe up to 84" diameter. Use minimum Class C riprap for pipe 84" diameter or larger.

Use minimum Class 4000 concrete (4000P for precast).

Use ASTM A-706 grade 60, low-alloy steel deformed rebar.

Use minimum AASHTO M-196 Alclad 3004-H32 alloy aluminum.

Use Type M Mortar Grout unless specified otherwise.

CONSTRUCTION REQUIREMENTS:

Use one of the following end treatments as specified in the plans or special provisions:



For all exposed crossline pipe ends, when an end treatment is not specified in the plans, use **Pipe Riprap Protection** (804-3xx-xx). For flexible pipe larger than 24" diameter, install pipe straight headwall, pipe end structure, flared end section, or wingwall section in addition to riprap. For all exposed driveway pipe ends where no end treatment is specified in the plans, use **Pipe Riprap Protection** (804-3xx-xx) unless directed otherwise by the engineer.



Use **Beveling of Pipe End** (719-610-00) when specified in the plans or special provisions. Beveled ends may only be used on flexible pipe up to 24" diameter and on rigid pipe up to 60" diameter. When beveling of pipe ends is specified on flexible pipe larger than 24" diameter, install pipe straight headwall, pipe end structure, flared end section, or wingwall section. Use factory fabricated beveled ends for all pipe types unless approved by the Engineer.



Use **Pipe Straight Headwall** (719-605-00) when specified in the plans or special provisions. Use straight headwall only in locations where pipe exposed end does not face the direction of traffic.



Use **Pipe End Structure** (719-615-00) when specified in the plans or special provisions. Use pipe end structure in locations where pipe exposed end faces the direction of traffic. Pipe end structures may be used in other locations if approved by the RCE.



Use **Pipe Flared End Section** when specified in the plans or special provisions.



Use **Pipe Wingwall Section** when specified in the plans or special provisions.

Completely seal interface between pipe and end treatment with grout. If bricks or shims are used to place pipe, take care to remove all air pockets and voids when grouting.

For systems not designed in the SCDOT Standard Drawings, provide shop drawings, installation procedure and design calculations for review by RCE. Design must include provision to control erosion around the structure and prevent the separation of the end treatment from the pipe system. Design must provide for a proper seal at all construction joints including the interface between the pipe and the structure. Design must be self-supporting and not induce any additional loads on the pipe. Submit designs for consideration as new standard drawings to the Design Standards Engineer at the address listed in the SCDOT Standard Drawings book.

MEASUREMENT:

Measure pipe in accordance with SC-M-714

Measure end treatments in accordance with Standard Specifications, Standard Drawings, or Special Provisions.

PAYMENT:

Beveling of pipe ends will be in addition to the standard pipe pay item. Payment for the item Beveling of Pipe Ends includes all labor required to factory (or field, if approved) fabricate a bevel on one end of pipe.

Pipe culvert and end treatments, measured as provided in **SC-M-714 Subsection x.4**, are paid for at the contract unit price for the respective items, which price and payment is compensation for furnishing all material, labor, equipment, tools including hauling and placing all pipe sections and materials, excavation of the entire standard trench, bedding, and pipe backfill as described in the measurement section (both structural and embankment backfill in this region), removal of existing pipe to be replaced, constructing pipe joints, removal of old end treatments, cleaning out pipe, disposal of surplus materials, all visual inspection, and all incidentals necessary to complete the work.

Add the following paragraph to SC-M-714 subsections x.5:

Payment for riprap and geotextile for erosion control under riprap as measured in subsection x.4 includes all direct and indirect costs and expenses necessary to complete the work.

SCDOT TRAFFIC SIGNALS

MATERIAL SPECIFICATIONS

Revised
5/16/2016

MATERIAL SPECIFICATION REVISIONS

NOTE: SCDOT has made note of revisions since the last set of specifications, however, it is the responsibility of the contractor/vendor to read the specifications and verify materials meet requirements. Do not rely solely on this revision sheet for specification changes.

Date	Specification	Description	Details of Revision
5/16/2016	M688.7	CONTROLLER AND CABINET ASSEMBLY	Various revisions
5/16/2016	M686.4	PEDESTRIAN PUSH BUTTON STATION ASSEMBLY WITH SIGN	Revised dual mount bracket requirement
3/1/2016	M686.1		Revised requirements for removable door
3/1/2016	M688.7		Replaced with 4/15/2013 spec until revision is complete – QPL items match this spec
3/1/2016	M677.4		Removed Furnish Fiber Interconnect Center specification
3/1/2016	M677.3		Revised Fiber Optic Cable specifications to be Industry Standards
2/1/2016	M688.6		Various minor revisions
2/1/2016	M688.5		Various minor revisions
9/14/2015	M688.3		Clarified processing unit type and added Network Services Policy
7/1/2015	M688.7		Revised required conflict monitor and accommodates operation of 18 phase
7/1/2015	M688.6		Various revisions
7/1/2015	M688.5		Revised hole requirements
6/23/2015	M682.4		Added information about powdercoating
12/15/2014	M686.3		Removed pay item information. See supplemental specifications.
12/15/2014	M686.1		Removed pay item information. See supplemental specifications.
7/31/2014	M686.1		Revised hanger and signal head specifications
6/11/2014	M686.1		Revised to include Non-Pixelated LED specification, revised backplate specifications
5/19/2014	M677.1		Updated specifications
12/2/2013	M686.2		Added Non-Pixelated LED specification
7/22/2013	M686.3		Revised module lens requirements
6/1/2013	M686.3		Revised modules types, to comply with latest ITE specification, revised terminal strip material, fade resistant for 5 years, identifiers on equipment and packaging, warranty
4/15/2013	M682.4		Revised Class 3000 Concrete
4/15/2013	M688.5		Revised Class 5000 Concrete
4/15/2013	M688.6		Revised Class 3000 Concrete
4/15/2013	M688.7		Revised Class 3000 Concrete
3/6/2013	M686.4		New State Contract, Added Pay Items

Traffic Signals
Material Specifications
5/16/2016

Table of Contents

		Revision Date
M677.1	FURNISH ELECTRICAL CABLE	5/19/2014
M677.3	INDUSTRY STANDARDS FOR FIBER OPTIC CABLE	3/1/2016
M677.6	FURNISH FACTORY TERMINATED PATCH PANEL	10/1/2012
M678.1	FURNISH WIRE, SEALANT, AND/OR MATERIALS FOR DETECTOR LOOP	10/1/2012
M680.2	FURNISH SPLICE BOX/JUNCTION BOX	10/1/2012
M682.3	FURNISH STEEL CABLE	10/1/2012
M682.4	FURNISH PEDESTRIAN POLE AND BASE	4/15/2013
M686.1	FURNISH VEHICLE SIGNAL HEADS AND BACKPLATES	3/1/2016
M686.3	FURNISH PEDESTRIAN SIGNAL HEADS	12/15/2014
M686.4	FURNISH PEDESTRIAN PUSH BUTTON STATION ASSEMBLY WITH SIGN	5/16/2016
M686.5	FURNISH SYMBOLIC LED BLANKOUT SIGN	10/1/2012
M688.3	FURNISH VIDEO DETECTION SYSTEM	9/14/2015
M688.5	FURNISH STEEL STRAIN POLE AND FOUNDATION	2/1/2016
M688.6	FURNISH CONCRETE STRAIN POLE	2/1/2016
M688.7	FURNISH CONTROLLER AND CABINET ASSEMBLY	5/16/2016
M688.9	FURNISH SOLAR POWERED FLASHER ASSEMBLY	10/1/2012

M677.1 ELECTRICAL CABLE

1.1 Description

This specification describes requirements for furnishing traffic signal, loop lead-in, pedestrian signal, and pedestrian push button Electrical Cable.

1.2 Materials

1.2.1 Black Cable

1.2.1.1 Traffic Signal Head Black 8 Conductor Wiring

BLACK - Unless specified elsewhere, the traffic signal cable shall be (8 conductor). The conductor shall be #14 AWG, 19 strands, bare copper. The conductor insulation shall be high density polyethylene and shall be both ultraviolet and weather resistant. The wall thickness for the single conductor shall be 0.025" minimum point thickness with a .124" nominal diameter. The Cabling overall lay shall be 6" with a left hand lay. 1 (60) Non-Hydroscopic Polypropylene filler material shall be utilized to produce a circular cross section. The conductor cable assembly shall be wrapped with a 0.001 inch clear Mylar tape material applied helically with a minimum 25% overlap. The overall cable assembly shall be provided with a black high density polyethylene jacket which is both ultraviolet and weather resistant. The wall thickness shall be 0.042 inch minimum point thickness. The cable shall have a nominal cabling diameter of .393" and a nominal jacket diameter of .487" and shall have a ripcord for easy jacket removal. The outer cable jacket shall have sequential foot marks. Traffic signal cable shall be manufactured in accordance with the requirements of Underwriters' Laboratories, SCDOT, IMSA 20-1, ROHS, Federal specifications, and the National Electric Code.

The traffic signal cable must also meet or exceed specifications in the chart below.

Conductor Insulation

Conductor Colors	External Jacket	
	Insulation Color	Size, AWG
White, Yellow Red, Green White w/Black Band, Yellow w/Black Band Red w/Black Band, Green w/Black Band	Black	#14

1.2.1.2 Pedestrian Signal Head Black 4 conductor Wiring

BLACK - Unless specified elsewhere, the traffic signal cable shall be (4 conductor). The conductor shall be #14 AWG, 19 strands, bare copper. The conductor insulation shall be high density polyethylene and shall be both ultraviolet and weather resistant. The wall thickness for the single conductor shall be 0.025" minimum point thickness with a .124" nominal diameter. The Cabling overall lay shall be 4.50" left hand lay. 4 (60) Non-Hydroscopic Polypropylene filler material shall be utilized to produce a circular cross section. The conductor cable assembly shall be wrapped with a 0.001 inch clear Mylar tape material applied helically with a minimum 25% overlap. The overall cable assembly shall be provided with a black high density polyethylene jacket which is both ultraviolet and weather resistant. The wall thickness shall be 0.045 inch minimum point thickness. The cable shall have a nominal cabling diameter of .296" and a nominal jacket diameter of .373" and shall have a ripcord for easy jacket removal. The outer cable jacket shall have sequential foot marks. Traffic signal cable shall be manufactured in

accordance with the requirements of Underwriters' Laboratories, SCDOT, IMSA 20-1, ROHS, Federal specifications, and the National Electric Code.

The traffic signal cable must also meet or exceed specifications in the chart below

Conductor Insulation

Conductor Colors	Insulation Color	External Jacket Size, AWG
White, Yellow, Red, Green	Black	#14

1.2.2 Gray Cable

1.2.2.1 Loop lead-in Gray 4 Pair Wiring

GRAY - Unless specified elsewhere, the loop lead-in cable shall be four individually shielded pairs (8 conductor). Each pair shall be individually twisted (two turns per foot minimum). The conductor shall be #14 AWG, 19 strands, bare copper. The conductor insulation shall be high density polyethylene and shall be both ultraviolet and weather resistant. The nominal insulation thickness shall be 0.025". The nominal insulation diameter shall be .134". Each pair shall be wrapped with a 0.001 inch aluminum mylar foiled shield with a minimum 25% overlap. Aluminum is to be located on the outside. 4 (60) non-hydrosopic polypropylene filler material shall be utilized to produce a circular cross section. The cabling overall lay shall be a 5.50" left hand lay. The drain wire shall be #16 AWG, 19 strands, tinned copper. The conductor cable assembly shall be wrapped with a 0.001 inch clear Mylar binder applied helically with a minimum 25% overlap. The overall cable assembly shall be provided with a high density polyethylene jacket which is both ultraviolet and weather resistant. Nominal Jacket diameter shall be 0.525" and shall have a ripcord for easy jacket removal. Nominal Cabling Diameter shall be .445". The nominal jacket thickness shall be 0.042". The outer cable jacket shall have sequential foot marks. Traffic signal cable shall be manufactured in accordance with the requirements of SCDOT, IMSA 50-2, ROHS, and the National Electric Code.

The twisted pair loop lead-in cable must also meet or exceed specifications in the chart below.

Conductor Insulation

Pair Color	Insulation Color	External Jacket Size, AWG
White-Yellow Red-Green White w/Black Band-Yellow w/Black Band Red w/Black Band-Green w/Black Band	Gray	#14

1.2.2.2 Pedestrian Push Button Gray 2 Pair Wiring

GRAY - Unless specified elsewhere, the loop lead-in cable shall be two individually shielded pairs (4 conductor). Each pair shall be individually twisted (two turns per foot minimum). The conductor shall be #14 AWG, 19 strands, bare copper. The conductor insulation shall be high density polyethylene and shall be both ultraviolet and weather resistant. The nominal insulation thickness shall be 0.025". The nominal insulation diameter shall be .124". Each pair shall be wrapped with a 0.001 inch aluminum mylar foiled shield with a minimum 25% overlap. Aluminum is to be located on the outside. 3 (60) non-hydrosopic polypropylene filler material shall be utilized to produce a circular cross section. The cabling overall lay shall be a 4.00" left hand lay. The drain wire shall be #16 AWG, 19 strands, tinned copper. The conductor cable assembly shall be wrapped with a 0.001 inch clear Mylar binder applied helically with a minimum 25% overlap. The overall cable assembly shall be provided with a high density polyethylene jacket which is both ultraviolet and weather resistant. Nominal Jacket diameter shall be

0.40" and shall have a ripcord for easy jacket removal. Nominal Cabling Diameter shall be .335". The nominal jacket thickness shall be 0.035". The outer cable jacket shall have sequential foot marks. Traffic signal cable shall be manufactured in accordance with the requirements of SCDOT, IMSA 50-2, ROHS, and the National Electric Code.

The twisted pair loop lead-in cable must also meet or exceed specifications in the chart below.

Conductor Insulation		External Jacket
Pair Color	Insulation Color	Size, AWG
White-Yellow Red-Green	Gray	#14

1.2.3 Certification

CATALOG CUTS ARE REQUIRED

1.2.4 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.2.5 Labeling and Delivery

Unless otherwise stated, the cable shall be supplied in minimum reels of 1,000 feet, for splice-free installation.

The Manufacturer shall be required to mark each cable and cable reel to facilitate easy identification of the various sizes when stored in stockpiles.

1.3 Measurement

Electrical Cable, of the size and numbers of conductors specified, shall be measured by LINEAR FEET and furnished in 1000' reels.

1.4 Payment

Furnishing Electrical Cable, measured as provided above, will be paid at the contract unit price bid for:

FURNISH NO. 14 COPPER WIRE, 4 CONDUCTOR - BLACK	1000' REEL
FURNISH NO. 14 COPPER WIRE, 2 PAIR CONDUCTOR - GRAY	1000' REEL
FURNISH NO. 14 COPPER WIRE, 8 CONDUCTOR - BLACK	1000' REEL
FURNISH NO. 14 COPPER WIRE, 4 PAIR CONDUCTOR - GRAY	1000' REEL

677.3 FIBER OPTIC CABLE

1.1.1 Industry Standard

- The optical fiber **cable plant** consists of optical fiber cables, connectors, mounting panels, jumper cables, and other passive components, but it does not include active components.
- TIA-526-7 (OFSTP-7)-2002+A1:2008, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*. This standard specifies singlemode optical loss measurement methods between two passively connected points using an optical source and power meter. An Optical Loss Test Set uses a light source to inject light in the fiber and a measurement device to measure the light out- this measures the attenuation (optical loss).
- Singlemode fiber (OS1, OS2) shall not have more than 0.5 dB attenuation (signal loss) per kilometer. That is measured with an Optical Loss Test Set.
- No more than 20% light loss will be accepted. Singlemode fiber (OS1, OS2, OSP) shall not have more than 0.5 dB attenuation (signal loss) per kilometer. That is measured with an Optical Loss Test Set.
- An OTDR is a good tool to “see” the overall “health” of the installed fiber OR to locate breaks, estimate connector and splice loss, identify macrobends (bends visible to the eye but hidden in the cable jacket) and microbends (a microbend could be caused if the fiber coating squeezes a fiber as it contracts at very low temperatures, ran over by a vehicle, or if it is stressed during installation). Both bends can result in increased attenuation that can degrade system performance and minimize optical throughput. Fusion or mechanical splices shall not have a loss of more than 0.3 dB. Mechanical splices are not SCDOT standard splice methodology. SCDOT allows Singlemode connector mating (patch cord to fiber interconnect center coupler) a max loss of 0.75 dB when planning and testing. The same loss is allowed from the patch cord to the Ethernet switch. Essentially signal loss of 0.75 dB is expected and allowed each time two factory connectors are mated. FYI- factory terminated patch cords have an average loss of 0.3 dB for factory-polished singlemode pigtails suitable for splicing.
- This standard includes an encircled flux launch condition metric (i.e. launch cable which allows the OTDR to settle down and analyze the true reflections of the installed cable, splices, and connectors) for measuring cable plant. Additionally, this standard includes the description of using an optical time domain reflectometer (OTDR) for total attenuation measurement and measurements of individual component loss.
- Outside Plant Cable OSP installation- The standard calls for water-blocked cables (cables suitable for outside plant use) with a minimum pulling tension of 600 pounds.
- Minimum bend radius is 20 times the cable diameter under max rated pulling tension and 10 times unloaded (unloaded means slack storing and permanently installed).
- ANSI/TIA/EIA-598-C-2005, *Optical Fiber Cable Color Coding*. This standard specifies the recommended identification for individual fibers, fiber units, and groups of fiber units
- within a cable structure (jacket).

1.1.2 Cable

- The cable shall meet all requirements stated in RUS-90 as well as those stated within this document. The cable shall be an accepted product of the United States Department of Agriculture Rural Utility Service as meeting the requirements of RUS-PE-90. The cable shall be new, unused, and of current design and manufacture.
- The single-mode fiber used in the cable shall conform to the following specifications:

Typical Core Diameter:	8.3 μm
Cladding Diameter:	125.0 + 1.0 μm by fiber end measurement
Core-to-Cladding Offset:	< 1.0 μm
Cladding Non-Circularity:	< 2.0% (Defined as: [1-(min. cladding dia. max. cladding dia.)] x 100)
Coating Diameter:	250 + 15 μm
Attenuation Uniformity:	No point discontinuity greater than 0.1 dB at either 1300 nm or 1550 μm .
- The change in attenuation at extreme operational temperatures for single-mode fibers shall not be greater than 0.40 dB/km at 1550 nm and 0.5 at 1310 nm, with 80% of the measured values no greater than 0.10 dB/km at 1550 nm.
- The maximum dispersion shall + 3.3 ps/(nm • km) for 1285 nm through 1330 and shall be < 18 ps/(nm • km) at 1550 nm.

1.1.3 Fiber Characteristics

- All fibers in the cable shall be usable fibers and meet required industry standards.
- All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements to this specification.

- Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.
- The coating shall be a dual-layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be capable of being mechanically or chemically striped without damaging the fiber.

1.1.4 **Cable Size and Configuration**

- The core or buffer tubes containing the fibers and the interstices between the buffer tubes, fillers, and strength members in the core structure are filled with a suitable material to exclude water. Fibers may be assembled in either loose tube fiber bundles or tight buffered configurations. Both construction types must pass all the requirements of current industry standards such as ICEA S-87-640, Telcordia GR-20-CORE and RUS PE-90.
- Each loose tube configuration shall contain twelve (12) fibers. The fibers shall not adhere to the inside of the buffer tube.
- Each fiber and loose tube buffer shall be distinguishable from each other by means of color coding according to ANSI/TIA/EIA-598-C-2005, *Optical Fiber Cable Color Coding* as referenced below. Tight buffered fibers shall adhere to the same color coding standards.

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

- Optical cable designs not specifically addressed by this section may be allowed if accepted by SCDOT. Justification for acceptance of a modified design must be provided to substantiate product utility and long term stability and endurance.

M677.6 FACTORY TERMINATED PATCH PANEL

1.1 Description

This specification describes requirements for furnishing a Factory Terminated Patch Panel. Included in this item is the splicing of the fiber optic cable; installing interconnection sleeves, jumpers, connectors and other hardware that may be needed for connecting the fiber optic cable to the signal system electronic devices.

1.2 Materials

1.2.1 *Factory Terminated Patch Panel*

The interconnect center shall be a factory terminated patch panel, including strain relief hardware and have termination/connection capacity for 12 fibers and a 200' tail.

1.2.2 *Certification*

CATALOG CUTS ARE REQUIRED

1.2.3 *Warranty*

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Furnishing a Factory Terminated Patch Panel will be measured by EACH.

1.4 Payment

The Factory Terminated Patch Panel, as measured above, will be paid for at the contract unit price bid for:

FURNISH FACTORY TERMINATED PATCH PANEL	EA
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M678.1 FURNISH WIRE, SEALANT, AND/OR MATERIALS FOR DETECTOR LOOP

1.1 Description

This specification describes requirements for furnishing Wire, Sealant, and/or Materials for a Detector Loop.

1.2 Materials

1.2.1 Loop Wire

Loop wire shall be splice-free lengths of: No. 14 AWG, 19 Strands, single-conductor bare copper wire. The conductor insulation (BLACK or GRAY) shall be high density polyethylene and shall be both ultraviolet and weather resistant. The wall thickness shall be 0.030 inch minimum point thickness. Cable shall be manufacturer in accordance with the requirements of Underwriters Laboratories, Federal specifications, and the National Electric Code.

1.2.2 Sealant

The loop sealant used to fill the saw cuts and other gaps, shall be of a type intended for traffic loop embedding. The cured sealant shall be semi-flexible, and be capable of adhering securely to concrete, asphalt, wood, metal, etc. It shall be unaffected by freeze-thaw cycling, salts, gasoline, oil, sewerage and corrosive chemicals. It shall be proportioned and mixed per the manufacturer's specifications. Acceptable sealants are listed on the SCDOT QPL.

1.2.3 Waterproofing Splice Materials

The splice at the "junction point" shall be made waterproof using the materials listed below:

- a) Cable Splice Kit - Commercially available, Low-Voltage, water-proof Splice-kit; to be Plymouth "PLYFLEX"; or 3M "SCOTCH-LOK", Unipak #3570, Resin 400, (or approved equal). To be installed per manufacturer's instructions.
- b) Heat Shrink tubes
- c) Gel Caps
- d) Vinyl plastic electrical tape (use where required)-Cold and weather resistant, 19 mm (3/4 inch) wide, 1.8 mm (7 mil) thickness, (Scotch 33+ or approved equal). Shall use liquid electrical coating (where required) - Fast-drying sealant compatible with vinyl tape, brush-applied (3M, Scotchkote or approved equal).

1.2.4 Underwater Splicing Kit

Where shown on the Plans, in very wet areas an Underwater Splice Kit may be required at the "junction point". This splicing kit shall consist of a two-piece mold-body, with pourable resin sealing compound, funnels, and end sealing strips (3M, Scotchcast 82-A1 or approved equal).

1.2.5 Wire Crimps

The PREFERRED splicing method at the "junction point", shall use a commercial/industrial grade, copper-alloy CRIMP-ON, with one end closed, of a size proper for the gauge of wires to be spliced, and

the number of conductors. It shall be installed with butt splice using a T & B type crimping tool or similar tool, intended for the purpose (NOT regular pliers). (Note: wire-nuts are not acceptable.)

1.2.6 Solder

The alternate method of splicing at the "junction point" is to use SOLDER, which shall be electronic-grade, rosin-core, 60 lead/40 tin. Acid-core solder is not acceptable, nor are acid-type soldering pastes.

1.2.7 Certification

The Vendor shall provide details for the loop sealant, loop wire, and lead-in wire proposed.

CATALOG CUTS ARE REQUIRED

SAMPLE REQUIRED

1.2.8 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Wire for Detector Loops, of the size and numbers of conductors specified, shall be measured by LINEAR FEET and furnished in 5000' reels.

1.4 Payment

Furnishing Wire for Detector Loops, measured as provided above, will be paid at the contract unit price bid for:

FURNISH NO. 14 COPPER WIRE, 1-CONDUCTOR FOR LOOP WIRE	5000' REEL
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M678.1 FURNISH WIRE, SEALANT, AND/OR MATERIALS FOR DETECTOR LOOP**1.1 Description**

This specification describes requirements for furnishing Wire, Sealant, and/or Materials for a Detector Loop.

1.2 Materials**1.2.1 Loop Wire**

Loop wire shall be splice-free lengths of: No. 14 AWG, 19 Strands, single-conductor bare copper wire. The conductor insulation (BLACK or GRAY) shall be high density polyethylene and shall be both ultraviolet and weather resistant. The wall thickness shall be 0.030 inch minimum point thickness. Cable shall be manufacturer in accordance with the requirements of Underwriters Laboratories, Federal specifications, and the National Electric Code.

1.2.2 Sealant

The loop sealant used to fill the saw cuts and other gaps, shall be of a type intended for traffic loop embedding. The cured sealant shall be semi-flexible, and be capable of adhering securely to concrete, asphalt, wood, metal, etc. It shall be unaffected by freeze-thaw cycling, salts, gasoline, oil, sewerage and corrosive chemicals. It shall be proportioned and mixed per the manufacturer's specifications. Acceptable sealants are listed on the SCDOT QPL.

1.2.3 Waterproofing Splice Materials

The splice at the "junction point" shall be made waterproof using the materials listed below:

- a) Cable Splice Kit - Commercially available, Low-Voltage, water-proof Splice-kit; to be Plymouth "PLYFLEX"; or 3M "SCOTCH-LOK", Unipak #3570, Resin 400, (or approved equal). To be installed per manufacturer's instructions.
- b) Heat Shrink tubes
- c) Gel Caps
- d) Vinyl plastic electrical tape (use where required)-Cold and weather resistant, 19 mm (3/4 inch) wide, 1.8 mm (7 mil) thickness, (Scotch 33+ or approved equal). Shall use liquid electrical coating (where required) - Fast-drying sealant compatible with vinyl tape, brush-applied (3M, Scotchkote or approved equal).

1.2.4 Underwater Splicing Kit

Where shown on the Plans, in very wet areas an Underwater Splice Kit may be required at the "junction point". This splicing kit shall consist of a two-piece mold-body, with pourable resin sealing compound, funnels, and end sealing strips (3M, Scotchcast 82-A1 or approved equal).

1.2.5 Wire Crimps

The PREFERRED splicing method at the "junction point", shall use a commercial/industrial grade, copper-alloy CRIMP-ON, with one end closed, of a size proper for the gauge of wires to be spliced, and

the number of conductors. It shall be installed with butt splice using a T & B type crimping tool or similar tool, intended for the purpose (NOT regular pliers). (Note: wire-nuts are not acceptable.)

1.2.6 Solder

The alternate method of splicing at the "junction point" is to use SOLDER, which shall be electronic-grade, rosin-core, 60 lead/40 tin. Acid-core solder is not acceptable, nor are acid-type soldering pastes.

1.2.7 Certification

The Vendor shall provide details for the loop sealant, loop wire, and lead-in wire proposed.

CATALOG CUTS ARE REQUIRED

SAMPLE REQUIRED

1.2.8 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Wire for Detector Loops, of the size and numbers of conductors specified, shall be measured by LINEAR FEET and furnished in 5000' reels.

1.4 Payment

Furnishing Wire for Detector Loops, measured as provided above, will be paid at the contract unit price bid for:

FURNISH NO. 14 COPPER WIRE, 1-CONDUCTOR FOR LOOP WIRE	5000' REEL
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M680.2 SPLICE BOX / JUNCTION BOX

1.1 Description

This specification describes requirements for furnishing a Splice Box and/or Junction Box. The Splice Box shall consist of a Box and Cover, installed over aggregate. The Splice Box is intended for use as a signal cable electrical enclosure. The Junction Box is intended for use as a loop detector "junction point".

1.2 Materials

1.2.1 Box and Cover

The Splice Box shall consist of a Base having an open top (the Box), with a separate removable Cover. They shall be made from a lightweight, blended modern material, using fiberglass reinforcement, and shall be NON-CONCRETE / NON-STEEL. They shall be GRAY IN COLOR. Covers shall have the LEGEND "TRAFFIC SIGNAL". They shall use HEX-HEAD stainless steel bolts. The PHYSICAL FEATURES AND THE NOMINAL SIZE AND DIMENSIONS for the Box and Cover, are shown on the Standards or the Design Details, and are listed below.

	<u>WIDTH</u>	<u>LENGTH</u>	<u>DEPTH</u>
SPLICE BOX:	13 inch	24 inch	18 inch
HAND BOX:	17 inch	30 inch	24 inch
MINI SPLICE BOX:	12 inch	12 inch	12 inch

1.2.2 Design Load

Boxes shall be designed to meet or exceed the loading requirements for a Tier 15 application per the Society of Cable Engineers (SCTE) ANSI/SCTE 77-2007 "Specification for Underground Enclosure Integrity, Table – Test Loads".

Thus, boxes shall be designed and tested for the following test loads: Cover- vertical load 22,500 pounds distributed over a 10 inch x 10 inch area. Box - vertical load 22,500 pounds distributed over a 5 inch x 10 inch. Box- lateral load of 1200 pounds per square foot . The cover deflection shall be less than 0.5 inch; and the box deflection less than 0.25 in/ft of length.

1.2.3 Western Underground Committee (WUC)

Using the above specified loads, the Splice Box shall meet or exceed the WUC "Recommended Guide No. 3.6, Non-Concrete Enclosures". Structural Requirements shall include: testing for Vertical Load on Cover; Vertical Load on Box; Lateral Load on Box. Further they shall meet WUC recommendations for: Accelerated Service per ASTM D-756; Chemical Resistance per ASTM D-543; Simulated Sunlight Resistance per ASTM G-53; plus Water Absorption; and Flammability. Covers shall be skid-resistant, with a minimum coefficient of friction of 0.50.

1.2.4 Certification

CATALOG CUTS ARE REQUIRED

1.2.5 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Furnishing a Splice Box will be measured by EACH Box including Box and Cover.

Furnishing a Junction Box will be measured incidental to the conduit to which it is used with.

1.4 Payment

Furnishing Splice Box and/or Junction Box, accepted and measured as provided above, will be paid for at the contract unit price bid for:

FURNISH 13"X24"X18"D.ELEC.FLUSH UNDGRD.ENCLOSURE-(STR.POLY.CONC.)HD	EA
FURNISH 17"X30"X24"D.ELEC.FLUSH UNDGRD.ENCLOSURE-(STR.POLY.CONC.)HD	EA
FURNISH 12"X12"X12"D.ELEC.FLUSH UNDGRD.ENCLOSURE-(STR.POLY.CONC.)HD	EA

M682.3 STEEL CABLE

1.1 Description

This specification describes requirements for furnishing splice-free lengths of Steel Cable with cable supports, for mounting signal heads, signs, interconnect runs, and installing back guys.

1.2 Materials

1.2.1 Fabrication

Steel Cable shall be fabricated of 7 steel wires, Class A double galvanized in accordance with ASTM A-475, and twisted into a single concentric strand to conform with the following schedule:

Diameter (inches)	Strand Size (AWG)	Tensile Strength (pounds)
1/4	14	3,150
3/8	11	6,950
7/16	9.5	9,350
1/2	8	12,000

Usage

Span Wire - All Steel Cable used as span wire shall be 3/8 inch in diameter, unless otherwise noted on the Plans.

Messenger Wire - All Steel Cable used as messenger shall be 1/4 inch in diameter, unless otherwise noted on the Plans.

Tether Wire - All Steel Cable used as tether wire shall be 1/4 inch in diameter, unless otherwise noted on the Plans.

Back Guy - All Steel Cable used for back guying shall be 3/8 inch in diameter, unless noted otherwise on the Plans.

Cable Supports

Aluminum Tie-wrap - Shall be Flat Aluminum Armor Tape, 0.05 inch Thick X 0.30 inch Wide, typically furnished in 10 pound coils.

Where specifically required, Support Rings (also called "cable rings", "messenger rings") shall be galvanized in accordance with ASTM A-153, and the design approved by the ENGINEER, and shall be 2 to 3 inches in diameter (to contain the Electrical Cables), and sized to specifically match the Steel Cable.

Miscellaneous Hardware

All hardware and fittings shall be of the type shown on the Standards or the Construction and Installations Details.

All hardware and fittings shall be made of galvanized steel or non-corrosive metal. The tensile strength of all hardware shall be equal-to or greater-than the Steel Cable installed.

All thimble-eye and oval eye-bolts used to connect the automatic compression dead-end clamps to wooden poles, shall be 3/4 inch diameter. S-hooks shall be the same diameter as the cable. Fiberglass insulators shall be fabricated from epoxy-resin impregnated fiberglass strands, and have a tensile strength 50% greater than the Steel Cable.

Certification

The Vendor shall provide a Certification from the Manufacturer that the Steel Cable has been tested to meet or exceed the required tensile strength.

Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Steel Cable of the SIZE specified shall be measured by the LINEAR FEET and furnished in 1000' reels.

1.4 Payment

Accepted quantities of Steel Cable, measured as stated above will be paid for at the contract unit price bid for:

FURNISH 3/8" GALVANIZED STEEL CABLE	1000' REEL
FURNISH 1/4" GALVANIZED STEEL CABLE	1000' REEL

M682.4 PEDESTRIAN POLE AND BASE

1.1 Description

This specification describes requirements for furnishing a Pedestrian Pedestal Pole and Base.

1.2 Materials

1.2.1 Aluminum Base

Pedestrian bases shall be constructed of aluminum. The neck of the base shall be threaded to accommodate a 4 inch diameter aluminum pole. The neck will also house a set screw that prevents counter rotation.

1.2.2 Anchor Bolts

Four (4) Anchor Bolts shall be supplied with each base. Each Anchor Bolt shall be threaded at the top, and shall have an L-bend at the bottom. A total of eight nuts and eight flat washers shall be supplied. Nuts shall be ASTM 563 Grade A.

1.2.3 Aluminum Pole

Aluminum pedestrian pole shall be 4 inches in diameter and 4 feet, 8 feet and/or 10 feet in length. It shall be constructed of polished aluminum and threaded on one end.

1.2.4 Concrete

The Concrete provided shall be CLASS 3000, and shall be mixed, poured, and finished in accordance with SC DOT STANDARD SPECIFICATIONS, Section 701, 702, 703, and 704.

1.2.5 Powdercoating

Color to be specified in special provisions or on signal plan. Powdercoating over aluminum shall be done at the factory or during the manufacturing process.

1.2.6 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Furnishing a Pedestrian Pedestal Pole and Base will be measured by EACH including all required incidental hardware.

1.4 Payment

Furnishing a Pedestrian Pole and Base measured as provided above, will be paid for at the contract unit price for:

	FURNISH 4' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA
	FURNISH 8' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA
	FURNISH 10' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA

M686.1 VEHICLE SIGNAL HEADS AND BACKPLATES

1.1 Materials

1.1.1 Signal Heads

All Signal Heads shall conform to the ITE July 2005 "VTCSH". Specifications of the ITE (Light Emitting Diode (LED) Vehicular Traffic Signal Modules (hereafter referred to as ITE July 2005 "VTCSH".) published by the INSTITUTE OF TRANSPORTATION ENGINEERS (ITE), "Standard for Adjustable Face Vehicular Traffic Control Signal Heads" (latest Revision). All sections of each head shall be furnished by the SAME MANUFACTURER. The only exception is where the top section must be aluminum. Polycarbonate Vehicle Signal Heads of the size, type, and arrangement specified, are to be furnished by the Manufacturer or Vendor, together with ALL the necessary hardware for make-up and mounting. The basic material requirements are listed below:

1.1.1.1 Housing

The COLOR shall be Federal YELLOW (13538).

Each Signal Head housing shall consist of an assembly of separate interchangeable sections, each holding an individual optical unit, and stainless steel parts between the signal heads. THE TOP SECTION OF EACH 3-SECTION HEAD SHALL HAVE AN ALUMINUM REINFORCING / BEARING PLATE INSIDE AS WELL AS ON THE OUTSIDE OF THE HEAD. The Aluminum reinforcing / bearing plate SHALL HAVE TWO STAINLESS ¼" retaining BOLTS WITH LOCK WASHER AND NUT AND shall provide for a watertight seal to prevent water from entering the housing. THE BOLTS SHALL PROTRUDE COMPLETELY THRU BOTH PLATES AND THE TOP OF THE HEAD. The TOP SECTION OF THE FIVE-SECTION CLUSTER, AND OF THE FOUR-SECTION IN-LINE, SHALL BE POWDER COATED ALUMINUM. The Aluminum section shall be Federal Yellow (13538) and shall be fade resistant for a minimum of five years. The rest of those configurations shall be POLYCARBONATE and it shall also be fade resistant for five years. Heads with noticeable premature Fading shall be subject for replacement covered under the warranty.

The material of the Housing, Door, and Visor shall be engineering-grade structural, ultraviolet-stabilized PURE POLYCARBONATE resin. Other plastics are NOT acceptable. All edges shall be milled to a uniform round edge and free of all sharp edges.

1.1.1.2 Polycarbonate

The Department is aware of the design characteristics of this material--particularly the fact that as fillers are added for strength, the material becomes more brittle. We also recognize that signal manufacturers have optimized their designs around a specific formulation. Therefore the VENDOR shall provide complete particulars about the polycarbonate type number proposed for the Signal head. Further the VENDOR shall submit strength and wind tunnel test results (See Paragraph 1.2.5 Certification)

1.1.1.3 Door

The COLOR shall be Federal YELLOW (13538).

The door latches shall consist of stainless steel latch eye-bolts, wing-nut, and washer; all retained to keep them from falling to the street.

The hinges shall be reinforced protrusions (mortise and tenon) from the door. The hinges shall be attached to the head with Stainless steel roll pins or reinforced polycarbonate pins that are made as part of the head.

1.1.1.4 Visor

The Visor COLOR shall be Federal YELLOW (13538) outside, and dull BLACK (37038) inside.

The Visor CLASSIFICATION shall be TUNNEL (slot at bottom), unless otherwise specified.

The Visor shall be twist-on, attached to the housing with four stainless steel SCREWS, through the twist-on tabs on the visor.

1.1.1.5 Wiring

Wiring and Electrical shall be in accordance with ITE Standards. Color Coded wiring shall be factory connected to a barrier type TERMINAL BLOCK in the LOWER PORTION OF THE RED SECTION of each Signal Head. In the five-section cluster, the TERMINAL BLOCK shall be located in the (TOP) SECTION.

The TERMINAL BLOCK shall be double sided barrier type with two screws per barrier section; and shall make connections to the lamp wires using fast-on SPRING-LOADED SPADE LUGS and screws, (i.e. provisions should be made so that spade lugs or screws can be used on the same terminal block.) ONE PER SCREW. More than one neutral is allowed per terminal. The neutral designated terminal shall have triple stack connections supplied. The number of barrier sections in the TERMINAL BLOCK for the three and four section head, shall be 6-position, 12-terminal. For the five section head, it shall be 8-position, 16-terminal. The screws in the terminal block shall be no less than 8mm in length.

1.1.1.6 Mounting Assemblies

All mounting hardware shall be furnished.

Span Wire Mounting

Hardware for Span-Wire shall be finished Powder Coated Federal YELLOW (13538)

For Span-Wire mounting, the HANGER shall be cast ALUMINUM, and shall contain two stainless steel J-Hooks with stainless steel pin, properly sized BOWTIE cotter pin, lock washers and nuts, and have seven notches to position the hanging signal. A double weatherhead entrance shall be used. The weatherhead entrance BUSHING shall have a 1 1/2 inch hole for wire entry. THE NIPPLE USED SHALL BE OF THE SAME BRAND AS THE GOOSENECK AND SHALL HAVE AT LEAST TWO INCHES OF THREAD. THE THREAD PATTERN SHALL BE VIBRATION RESISTANT SEMI COURSE THREAD. THE NIPPLE SHALL BE TORQUED TO PROPER MANUFACTURER SPECIFICATIONS. THE SET SCREW SHALL BE INSTALLED WITH BLUE LOCTITE AND TIGHTNED SO THAT NIPPLE WILL NOT TURN. THE NIPPLE SHALL ALSO HOLD THE INTERNAL BEARING PLATE IN PLACE. The entrance diameter shall be maintained throughout the weatherhead, without restriction or reducing the hole diameter, into the signal head. No Tri-Stud hangers allowed. No special tools shall be required to tighten or adjust signal heads. Hangers with mismatched threads that will not tighten will be rejected. Span wire hangers shall not require disassembly to install on span wire.

For Span-Wire mounting, for MULTI-WAY heads, there shall be included a "SWIVEL BALANCE ADJUSTER" for proper vertical alignment.

For 5-SECTION CLUSTER signal assemblies, ONE Span-Wire Hanger shall be furnished, attached to the top signal section. The configuration shall be FHWA MUTCD TYPE 'S', known as the "dog-house head". At the bottom of the top signal section, a cast-aluminum bracket shall connect with the

arrow side, and with the ball indication side. This bracket shall have a removable, threaded "knockout" plug at each 90-degree turn, to facilitate wiring.

A 2 inch wide ribbed, cast aluminum BOTTOM BRACKET (No. 10 018 or equiv.), having holes 17 inches on-center, shall be used to unify the assembly. (The two sides of the cluster shall be not more than 8 inches apart.)

For 4-SECTION "T" ASSEMBLY, ONE Span-Wire Hanger shall be furnished, together with two cast aluminum brackets. The two red sections shall be not more than 8 inches apart. Tri-studs will not be accepted.

Mast Arm Mounting

Unless otherwise shown on the plans, rigid signal head mounting brackets shall be used. The bracket shall consist of a top- and bottom-arm, an extruded aluminum vertical tube, a vertical tube clamp, and a mast-arm clamp, with all hardware. The Bracket shall be COMPLETELY RUST PROOF, and shall be fully adjustable in all dimensions and angles.

1.1.1.7 Balance Adjuster

When needed, a Balance adjuster shall be aluminum with a 3/4" WEH. It shall be furnished Powder Coated Federal Yellow (13538) and shall have stainless steel bushing, stainless steel hardware, and a stainless steel eye. This item, as part of the furnish contract, shall not come attached to the signal head assemblies.

1.1.2 LED Modules

Provide modules that consist of an assembly that utilizes LEDs as the light source in lieu of an incandescent lamp for use in traffic signal sections. Use LEDs that are AlInGaP technology for red and yellow indications and InGaN for green indications. Install the ultra-bright type LEDs that are rated for 100,000 hours of continuous operation from -40°C to +74°C. Design modules to have a minimum useful life of 60 months, and to meet all parameters of this specification during this period of useful life.

Ensure, unless otherwise stated in these specifications, that each module meets or exceeds the requirements of the Interim Purchase Specification of the ITE July 2005 "VTCSH". (Light Emitting Diode (LED) Vehicular Traffic Signal Modules (hereafter referred to as ITE July 2005 "VTCSH". Arrow displays shall meet or exceed the electrical and environmental operating requirements of ITE July 2007 "VTCSH" of the ITE specifications.

Each LED module supplied shall be as a set from the same manufacturer.

Lamp socket 'Screw-in' type products shall not be allowed for vehicle traffic signals.

Inline fuses shall not be used in the wire from the head to the terminal end. This wire shall not have any splice points

1.1.2.1 Electrical

Provide modules that have maximum power consumption equal to or below the requirements of Table 1. Design the modules to operate from a 60 ± 3 HZ AC line voltage ranging from 80 volts to 135 volts. Ensure that fluctuations of line voltage have no visible effect on the luminous intensity of the indications. Design the module to have a normal operating voltage of 120 VAC, and measure all parameters at this voltage.

Certify that the module has a power factor of 0.90 or greater, and that THD (current and voltage) induced into an AC power line by the module does not exceed 20 percent for modules with power ratings

above 15W, and 40 percent for modules with power ratings of 15W or less. Design the modules onboard circuitry to include voltage surge protection to withstand high repetition noise transients as stated in Section 2.1.6 of NEMA Standard TS-2, 1992. Ensure all wiring meets the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards, ITE July 2005 "VTCSH". Provide spade terminals appropriate to the lead wires and sized for a #10 screw connection to the existing terminal block in a standard signal head.

Ensure that the module is compatible with signal load switches and conflict monitors. Design the module to provide sufficient current draw to ensure proper load switch operation while the voltage is varied from a regulated 80Vrms to 135 Vrms. Design off-state for green and yellow modules to be 30Vrms or greater, and on-state to be 40Vrms or greater. Also for green and yellow modules, design the voltage decay to 10 Vrms or less to be 100 milliseconds or less. Ensure that the control circuitry prevents current flow through the LEDs in the off state to avoid a false indication.

Design all modules to meet existing SCDOT monitor specifications for the following type of signal monitors: 170 controller/cabinet Type 210, 2010, 2010ECL and 2010ECLIP conflict monitors (including red monitoring and so-called plus features such as dual indication detection and short yellow time detection).

Ensure that the modules and associated onboard circuitry meet Class A emission limits referred to in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

1.1.2.2 Photometric and Chromaticity Requirements

The maintained minimum luminous intensity values for the modules are shown in ITE July 2005 "VTCSH" specifications. Test all ball modules for luminous intensity at 25°C to meet 115% of values in table 2. Design and certify the modules to meet or exceed the maintained minimum luminous intensity values throughout the warranty period based on normal use in a traffic signal operation over the operating temperature range. Test the Red and Green modules for maintained luminous intensity at 74°C using ITE July 2005 "VTCSH" specifications. Use LEDs that conform to the chromaticity requirements of ITE July 2005 "VTCSH" specifications throughout the warranty period over the operating temperature range. Make chromaticity coordinate compliance measurements at 25°C.

1.1.2.3 Physical and Mechanical Requirements

Design the modules as retrofit replacements for installation into standard incandescent traffic sections that do not contain the incandescent lens, reflector assembly, lamp socket and lens gasket. Ensure that installation does not require special tools or physical modification for the existing fixture other than the removal of the incandescent lens, reflector assembly, lamp socket, and lens gasket.

1.1.2.4 Environmental Requirements

Provide modules that are rated for use in the operating temperature range of -40°C (-40°F) to +74°C (+165°F). Ensure that the modules (except yellow) meet all specifications throughout this range. Fabricate the module to protect the onboard circuitry against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal components.

1.1.2.5 Module Construction

Design the module to be a single, self-contained device with the circuit board and power supply for the module inside and integral to the unit.

Design the assembly and manufacturing process for the module to ensure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and

other sources. Wire the individual LEDs such that a catastrophic loss or the failure of one LED will result in the loss of not more than 20 percent of the signal module light output. LEDs shall be soldered to the circuit board.

1.1.2.6 Materials

Fabricate the lens and signal module from material that conforms to ASTM specifications. Enclosures containing either the power supply or electronic components of the module shall be made of UL94VO flame retardant materials. The lens of the signal module is excluded from this requirement.

1.1.2.7 Module Identification

Permanently mark each module with the manufacturer's name, model number, serial number, date of manufacture, and lot number if applicable. Identifiers shall be clearly understood. A Barcode shall also be incorporated into the label with all identifiers.

Permanently mark the following operating characteristics on the back of the module: rated voltage and rated power in Watts and Volt-Ampere.

If a specific mounting orientation is required, provide permanent markings consisting of an up arrow, or the word "UP" or "TOP" for correct indexing and orientation within the signal housing.

1.1.2.8 Lens

Provide a lens that is integral to the unit with a smooth outer surface and UV stabilized to withstand ultraviolet exposure for a minimum period of 60 months without exhibiting evidence of deterioration. Coat the front of a polycarbonate lens to make it more abrasion resistant. Seal the lens to the module to prevent moisture and dust from entering the module.

Tint the red and yellow lens to match the wavelength (chromaticity) of the LED. Provide a green lens that is either colorless or tinted to match the wavelength (chromaticity) of the LED.

1.1.2.9 12 Inch Arrow

The following specification requirements apply to the 12 inch (300 mm) arrow module only, which is the only size arrow allowed. All general specifications apply unless specifically superseded in this paragraph. Ensure that the arrow module meets specifications stated in ITE 2007 (VTCSH) for arrow indications. Design arrow displays to be LEDs to meet ITE 2007 (VTCSH) specifications. Determine the luminous intensity using the CALTRANS 606 method or similar procedure. <http://itvendors.dot.ca.gov/hq/esc/ctms/ctmsindex600.html>

1.1.2.10 Testing

Provide test results for ball modules from an independent testing laboratory showing wattage and compliance with ITE 2007 (VTCSH) arrow specifications.. Ensure that the LED signal modules tested are typical, average production units.

Burn In

Energize the sample module(s) (a sample of one module minimum) for a minimum of 24 hours, at 100 percent on-time duty cycle, at a temperature of +74°C (+165°F) before performing any qualification testing. Any failure of the module, which renders the unit non-compliant with the specification after burn-in, shall be cause for rejection. All specifications will be measured including, but not limited to:

Photometric (Rated Initial Luminous Intensity)

Measure at +25°C. Measure luminous intensity for red and green modules upon the completion of a 30 minute 100 percent on-time duty cycle at the rated voltage. Measure luminous intensity for yellow modules immediately upon energizing at the rated voltage.

Chromaticity (Color)

Measure at +25°C. Measure chromaticity for red and green modules upon the completion of a 30 minute 100 percent on-time duty cycle at the rated voltage. Measure chromaticity for yellow modules immediately upon energizing at the rated voltage.

Electrical

Measure all specified parameters for quality comparison of production quality assurance on production modules. (rated power, etc.)

Equipment Compatibility

In addition to the test of modules for compatibility with controllers, conflict monitors, and load switches, perform the following test, and certify the results. Connect each signal module to the output of a standard load switch connected to a variable AC voltage supply (95 to 135 VAC). With the load switch "off," vary the AC voltage from 95 Vrms to 135 Vrms, and measure the drop across the module. Readings greater than 15 Vrms are unacceptable.

1.1.2.11 Photometric Maintenance

Provide testing at an independent laboratory for a designated module to be tested for maintained luminous intensity at 25°C once each year during the five-year warranty period.

Notes:

Design signal modules to meet ITE requirements as a minimum throughout the warranty period.
Design signal modules to have a minimum initial intensity equal to 115% of Table 2 at 25°C.
Independent laboratory test reports are required to validate the initial intensity

1.1.3 Signal Backplate

A Signal Backplate constructed of thin strip of polycarbonate material that extends outward from and parallel to a signal face on all sides of a signal housing to provide a background for improved visibility of the signal locations shall be installed on all Signal Heads. Signal backplates shall be appropriate for the size and manufacturer of each signal head and be of monolithic construction. The backplate shall have a 2" retro reflective yellow border (Type XI (eleven) prismatic sheeting) applied, unless noted otherwise. See Standard Drawing for application.

1.1.4 Certification**CATALOG CUTS ARE REQUIRED**

The Vendor shall provide written Certification from the Manufacturer that the latest ITE STANDARDS have been met.

The Vendor shall provide design details and drawings in sufficient detail for complete evaluation and comparison with these Specifications. Any exceptions to these Specifications must be stated in writing at that time.

The Vendor shall provide written specifications (product sheets) for the specific POLYCARBONATE (LEXAN TYPE NO.) formulation that is proposed. Bids shall provide the tests results for the IZOD IMPACT tests.

Housing Type No. _____ or See Attached Letter _____

The Vendor shall provide written TEST RESULTS DEMONSTRATING THE STRENGTH OF THE 3-SECTION SIGNAL HEAD. The test signal shall not have the SCDOT aluminum bearing plate installed. The tests should include static stress and wind tunnel setups.

Sample modules shall be provided for Department approval upon request. The sample modules submitted shall be representative of typical average production units. Samples will not be returned unless requested by the vendor.

The manufacturer of LED Modules shall have previously supplied indications to other states or cities and shall supply a list of these cities and/or states with the bid. The reference shall include name of city or state, contact person and model number of the LED display(s) previously supplied.

Sample modules shall be provided for Department approval upon request. The sample modules submitted shall be representative of typical average production units. Samples will not be returned unless requested by the vendor.

1.1.5 Warranty

The Vendor shall furnish SCDOT a **60 month** warranty from purchase date on equipment, materials, modules and lamps that are provided by the Manufacturer or Vendor as normal trade practice.

Replacement shall be provided within 30 days of receipt of failed equipment at no cost to the Department (including shipping costs). Faulty equipment shall be picked up from the seven signal shops by the vender.

M686.3 PEDESTRIAN SIGNAL HEADS

1.1 Materials

1.1.1 Pedestrian Head Housing

All signal heads shall conform to the specifications of the INSTITUTE OF TRANSPORTATION ENGINEERS (ITE), "Pedestrian Traffic Control Signal Indications" (latest Revision) August 4, 2010. All pedestrian signal heads shall be furnished by the same manufacturer and shall be new and current production models. Pedestrian signal heads of the size, type, and arrangement specified, are to be furnished, together with ALL the necessary hardware for make-up and mounting. For the purpose of this Specification, the basic material requirements are listed below:

1.1.1.1 General

All pedestrian signal heads shall use a SOLID display LED HAND/MAN module as a light source; a nominal message bearing surface of 16 inches; and SYMBOLIC MESSAGES; the Portland Orange UPRIGHT HAND for "Don't Walk", and Lunar White WALKING MAN for "Walk" OR a countdown display with a nominal message bearing surface of 16 inches with a SOLID SYMBOLIC MESSAGE Hand/Man overlay on the left and the countdown on the right. The Module and the Housing shall be two separate pieces.

1.1.1.2 Housing, Visor

The housing shall be a one piece ultra-stabilized, permanently colored, flame-retardant, PURE Polycarbonate resin. The materials and construction used shall comply with ITE specifications (latest Revision) August 4, 2010. A single housing shall contain the LED module. A weather tight neoprene gasket shall be provided. All Housing hardware shall be stainless steel or aluminum. The terminal strip shall be a minimum 4 position, double row, tinned over brass with zinc plated #10 steel screws. The DOOR shall swing down with two hidden hinges at the bottom, with removable locking pins. The DOOR shall be a corrosion resistant, powder coated, one-piece aluminum alloy die-casting, and pins.

A visor shall also be furnished and shall be securely fastened with stainless steel screws to the front of the signal housing, to shield the lens from the sun.

1.1.1.3 Finish

The finish colors shall be FEDERAL YELLOW (13538) for the door, housing, and exterior surfaces of the visor; and FLAT BLACK (37038) for the inside of the visor and for the part of the door within the visor.

1.1.1.4 Mounting

Pedestrian Heads must fit with brackets and related hardware described below for properly installing the pedestrian signal heads.

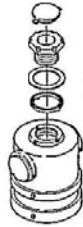
For *single post-top mount*.

A 1½" aluminum post top signal mounting shall be furnished. It shall consist of a slip fitter assembly for a one-way signal. It should be Pelco Product Part Number SE-3037 or equivalent with a FEDERAL YELLOW finish. See Diagram 1.

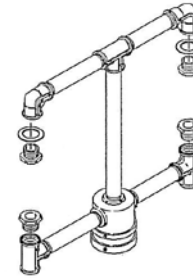
For *dual post-top mount*.

A 1½” aluminum post top signal mounting shall be furnished. It shall consist of a slip fitter for 1- and 2-way signal heads with a 4 inch slip-fitter bracket with a set screw, a lower mounting assembly, a support tube, and an upper mounting assembly. This mounting assembly should be Pelco Product Part Number SE-3257 or equivalent with a FEDERAL YELLOW (13538) finish. See Diagram 2.

**Diagram 1.
Single Post-
Top Mount**



**Diagram 2.
Dual Post-Top
Mount**

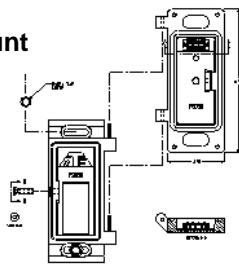


For *side-of-pole mount*.

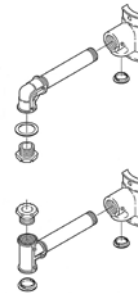
A CLAMSHELL mount shall be furnished, compatible with a 4-1/2 inch and larger pole. The clamshell mount shall be compatible with either bolt mounting (to a wood pole), or band-on mounting to a steel pole. The side-mount shall make provisions for a hinge, and for wiring and terminal block. All hardware shall be tamper resistant. See Diagram 3.

A 1½” aluminum side-of-pole signal mounting shall be furnished. It shall consist of hub plates with conduit openings, and upper and lower arm assemblies for a 1-way signal. This mounting assembly should be Pelco Product Part Number SP-5523 or equivalent with a FEDERAL YELLOW (13538) finish. See the Diagram 4.

**Diagram 3.
Clamshell Mount**



**Diagram 4.
Side-of-pole Mount**



Locking devices equivalent to serrated washers shall be furnished with each type of mounting brackets, so that the pedestrian signal heads may be firmly and positively held in their required alignment.

1.1.2 Hand/Man LED Module and Hand/Man COUNTDOWN LED Module

Each LED module supplied shall be factory installed in the pedestrian signal head or shipped as a complete module with weather tight neoprene gasket to retrofit existing SCDOT polycarbonate pedestrian signal heads if applicable. Design the LED pedestrian signal module for installation into existing standard pedestrian signal head. All signal heads shall conform to the specifications of the INSTITUTE OF TRANSPORTATION ENGINEERS (ITE), "Pedestrian Traffic Control Signal Indications" (latest Revision) August 4, 2010

Identify each module with the manufacturer’s name, model number, serial number, date of manufacture, and lot number if applicable per “The Equipment and Materials Standards” of the Institute of Transportation Engineers “Vehicular Traffic Control Signal Heads”. The Identifiers shall be clearly understood with no need to decipher. A Barcode shall also be incorporated into the label with all identifiers.

The lens shall be a clear, non-glare, non-frosted polymeric lens with a matte finish. It shall be UV stabilized to withstand ultraviolet exposure for a minimum period of 60 months without exhibiting evidence

of deterioration. Coat the front surface of a polycarbonate lens to make it more abrasion resistant. Ensure that the lens has light transmission properties equal to or greater than 80%.

1.1.2.1 Optical

Comply with "The Equipment and Materials Standards" of the Institute of Transportation Engineers "Vehicular Traffic Control Signal Heads.

LED Hand/Man Module

Provide **16 inch displays** that have SOLID Symbolic Messages that meet the dimension requirements cited in Chapter 3, Table 1 Symbol Message for Class 3 displays (minimum 11 inches high and 7 inches in width each). Configure the pedestrian signal module with a sufficient number of LEDs to provide an average luminous intensity which meets the specifications of the ITE specifications (latest Revision) August 4, 2010. Ensure they meet this average luminous intensity throughout the warranty period over the operating temperature range. Wire the LEDs such that a catastrophic loss or failure of one or more LEDs will result in the loss of not more than five percent of the pedestrian signal module light output.

LED Hand/Man Countdown Module

Provide **16 inch displays** that have SOLID Symbolic Messages that meet the dimension requirements cited in Chapter 3, Table 1 *Symbol Message* for Class 3 displays. Ensure that the countdown number display is a minimum of 7 inches high by 6 inches wide. Configure the pedestrian signal module with a sufficient number of LEDs to provide an average luminous intensity which meets the specifications of the ITE specifications (latest Revision) August 4, 2010. Ensure they meet this average luminous intensity throughout the warranty period over the operating temperature range. Wire the LEDs such that a catastrophic loss or failure of one or more LEDs will result in the loss of not more than five percent of the pedestrian signal module light output.

Design the countdown display as a double row of LEDs, and ensure the countdown display blanks-out during the initial cycle while it records the countdown time. Ensure that the countdown display is operational only during the flashing don't walk, clearance interval. Blank out the countdown indication after it reaches zero until the beginning of the next flashing don't walk indication, and design the controlling circuitry to prevent the timer from being triggered during the solid hand indication.

Provide *certification with the bids* for evaluation that the pedestrian signal module complies with the ITE specifications (latest Revision) August 4, 2010. Provide **with the bids**, written independent testing laboratory results showing that the pedestrian signal modules meet or exceed the luminous intensity requirements of ITE specifications (latest Revision) August 4, 2010.

Portland Orange LEDs for the hand and countdown shall be of the latest AllnGaP technology or higher and Lunar White LEDs for the man shall be of the latest InGaN technology or higher. All modules shall be ETL certified and on the ETL certification program.

1.1.2.2 Electrical

Ensure that LED modules are compatible with signal load switches and conflict monitors meeting NEMA Standard TS 1 - 1989. Design the module to provide sufficient current draw to ensure proper load switch operation while the voltage is varied from a regulated 80Vrms to 135Vrms. Provide control circuitry to prevent current flow through the LEDs in the off state to avoid a false indication. Design all modules to meet existing SCDOT monitor specifications for the following types of signal monitors: 170 cabinet/controller compatible SCDOT specified Type 210, Type 2010, Type 2010ECL, and Type 2010ECL-ip conflict monitors (including red monitoring and so-called plus features such as dual indication detection and short yellow time detection).

Provide lead wires that are eighteen gauge (18AWG) minimum copper conductors with 105 degree Celsius insulation and also be anti-capillary. There shall be no more than three lead wires exiting the unit with no external splices. Lead wires shall be a minimum of 36 inches long with NEMA "Locking spade" terminals that are appropriate to the lead wires and sized for a #10 screw connection to the existing terminal block in the pedestrian signal head.

The LED's shall be soldered to the circuit board.

Ensure that the power consumption for the pedestrian signal modules is equal to or less than the following in watts, and that the modules have EPA Energy Star compliance ratings, it applicable to the shape, size and color.

TEMPERATURE	25°C	74°C
HAND	10	12
MAN	9	12
COUNTDOWN	9	12

1.1.3 Packaging

Each single pedestrian signal head, complete with visor and LED specified, completely assembled and designated mounting assembly, shall be packaged in a separate corrugated cardboard box. It shall be clearly labeled on the END of the box, in English, as to the type of mounting assembly contained therein. Manufacturer shall provide a packing list with the serial number(s), date(s) of manufacture, and lot number(s) if applicable.

Each style of retrofit module complete with weather tight neoprene gasket shall be packaged in a separate corrugated cardboard box. It shall be clearly labeled on the END of the box, in English.

1.1.4 Certification

Provide **with the bids**, written Certification from the intended Manufacturer, that ITE specifications (latest Revision) August 4, 2010 have been met for heads and modules.

The manufacturer shall have previously supplied indications to other states or cities and shall supply a list of these cities and/or states with the bid as references. The references shall include name of city or state, contact person, phone number, and model number of the LED display(s) previously supplied. Failure to submit references upon request shall be grounds for refection of the bid.

The Vendor SHALL FURNISH, the design details and drawings in sufficient detail for complete evaluation of the Proposal, and comparison with these Specifications. Any exceptions to these Specifications must be stated in writing at that time.

Sample modules shall be provided for Department approval upon request. The sample modules submitted shall be representative of typical average production units. **Samples will not be returned unless requested by the vendor.**

NOTE: CATALOG CUTS ARE REQUIRED AT BID OPENING.

1.1.5 Warranty

During the period of **60 months** following the date of Delivery, the Manufacturer or Vendor shall replace, at no expense to the Department (including shipping costs), any part of Polycarbonate Pedestrian Signal Head that fails by reason of defective material or workmanship. The Manufacturer or Vendor shall be responsible for pickup and delivery to the seven district signal shops and shall be within 150 miles of Columbia, South Carolina.

Performance shall be warranted for a period of **60 months** of the date of delivery and shall include repair or replacement of an LED pedestrian module that exhibits light output degradation which in the judgment of the department, cannot be easily seen at 150 feet in bright sunlight with the visor on the housing or that drops below the luminous intensity output requirements of sections 3.2 and 3.3 of this specification. Failure due to workmanship, materials, and manufacturing defects shall be warranted for repair or replacement of the first 60 months of the date of delivery. The vendor shall replace any failed modules within 30 calendar days of notification.

M686.4 PEDESTRIAN PUSH BUTTON STATION ASSEMBLY WITH SIGN

1.1 Description

These items consists of furnishing AMERICAN DISABILITIES ACT APPROVED ALUMINUM PEDESTRIAN PUSH BUTTON STATION ASSEMBLIES AND PUSH BUTTON SIGNS of the types, sizes, and mounting specified, in accordance with these Specifications. All PUSH BUTTON STATION ASSEMBLIES AND PUSH BUTTON SIGNS shall be supplied with the appropriate mounting hardware.

1.2 Materials

1.2.1 Aluminum Push Button Station Assemblies

Each aluminum push button station assembly shall conform to the specifications as set forth by the AMERICAN DISABILITIES ACT (ADA). Each aluminum push button station assembly shall be provided with an adjoining sign and must be able to accommodate to the size of the specified sign (either 9 x 12 inch or 9 x 15 inch).

1.2.2 Dual Mount Bracket

A single dual mounting bracket shall be provided to allow for two push button station assemblies to be mounted on one pole with the buttons positioned below the sign.

1.2.3 Push Buttons (with or without adjoining sign)

The long life switch shall be actuated by a 2 inch diameter chrome plated button and shall be included into a vandal resistant one-piece cast aluminum assembly and include a cable guide. Any exposed screws on the push button station assembly shall be stainless steel or other rust resistant material, and be tamper-proof. There shall be no sharp edges.

1.2.4 Finish

The finish color shall be FEDERAL YELLOW (13538) for the aluminum push button station assembly
The push button shall operate on a circuit not to exceed 24 Volts.

1.2.5 Push Button Signs

Each aluminum push button station assembly shall be provided with an adjoining sign.

The push button sign shall be aluminum with minimum thickness of 0.1 inch, with rounded corners, and have a black legend on white background. **The message shall be in accordance with the MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS (latest edition).**

The signs shall be 9 x 12 inch for:

R10-3 "PUSH BUTTON FOR GREEN LIGHT" when used without Pedestrian Signal Heads (see diagram below)

R10-3b "TO CROSS PUSH BUTTON (MAN WALK SYMBOL W/DEFINITIONS) ← → (arrow-left/right)" when used with hand/man Pedestrian Signal Heads The sign shall be reversible, such that one side displays the message with a left arrow and the other side displays the message with a right arrow (see diagram below).



R10-3



R10-3b

or should be 9 x 15 inch for:

R10-3e "TO CROSS PUSH BUTTON (COUNTDOWN)" when used with countdown Pedestrian Signal Heads The sign shall be reversible, such that one side displays the message with a left arrow and the other side displays the message with a right arrow (see diagram below).



R10-3e

1.2.6 Certification

CATALOG CUTS ARE REQUIRED

Provide written Certification from the intended Manufacturer, that ADA SPECIFICATIONS have been met for push buttons.

Provide design details and drawings sufficiently detailed. This is necessary for a complete evaluation of the Proposal, and comparison with these Specifications. Any exceptions to these Specifications must be stated in writing at that time.

Samples of each of the aluminum Pedestrian Push Button Station Assemblies and Signs shall be for Department approval upon request. The samples submitted shall be representative of typical average production units. **Samples will not be returned unless requested by the vendor.**

1.2.7 Warranty

During the period of **12 months** following the date of purchase, the Manufacturer or Vendor shall replace, at no expense to the Department (including shipping costs), any part of the Pedestrian Push Button Station Assembly, Sign or Bracket that fails by reason of defective material or workmanship.

1.3 Measurement

Furnishing a Pedestrian Push Button Station Assembly and Sign will be measured by EACH unit, including all dual mounting brackets and incidental hardware.

Furnishing a Sign will be measured by EACH unit.

1.4 Payment

Furnishing a Pedestrian Push Button Station Assembly and Sign, measured as provided above, will be paid for at the contract unit price bid for:

FURNISH PEDESTRIAN PUSH BUTTON MICROSWITCH TYPE STATION ASSEMBLY (9"x12") AND SIGN (R-10-3E)	EA
FURNISH PEDESTRIAN PUSH BUTTON MICROSWITCH TYPE STATION ASSEMBLY (9"x15") AND SIGN (R-10-3E)	EA
FURNISH PEDESTRIAN PUSH BUTTON MICROSWITCH TYPE	EA
FURNISH PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE STATION ASSEMBLY (9"x12") AND SIGN (R-10-3E)	EA
FURNISH PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE STATION ASSEMBLY (9"x15") AND SIGN (R-10-3E)	EA
FURNISH PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE	EA
FURNISH DUAL MOUNTING BRACKET FOR (9 X 15 inch) SIGN	EA
FURNISH 20' SPUN ALUMINUM PEDESTRIAN POLE 4 ½" DIAMETER	EA

For Signs:

FURNISH SIGN R10-3 (PUSH BUTTON FOR GREEN LIGHT)	EA
FURNISH SIGN R10-3b "TO CROSS PUSH (MAN/WALK SYMBOL WITH DEFINITIONS)" REVERSABLE FOR ARROWS IN BOTH DIRECTIONS	EA
FURNISH SIGN R10-3e "TO CROSS PUSH BUTTON (COUNTDOWN - ARROW)" REVERSABLE FOR ARROWS IN BOTH DIRECTIONS	EA

M686.5 SYMBOLIC LED BLANKOUT SIGN

1.1 Description

This specification describes requirements for furnishing Symbolic LED (Light Emitting Diode) No Right/Left Turn Blankout Sign, of Clam-Shell configuration, with Sun Visor and designated mounting hardware. The Blankout Sign and the mounting hardware are stated as one item.

1.2 Materials

1.2.1 Blankout Sign

All Blankout Signs shall be built to Institute of Transportation Engineers "Vehicular Traffic Control Signal Heads" (VTCSH) standards. All Blankout Sign housings shall be furnished by the same manufacturer and shall be new and current production models. The Blankout Sign shall be capable of displaying three distinct messages including blank message. The furnished Blankout Sign shall include all electrical and electronic hardware, structural materials, housings, and all the necessary hardware for make-up and mounting. The Blankout Sign, and its associated equipment, shall be capable of operating on a 24 hour a day, 7 day per week basis and shall conform to the physical and functional requirements of this Specification.

1.2.1.1 Symbol

All blankout signs shall use an illumination of International Symbol consisting of a red circle and slash and either a white right arrow or white left arrow. Symbols shall conform to MUTCD sign standards. When the display is not energized, the sign shall be effectively blank. The Symbol shall be illuminated by an assembly of high output lunar white and red LEDs.

1.2.1.2 Housing

The housing shall be a constructed of Aluminum and shall be weatherproof. The outside dimensions shall not be less than 26 inches high by 26 inches wide and 4 inches deep. The housing shall not be less than 0.125 inch aluminum with all corners being welded their full length. All welds shall use the tungsten inert gas method. A fitting shall be installed on the bottom of the sign in the middle for tethering. The back shall be aluminum of not less than 0.063 inches thick. The door shall be extruded aluminum of not less than 0.125 inch thickness and shall be welded on two corners and screwed together on the other two corners to provide access for installation of a faceplate and polycarbonate lens. The aluminum door shall be attached to the housing utilizing stainless steel hinges. The door shall be held secure to a neoprene gasket by stainless steel, quarter turn link locks. All hardware shall be stainless steel and no tools shall be required for routine maintenance. A retaining rod shall be provided to secure the door in the open position.

1.2.1.3 Visor

A three sided aluminum visor of not less than 0.063 inch thickness and 7 inches deep shall also be furnished and shall be securely fastened with corrosion resistant screws to the aluminum door, to shield the lens from the sun.

1.2.1.5 Finish

The finish colors shall be FEDERAL YELLOW (13538) for the door, exterior and interior of the sign enclosure, and exterior surfaces of the visor. Apply the yellow by the dry powder method. Apply the yellow finish by electrostatic spray and heat cure. Ensure the thickness of the finish is a minimum of 2.5 mils thick. Do not apply paint to the latching hardware. Paint two coats of FLAT BLACK (37038) for the inside of the visor, and for the part of the door within the visor.

1.2.1.6 Mounting

All mounting hardware shall be furnished for Span-Wire mounting, as requested by the purchase order. Hardware for Span-Wire shall be finished FEDERAL YELLOW (13538).

For Span-Wire mounting, the HANGER shall be cast ALUMINUM, and shall contain two (2) stainless steel J-Hooks with stainless steel lock washers and nuts, and have seven (7) notches to position the hanging signal. A double weatherhead entrance shall be used. The weatherhead entrance BUSHING shall have a 1.5 inch hole for wire entry. That entrance diameter shall be maintained throughout the weatherhead, without restriction or reducing the hole diameter, into the sign. No special tools shall be required to tighten or adjust signs. Span wire hangers shall not require disassembly to install on span wire.

A fastener shall be installed in the bottom of the sign housing to provide for attachment to a tether cable of ¼ inch diameter.

1.2.2 *Symbolic LED Module*

Provide a symbolic display that is a PCB (Printed Circuit Board) matrix with a mat black solder mask with minimum thickness of 0.093 inches and a silk screened component identifier. Mount LEDs on front of the PCB matrix. Mount all other components on the back of the black matrix. Ensure that a person with 20/20 vision can read a fully intensified, legible message from 500 feet in front of the sign under any light conditions. Ensure the message is not legible when the sign is off, even if in direct sunlight.

Design and certify the LED Blankout Sign to operate over a temperature range of -40°F to 165°F with an operating voltage range of 105 to 130 volts and a power factor >95%. Ensure that all electronic components are standard industry items that are available from wholesale electronics distributors. Provide components that are "solid state" type. Do not use electro-mechanical components such as relays, transformers or solenoids.

Ensure compatibility and proper triggering and operation with load switches and conflict monitors in signal controllers currently used by the Department. Ensure the on-board circuitry meets FCC title 47, sub-part B, section 15 regulations on the emission of electronic noise. The presence of ambient radio signals, magnetic or electromagnetic interference, including those from power lines, roadway lights, transformers or motors, within 1 foot of any of the components of the Blankout Sign, shall not impair the performance of the Blankout Sign. The Blankout Sign shall not radiate any electrical or electromagnetic signals that could adversely affect any other electrical or electronic device.

1.2.2.1 LED Specifications

Use Red LEDs that are the latest Aluminum Indium Gallium Phosphide (AlInGaP) technology and White LEDs that are the latest Indium Gallium Nitride (InGaN) technology or better with a minimum luminous output requirement of 9,000 candelas per meter square when each discrete LED is driven at a current of 20 milliamperes. Install the ultra-bright type LEDs that are rated for 100,000 hours of elapsed time calendar hours use in an ambient temperatures, based on an average daily on-time usage factor of 11%, when driven at the specific forward current used for normal daylight LED Blankout Sign display

operation. Distribute the LEDs evenly. Ensure that the maximum distance, center to center, between consecutive LEDs is 0.5 inches, plus or minus 10%. Connect the individual LED light sources so that failure of a single LED will result in a loss of no more than 5 LEDs. Protect and seal the rear side of the PCB with a molded polymeric back cover. Mount the display PCB with back cover into the front door, which consist of an aluminum frame and face lens.

The LED driver electronics shall not be mounted on the same board as the LED displays. The driver boards shall be easily disconnected from the LED display modules. Removal of any display module shall not affect the operation of the remaining modules.

1.2.2.2 Lens

Provide a clear, non-glare, mat finish polycarbonate lens with a UV resistant surface treatment and super abrasion resistant properties. Ensure that the lens has light transmission properties equal to or greater than 80%. The module shall be completely sealed against moisture and dust intrusion.

1.2.2.3 Dimming

Provide a photocell and dimming circuitry to automatically reduce the light intensity of the display by 35% based on the ambient light to reduce long term degradation of the LEDs. Include a 30-second delay to prevent interference caused by extraneous light.

1.2.2.4 Labels

Identify each Symbolic LED Module with the manufacturer's name, model number, serial number, date of manufacture, and lot number if applicable.

1.2.3 *Packaging*

Each single Symbolic Blankout Sign, complete with visor, and LED Symbolic module capable of displaying either a right or left arrow, as specified, completely assembled with mounting assembly and tether fastener, shall be packaged in a separate corrugated cardboard box. The box shall be clearly labeled on the END of the box, in plain English, as to what's contained therein. All packages shall be identified with the Department PURCHASE ORDER NUMBER. Packing lists and EQUIPMENT LABELS shall be glued to every carton showing its contents.

Each Symbolic LED Module shall be packaged in a separate corrugated cardboard box. The box shall be clearly labeled on the END of the box, in plain English, as to what's contained therein. All packages shall be identified with the Department PURCHASE ORDER NUMBER. Packing lists and EQUIPMENT LABELS shall be glued to every carton showing its contents.

1.2.4 *Certification*

CATALOG CUTS ARE REQUIRED

Provide written Certification from the **Manufacturer or Vendor** that ITE Standards, MUTCD standards, and all the requirements of this specification have been met.

Samples shall be provided for Department approval if requested. The sample submitted shall be representative of typical average production units. Samples will not be returned unless requested by the vendor.

1.2.5 Warranty

During the period of **SIXTY (60) MONTHS** following the date of purchase, the Manufacturer or Vendor shall replace, at no expense to the Department (including shipping costs), any part of Symbolic LED Blankout Sign that fails by reason of defective material or workmanship.

Performance shall be warranted for a period of **SIXTY (60) MONTHS** of the date of purchase and shall include repair or replacement of a Symbolic LED NRT/NLT Module that exhibits light output degradation, which in the judgment of the department, cannot be easily seen at one hundred fifty feet (150') in bright sunlight with the visor on the housing or that drops below the luminous intensity output requirements of this specification. The vendor shall replace any failed modules within 30 calendar days of notification.

1.3 Measurement

Furnishing a No Right/Left Turn Symbolic LED Blankout Sign shall be measured by EACH with LED module installed, including ALL internal electrical and electronic hardware, structural materials, housings, and all the necessary hardware for proper mounting.

Furnishing a No Right/Left Turn Symbolic LED Module, measured by each, shall be complete with weather tight neoprene gasket for replacing defective existing modules if applicable.

1.4 Payment

Furnishing a No Right/Left Turn Symbolic LED Blankout Sign with LED module with span wire mount, measured as provided above, will be paid at the contract unit price bid for:

FURNISH NO RIGHT/LEFT TURN SYMBOLIC LED BLANKOUT SIGN W/ SPAN WIRE MOUNTING	EA
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Furnishing a Symbolic LED module, measured as provided above, will be paid at the contract unit price bid for:

FURNISH NO RIGHT/LEFT TURN SYMBOLIC LED MODULE	EA
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M688.3 VIDEO DETECTION SYSTEM

1.1 Description

This specification describes requirements for furnishing video detection system components with all necessary hardware and software and includes the Network Security Policy as part of this specification. A complete Video Detection System includes Camera, Camera Mounting Hardware, Camera Cable, CPU, Surge Arrestors, and Power Panel.

1.2 Materials

1.2.1 Video Imaging

Material and equipment furnished under this section must be pre-approved by SCDOT by the date of installation. Miscellaneous hardware such as cables and mounting hardware do not need to be pre-approved.

Ensure that software is licensed for use by SCDOT and by any other agency responsible for maintaining or operating system.

Design and furnish video detection systems that detect vehicles at signalized intersections by processing video images and providing detection outputs to the signal controller in real time (within 150 milliseconds of vehicle arrival).

Furnish all required camera sensor units, processor units, hardware and software packages, cabling, luminaire arms, harnesses, camera mounting assemblies, surge protection panels, grounding systems and all necessary hardware. Furnish systems that allow the display of detection zones superimposed on an image of the roadway on an SCDOT-furnished monitor or laptop computer screen. Ensure detection zones can be defined and data entered using a simple keyboard or mouse and monitor, or using a Windows® Xp (or newer) based laptop PC with software.

Provide design drawings showing design details and camera sensor unit locations for review and acceptance before installation. Provide mounting height and location requirements for camera sensor units on the design, based on site-survey. Design video detection systems with all necessary hardware. Indicate all necessary poles, spans, mast arms, luminaire arms, cables, camera mounting assemblies and hardware to achieve the required detection zones where SCDOT owned poles are not adequate to locate the camera sensor units. The vendor is responsible for the final design of video detection systems.

Review and acceptance of the designs by SCDOT does not relieve the vendor from the responsibility to provide fully functional systems and to ensure that the required detection zones can be provided.

Provide the ability to program each detection call with the following functions:

- Full Time Delay – Delay timer is active continuously,
- Normal Delay – Delay timer is inhibited when assigned phase is green (except when used with TS 2 and 170/2070L controllers),
- Extend – Call is extended for this amount of time after vehicle leaves detection area,

- Delay Call/Extend Call – This feature uses a combination of full time delay and extend time on the same detection call. Ensure operation is as follows: Vehicle calls are received after the delay timer times out. When a call is detected, it is held until the detection area is empty and the programmed extend time expires. If another vehicle enters the detection area before the extend timer times out, the call is held and the extend timer is reset. When the extend timer times out, the delay timer has to expire before another vehicle call can be received.

Provide the ability to program each detection zone as one of the following functions:

- Presence detector,
- Directional presence detector,
- Pulse detector,
- Directional pulse detector.

Ensure previously defined detector zones and configurations can be edited.

Provide systems that allow for the placement of at least 8 detection zones within the combined field of view of a single camera sensor unit.

Provide a minimum of 4 detection outputs per processing unit. If additional outputs are needed, provide all necessary hardware to allow for additional calls to be placed to the Controller via the input file.

Provide detection zones that can be overlapped. Ensure systems reliably detect vehicles when the horizontal distance from the camera sensor unit to the detection zone area is less than ten times the mounting height of the sensor. Ensure systems detect vehicles in multiple travel lanes.

Ensure systems can detect vehicle presence within 98 to 102 percent accuracy (up to 2 percent of the vehicles missed and up to 2 percent of false detection) for all weather and lighting conditions, in the absence of occlusion.

SCDOT may conduct field-testing to ensure the accuracy of completed video detection systems.

1.2.2 Video Detection System

Furnish video detection systems that receive and simultaneously process information from camera sensor units, and provides detector outputs to signal controllers.

Ensure systems provide the following:

- Operate in a typical roadside environment and meet the environmental specifications and are fully compatible with NEMA TS 1, NEMA TS 2, or Type 170/2070L controllers and cabinets,
- provide a “fail-safe” mode whereby failure of one or more of the camera sensor units will cause constant calls to be placed on the affected vehicle detection outputs to the signal controller,
- provide compensation for minor camera movement of up to 2 percent of the field of view at 400 feet without falsely detecting vehicles,
- process the video at a minimum rate of 30 frames per second,
- provide separate wired connectors inside the controller cabinet for viewing each camera,

Furnish camera sensor units that comply with the following:

- have an output signal conforming to EIA RS-170 standard,

- have a nominal output impedance of 75 ohms,
- be immune to bright light sources, or have built in circuitry or protective devices to prevent damage to the sensor when pointed directly at strong light sources,
- be housed in a light colored environmental enclosure that is water proof and dust tight, and that conforms to NEMA-4 specifications or better,
- simultaneously monitor at least five travel lanes when placed at the proper mounting location with a zoom lens,
- have a sunshield attached to the environmental enclosure to minimize solar heating,
- meet FCC class B requirements for electromagnetic interference emissions,
- have a heater attached to the viewing window of the environmental enclosure to prevent ice and condensation in cold weather,
- have the Video Processing unit in the cabinet.

Where coaxial video cables and other cables are required between the camera sensor and other components located in the controller cabinet, furnish surge protection in the controller cabinet.

Coaxial communications cable shall comply with the following, as recommended by the manufacturer:

- Belden 8281 or approved equivalent Number 20 AWG, solid bare copper conductor terminated with crimped-on BNC connectors (do not use BNC adapters) from the camera sensor to the signal controller cabinet.
- Belden 9259 or approved equivalent Number 22 AWG, stranded bare copper conductor terminated with crimped-on BNC connectors (do not use BNC adapters) from the camera sensor unit to the junction box, and within the signal controller cabinet.

Furnish power cable appropriately sized to meet the power requirements of the sensors. At a minimum, provide three conductor 120 VAC field power cable.

As determined during the site survey, furnish sensor junction boxes with nominal 6 x 10 x 6 inches dimensions at each sensor location. Provide terminal blocks and tie points for power cable.

1.2.1 Video Detection System Support

Furnish video detection systems with either a simple keyboard or a mouse with monitor and appropriate software, or with system software for use on SCDOT-owned laptop PCs. Ensure the system is Windows® 2000 compatible, or newer.

Provide Hardware and Windows® XP compatible (or newer) personal computer software, if needed, to provide remote video and video detection monitoring via standard telephone line.

Provide each individual system with all the necessary equipment to focus and zoom the camera lenses without the need to enter the camera enclosure.

Ensure systems allow the user to edit previously defined detector configurations. When a vehicle is within a detection zone, provide for a change in color or intensity of the detection zone perimeter or other appropriate display change on the monitor or laptop computer screen.

Provide cabling and interconnection hardware with 6-foot minimum length interconnection cable to interface with the system.

Provide all associated equipment manuals and documentation.

1.2.2 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Furnishing Video Detection System components shall be measured as EACH unit.

Furnishing Video Detection Camera Cable shall be measured by LINEAR FEET and furnished in 500' REELS or 1000' REELS.

Furnishing Video Detection System On Site Training shall be measured by DAY.

1.4 Payment

Furnishing Video Detection System components, Cable, and On Site Assistance, measured as provided above, will be paid for at the contract unit price for:

FURNISH VIDEO DETECTION CPU	EA
FURNISH VIDEO DETECTION CAMERA	EA
FURNISH VIDEO DETECTION CAMERA MOUNTING HARDWARE	EA
FURNISH VIDEO DETECTION CAMERA CABLE – 1000'	1000' REEL
FURNISH VIDEO DETECTION CAMERA CABLE – 500'	500' REEL
FURNISH MONITOR WITH VIDEO CABLE	EA
FURNISH VIDEO DETECTION ON SITE ASSISTANCE	DAY
FURNISH VIDEO DETECTION SURGE ARRESTORS	EA
FURNISH VIDEO DETECTION POWER PANEL WITH BREAKER	EA
FURNISH VIDEO DETECTION LENS ADJUSTMENT MODULE	EA

** Network Security Policy to follow on the next three pages:

Network Services Security Policy for network attached devices

This policy is subject to change at any time, as deemed necessary by Network Services and/or the ISO.

Last Update Status: *Updated August 27, 2015*

1. Overview

See Purpose.

2. Purpose

This document describes the required minimal security configuration for all networked devices connecting to a production network or used in a production capacity at or on behalf of South Carolina Department of Transportation (SCDOT).

3. Scope

All employees, contractors, consultants, temporary and other workers at SCDOT and its subsidiaries must adhere to this policy. All networked devices connected to SCDOT production networks are affected.

4. Policy

Every active network device must meet the following operational standards (if applicable):

1. No local user accounts are configured on the network device. Network devices must use TACACS+ /Radius/AD for all user authentication.
2. The super user password on the network device must be kept in a secure encrypted form. The network device must have the super user password set to the current production network device password from the device's support organization.
3. The following services or features must be disabled:
 - a. IP directed broadcasts
 - b. TCP small services
 - c. UDP small services
 - d. All source routing and switching
 - e. Any discovery protocols on Internet connected interfaces
 - f. Telnet, FTP, and HTTP services
 - g. Auto-configuration
4. The following services should be disabled unless a business justification is provided:
 - a. Cisco discovery protocol and other discovery protocols
 - b. Dynamic trunking
 - c. Scripting environments, such as the TCL shell
5. The following services must be configured:
 - a. Password-encryption
 - b. NTP configured to a corporate standard source
6. Any routing updates shall be done using secure routing updates.
7. Support for SNMPV3. Use corporate standardized SNMP community strings. Default strings, such as public or private must be removed. SNMP must be configured to use the most secure version of the protocol allowed for by the combination of the device and management systems.
8. Access control lists must be used to limit the source and type of traffic that can terminate on the device itself.

9. Access control lists for transiting the device are to be added as business needs arise.
10. The network device must be included in the corporate enterprise management system with a designated point of contact.
11. Each network device must have the following statement presented for all forms of login whether remote or local:

WARNING TO USERS

This computer system is the property of the South Carolina Department of Transportation (SCDOT) and may only be accessed by authorized users. Unauthorized access, use, misuse, or modification of this computer system or of the data contained herein or data in transit to/from this system constitutes a violation of Title 18, United States Code, Section 1030. SCDOT shall monitor system usage for unauthorized activities. You should have no expectation of privacy in your use of this network, including information stored locally on the hard drive or other media in use with this unit (e.g., floppy disks, USB drives, PDAs and other hand-held peripherals, CD-ROMs, etc.) Any or all activity of this system may be intercepted, monitored, recorded, copied, audited, or inspected by authorized SCDOT personnel. Improper use or criminal activity can lead to administrative disciplinary actions as well as civil and criminal penalties.

ANYONE USING THIS SYSTEM EXPRESSLY CONSENTS TO SUCH MONITORING. LOG OFF OR DISCONNECT IMMEDIATELY IF YOU DO NOT AGREE TO THE CONDITIONS STATED IN THIS WARNING

12. Telnet may never be used across any network to manage a router, unless there is a secure tunnel protecting the entire communication path. SSH version 2 is the preferred management protocol.
13. Any dynamic routing protocols (if any) must use authentication in routing updates sent to neighbors. Password hashing for the authentication string must be enabled when supported. Password will be provided by the SCDOT
14. The network device configuration standard will define the category of sensitive routing and switching devices, and require additional services or configuration on sensitive devices including:
 - a. IP access list accounting
 - b. Device logging
 - c. Incoming packets at the router sourced with invalid addresses, such as RFC1918 addresses, or those that could be used to spoof network traffic shall be dropped
 - d. Router console and modem access must be restricted by additional security controls

5. Policy Compliance**5.1 Compliance Measurement**

The InfoSec team will verify compliance to this policy through various methods, including but not limited to, periodic walk-thrus, video monitoring, business tool reports, internal and external audits, and feedback to the policy owner.

5.2 Exceptions

Any exception to the policy must be approved by the InfoSec team in advance.

5.3 Non-Compliance

An employee found to have violated this policy may be subject to disciplinary action, up to and including termination of employment.

6 Related Standards, Policies and Processes

None.

7 Definitions and Terms

None.

8 Revision History

Date of Change	Responsible	Summary of Change
August 1, 2015	NS Policy Team	Reviewed and accepted
August 27, 2015	NS Policy Team	Reviewed and accepted

M688.5 STEEL STRAIN POLE AND FOUNDATION

1.1 Description

This specification describes requirements for furnishing a Steel Strain Pole, of the sizes and colors specified. Anchor bolts and all miscellaneous hardware shall be supplied with each pole as required.

All anchor bolt nuts, caps, pole clamps, and miscellaneous pole hardware shall be **BAGGED IN BURLAP** for each pole during shipping. In addition, individual parts shall also be furnished as specified.

1.2 Materials

1.2.1 General

ALL STEEL STRAIN POLES PROVIDED FOR ANY INDIVIDUAL PROJECT SHALL BE FROM THE SAME MAUFACTURER.

Each Steel Strain Pole Assembly shall consist of:

1. A steel Shaft,
2. A steel Anchor Base,
3. Four steel Anchor Bolts with eight nuts,
4. A removable top plate which will bolt to the shaft with a ¼" J-Bolt and attached to a ½" bar that is welded inside the shaft,
5. Four removable anchor bolt Covers,
6. Two adjustable heavy duty Pole Clamps, and
7. Miscellaneous hardware as specified.

1.2.2 Pole Materials

1.2.2.1 Shaft

The design of the shaft will be based on minimum mill certified 55,000 yield strength steel. One of the following steel must be used in the fabrication of the shaft: American Society for Testing and Materials (ASTM): A570-50, ASTM A572-50, ASTM A572-60, ASTM A607-50, ASTM A607-55, ASTM A607-60, ASTM A595-A or ASTM A595-B.

Only one (1) longitudinal weld, and no transverse welds, shall be permitted.

After being formed and welded, the Shaft shall then be longitudinally cold-rolled with sufficient pressure to flatten the weld. Break formed, (multi-sided) poles shall have a minimum of eight (8) sides and a guaranteed mill certified minimum yield of 55,000 Pounds per square inch (PSI).

The Shaft shall have a uniform taper in diameter from base to top of 0.14" per foot. The minimum base diameter and length shall be as specified in the Dimensions Chart.

A reinforced hand hole, complete with frame and cover with a minimum size of 4" x 6 1/2", shall be welded into the Shaft approximately 12" above the base plate at 0 degrees. The frame shall be tapped with a 1/2" - 13 Unified Thread Standard (UNC) for a grounding bolt. Stainless-steel hardware shall be supplied.

A J-hook wire support shall be welded inside near the top of the Shaft.

Round holes shall be provided in EVERY POLE as follows:

- 3" diameter hole, at 6" on-center below pole TOP; at 0 degrees (above hand hole).
- 3" diameter hole, at 6" on-center below pole TOP; at 270 degrees (orientate counter-clockwise).
- 3" diameter hole, at 15 ¼" on-center above pole BOTTOM; at 90 degrees (orientate counter-clockwise).
- 1" diameter hole, at 35" on-center above pole BOTTOM: at 90 degrees (orientate counter-clockwise).
- 1" diameter hole, at 35" on-center above pole BOTTOM: at 270 degrees (orientate counter-clockwise).

The two (2) 3" upper holes are for installing weatherheads w/nipple and the lower 3" hole is to permit the installation of a pole mounted Controller Cabinet. A 3" threaded, half-blind coupling shall be FACTORY WELDED, to the pole surface and protrude ¼" in each hole. The two (2) 1" diameter holes are for mounting the electrical service. These holes shall have a 1" threaded half-blind coupling FACTORY WELDED, to the pole surface and shall be flush mounted. The entire pole coupling shall then be hot dipped galvanized.

1.2.2.2 Anchor Base and Flange Plates

The Anchor Base and flange plates shall be made from ASTM A36 steel.

The Anchor Base shall be square (with rounded corners), and shall be of the size and thickness specified in the DIMENSIONS TABLE below.

The Anchor Base shall be provided with four (4) holes to accept Anchor Bolts. The size of the holes and the bolt circle shall be as specified in the DIMENSIONS TABLE below.

Tapped holes shall be provided for attaching removable Anchor Bolt covers, which shall be provided with stainless steel hex-head bolts.

The Anchor Base shall telescope the Shaft, and shall be secured to the Shaft by two fillet welds. One weld shall be on the inside of the base at the end of the Shaft, and the other shall be on the outside at the top of the base. The welded connection shall develop the full strength of the adjacent cross-section to resist bending action.

1.2.2.3 Anchor Bolts and Nuts

Anchor Bolts shall be steel rods of ASTM A-36 M-55, modified to have a minimum yield point of 55,000 PSI.

Four (4) Anchor Bolts shall be supplied with each pole. The Anchor Bolt size shall be specified in the Dimensions Chart.

Each Anchor Bolt shall be threaded at the top for 10", and shall have a 6" L-bend at the bottom, or a bearing plate as specified on larger pole sizes.

A total of eight (8) nuts and eight (8) flat washers shall be supplied and installed for each pole. Nuts shall be ASTM 563 Grade A. The two (2) nuts per bolt may be either:

- two (2) hex nuts (preferred), or
- one (1) hex nut and one square nut (acceptable).

Note: All other bolts shall be ASTM A325 or A307, (threaded per UNC series).

1.2.2.4 Pole Cap or Top Plate

Each pole shall be supplied with a Cap or top which shall be made from 7 GA. Galvanized steel or from cast aluminum, ASTM B-108; Alloy 356.OT6.

The Pole Cap shall be of a size greater than the pole top diameter and designed to prevent water from entering the top of the pole.

1.2.2.5 Bolt Cover

With each Pole there shall be supplied four (4) removable bolt covers capable of hiding the installed Anchor Bolts and the top nut. The covers shall have a clean-lined modern appearance. They shall attach to the pole with stainless-steel hex-head bolts. Acorn nuts are also acceptable.

1.2.2.6 Pole Clamp

With each Strain Pole there shall be supplied two (2) adjustable Span Wire Clamps. Each span wire clamp shall be constructed of 1/4" x 3" steel minimum, complete with two 7/8" x 4" stud bolts including two (2) lock washers and two (2) hex nuts per stud bolt. Each span wire clamp shall also include a clevis complete with a 7/8" x 3" bolt with one (1) lock washer and one (1) hex nut.

1.2.2.7 Pole Plugs

Plugs, either galvanized or stainless, shall be supplied for all holes in the steel pole. Plugs shall be installed in all un-used holes in the steel pole in a construction project.

1.2.2.8 Foundation Rebar Cage

See Standard Drawing, Poles, 675-115-02 for Foundation Cage details or separate drawing from Standard Drawing, Poles, 675-115-02 as part of this specification. <http://www.scdot.org/doing/technicalPDFs/standardDrawings/675-000-00.pdf>

1.2.3 Dimensions

Strain Poles shall be supplied on a per EACH basis, with dimensions in accordance with the following table:

DIMENSIONS TABLE

GALVANIZED STEEL SHAFT			GALVANIZED STEEL PLATE BASE			ANCHOR BOLTS			
Type	Diameter at Base	Length	Mfr's Standard Gauge	Plate Size	Plate Thickness	Bolt Circle	Bolt Hole Diameter	Diameter X Pole Total Length	Design Load @ Yield
13" X 26'	13"	26'	#3 gauge	19" square	2"	18"	2 3/8"	2"X90" (including L-bend)	5,200 lb.
13" X 28'	13"	28'	#3 gauge	19" square	2"	18"	2 3/8"	2"X90" (including L-bend)	5,200 lb.
13" X 32'	13"	32'	#3 gauge	19" square	2"	18"	2 3/8"	2"X90" (including L-bend)	5,800 lb.

1.2.4 Other Materials

All other hardware or components shall be made of a non-corrosive material, or be of the same material as the item being installed.

1.2.4.1 Concrete

The concrete used in the pole base, shall conform to the requirements of SCDOT STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, Section 701, 702, 703, and 704. The concrete shall be CLASS 5000, with "WATER-REDUCER ADMIXTURE", installed in ONE MONOLITHIC POUR, with VIBRATION.

1.2.4.2 Reinforcing Steel

Steel reinforcement shall conform to the requirements of DOT STANDARD SPECIFICATIONS, Section 703.2.1, which is amended to include the following:

"All references to AASHTO M 31 or ASTM A 615 are hereby deleted and replaced by ASTM A 706 with a single minimum yield strength level of 60,000 psi, designated as Grade 60."

The bars shall be of the size and type shown on the Design Details or in the Standards.

1.2.4.3 Conduit Elbow

Conduit Elbows shall be in accordance with FURNISH AND INSTALL ELECTRICAL CONDUIT. Conduit Elbows in pole bases shall be PVC, of the size and type shown on the Plans. As a minimum, THERE SHALL BE AT LEAST 1 CONDUIT ELBOW (2 INCH PVC ELBOW) IN EACH POLE BASE.

1.2.4.4 Ground Rod

Ground rods shall be 5/8 inch by 8 feet (minimum) Copper-Clad. A No. 6 AWG bare, stranded copper wire shall be used in the ground connection. EACH STRAIN POLE SHALL HAVE 1 GROUND ROD.

1.2.4.5 Pole Plugs

Plugs/Caps, either galvanized or stainless, shall be installed in all un-used holes in steel pole.

1.2.4.6 Miscellaneous

All other hardware or components shall be made of a non-corrosive material, or be of the same material as the item being installed.

1.2.5 **Galvanizing**

The following shall be hot-dipped galvanized to ASTM A-123:

Shaft, Anchor Base, nuts, and hand hole frame and cover, the top 12" of the Anchor Bolts, Pole Clamp, and all other steel or iron parts.

1.2.6 **Powder Coating Over Base (Optional)**

Powder Coating over base shall be an option. The finish color shall be specified at the time of ordering. The following shall be powder coated: Shaft, anchor base, nuts, hand hole frame and cover, the top 12" of the anchor bolts, pole clamp, and all other steel or iron parts.

1.2.7 **Powder Coating Over Galvanized (Optional)**

Powder Coating over galvanized shall be an option. The finish color shall be specified at the time of ordering. The following shall be powder coated after they have been hot-dipped galvanized: Shaft, anchor base, nuts, hand hole frame and cover, the top 12" of the anchor bolts, pole clamp, and all other steel or iron parts.

1.2.8 Pole Labeling

Every Pole shall be easily read and prominently labeled on the outside edge of the base plate. The method used shall be that the pole description is inscribed with "WELDING-BEAD", neatly hand-written, in 1-1/2" to 2" high letters. The legend used shall be one of the following:

- 13" X 26'
- 13" X 28'
- 13" X 32'

Note: Codes shall not be acceptable for pole size labeling. The welding bead shall be applied prior to galvanizing.

In addition to the welding bead identification every pole shall have a metal "Builders Plate" (name plate) with raised or stamped letters stating the manufacturer, the date of manufacture, lot number, the length and diameter of the pole and a ID number. The name plate shall be welded to the outside pole wall about 5' above the base at 0 degrees. Color Coding shall be included on each plate to facilitate ease of selection and identification.

1.2.9 Design and Drawings

The Vendor shall furnish pole design details and shop-drawings in sufficient detail for complete evaluation and comparison with these Specifications. Any exceptions to these Specifications must be stated in writing.

1.2.10 Quality Control, Testing, Certification

Where required, materials must be in full compliance with AASHTO and ASTM in effect on the date of advertisement.

Performance Testing - SCDOT reserves the right to receive on demand a test report from an independent laboratory certifying that the equipment furnished meets these specifications, at no costs to the Department. The bidder shall also provide a certification from the manufacturer that all strain poles shall have a guaranteed minimum yield strength, (mill certified), of 55,000 PSI.

Rejection - SCDOT reserves the right to reject an entire shipment of poles covered by this specification and project, if ten percent (10%) or more are found to be defective within a thirty (30 day period following receipt of materials.

1.2.11 Packaging

For Anchor Bolts – To preserve the threads, to help improve stock yard inventory procedures, and to enhance loading/unloading of the shipment, the Anchor Bolts (for either a pole shipment or as spares) shall be packaged and mounted on a pallet with four (4) anchor bolts across and four (4) levels high. Each layer should lay opposite so that the six inch bend protects the threaded end of the next level.

For Pole Hardware – To help improve stock yard inventory procedures, and to make outside storage possible, all anchor bolt hardware and all pole hardware for each pole shall be included in ONE (1) BURLAP BAG. No cardboard boxes shall be permitted. The bag shall contain the nuts, washers, pole cap, pole covers, pole clamps, pole plugs and all associated hardware. The bag shall be placed inside each steel pole.

If necessary, the bag shall be labeled by pole size if smaller clamps are needed for the 26' poles.

1.2.12 Delivery

SCDOT pickup from Vendor or Supply Depot is an option and will be specified at the time of the order.

Shipment for the poles shall be made via open-bed truck to facilitate unloading. Delivery shall be made to the SCDOT Supply Depot, 1418 Shop Road, Columbia, SC or one of seven District Signal Shops. Notice shall be given to the supervisor at the supply depot (803-737-6631) or the District Signal Shop at least two (2) working days in advance, as to the date of shipment, and expected delivery date to the supply depot. Vendor must have lay down yard and means to load poles on site in South Carolina for SCDOT pickup. Vendor to keep eight (8) 28' steel poles and eight (8) 32' steel poles with hardware in stock at all times for rapid use.

SCDOT District 1 Signal Shop
803-737-6974
1408 Shop Rd
Columbia, SC 29201

SCDOT District 3 Signal Shop
803-241-1117
13 Saluda Dam Rd
Greenville, SC 29611

SCDOT District 5 Signal Shop
803-661-4812
3018 East Palmetto St
Florence, SC 29506

SCDOT District 7 Signal Shop
803-395-7188
1768 Charleston Highway
Orangeburg, SC 29115

SCDOT District 2 Signal Shop
864-889-8030
510 W. Alexander Avenue
Greenwood, SC29646

SCDOT District 4 Signal Shop
803-581-8551
1143 SCDOT Rd
Chester, SC 29706

SCDOT District 6 Signal Shop
843-740-1668
6355 Fain Blvd
N. Charleston, SC 29406

1.2.13 Manufacturer/Supplier

Poles must be manufactured within the United States at a facility solely owned by a company incorporated in the United States. Steel used shall comply with current Federal laws limiting foreign steel.

1.2.14 Warranty

The Manufacturer or Contractor shall warrant the poles and all associated hardware to be free from defects in material and workmanship for a period of two (2) years from date of shipment. Any defects within this period shall be repaired or replaced by the Contractor, at total cost to the Manufacturer or Contractor, including labor, parts and transportation.

1.3 Measurement

Furnishing Steel Strain Poles, will be measured by each, of the size(s) specified, anchor bolts, nut covers, pole cap, reinforcing steel, ground rod, ground wire, and all miscellaneous hardware as required.

1.4 Payment

Furnishing Steel Strain Poles, accepted, and measured as above, will be paid for at the contract unit price bid for:

FURNISH 13" X 26' STEEL STRAIN POLE	EA
FURNISH 13" X 26' STEEL STRAIN POLE (POWDER COATED OVER BASE)	EA
FURNISH 13" X 26' STEEL STRAIN POLE (POWDER COATED OVER GALVANIZED)	EA
FURNISH 13" X 28' STEEL STRAIN POLE	EA
FURNISH 13" X 28' STEEL STRAIN POLE (POWDER COATED OVER BASE)	EA

	FURNISH 13" X 28' STEEL STRAIN POLE (POWDER COATED OVER GALVANIZED)	EA
	FURNISH 13" X 32' STEEL STRAIN POLE	EA
	FURNISH 13" X 32' STEEL STRAIN POLE (POWDER COATED OVER BASE)	EA
	FURNISH 13" X 32' STEEL STRAIN POLE (POWDER COATED OVER GALVANIZED)	EA

M688.6 CONCRETE STRAIN POLE

1.1 Description

This specification describes requirements for furnishing pre-stressed Concrete Strain Poles, of the sizes specified. These poles shall be of the type intended for direct embedding, with the hole back filled with concrete.

The following covers the design and fabrication of pre-stressed concrete strain poles, to be used for supporting steel cable suspended traffic signals or supporting lane control signs.

1.2 Materials

1.2.1 General

ALL CONCRETE STRAIN POLES PROVIDED FOR ANY INDIVIDUAL PROJECT SHALL BE FROM THE SAME MANUFACTURER.

Each Concrete Strain Pole assembly shall consist of:

1. A round pre-stressed hollow concrete shaft,
2. A pole cap, and
3. Miscellaneous hardware as specified.

The poles shall meet or exceed the specifications stated in the latest publication of “American Association of State Highway and Transportation Officials” (AASHTO); “Standard Specifications For Structural Supports For Highway Signs, Luminaires And Traffic Signals” and in particular, “Pre-Stressed Concrete Design”. Stress in concrete due to pre-stressing shall be within the limits stated in the AASHTO Standard. Loss of pre-stress shall be calculated using AASHTO methods. Further, the manufacturer shall provide documentation showing the permeability/water-absorption of their product. Other procedures shall be according to the American Concrete Institute (ACI).

Poles shall be designed and constructed so that all wiring and grounding facilities are concealed within the hollow poles. All hand holes, wire inlets/outlets, inserts for pole steps, through bolt holes and the ground wire shall be cast into the pole during the manufacturing process. **NO FACTORY NOR FIELD DRILLING SHALL BE ALLOWED AFTER THE POLES HAVE BEEN STRIPPED FROM THEIR MOLDS.**

Poles shall be designed in accordance with the following requirements, to provide the Mandatory Ultimate Ground Line Moment and with the cable attachment heights stated below. As given, the design shall assume:

OVERALL POLE LENGTH	EMBEDMENT (below ground line)
35 feet	8 feet
40 feet	10 feet
45 feet	11 feet

The *Defined Attachment Height* = Overall Pole Length – Embedment. The design shall assume a worst case strain (pull) of 22,200 Newtons (5000 pounds force) applied at the top of the pole (the design Defined Attachment Height).

Poles shall be designed using the South Carolina Department of Transportation (SCDOT) design method. A worst case application of AASHTO and ACI "Ultimate Strength Design" has been used. M is moment, T is torsion, U is ultimate.

The formula used: $(1.25 \cdot M / \phi M_u) + (1.25 \cdot T / \phi T_u)^2 \leq 1.0$. The contribution of torsion was neglected. A ϕ of 0.90 was used. Substituting gives $M_u > (1.25/.9) \cdot M$ or $M_u > 1.39 M$. We increased the 1.39 multiplier by 7 percent, to allow for torsion, fatigue and possible accidental vehicle damage.

Design Formula: $M_u > 1.5 M$

1.2.2 Pole Materials

1.2.2.1 Concrete

The concrete mix shall be designed to achieve a minimum twenty-eight (28) day compressive strength (f'c) of 58,650 kPa (8,500 psi) Pounds per square inch. Cement shall conform to the latest requirement of Type I or Type III Portland cement in accordance with ASTM C-150. The maximum size aggregate may be is 19 mm (Millimeter). (3/4 inch) or (3/4") of the clear spacing between the main reinforcing steel and the surface of the pole. Any water reducers, retarders or accelerating admixture used shall conform to ASTM C-494. The water used shall be free from foreign materials in amounts harmful to concrete or embedded steel. The compressive strength at release of pre-stress (f'ci) shall be 31,050 kPa (4,500 psi).

1.2.2.2 Reinforcing Steel

NO deformed steel reinforcement (ASTM A-615) shall be used in the manufacturing process.

1.2.2.3 Pre-stressing Steel

Pre-stressing steel stranded rope cable, which shall conform to uncoated 12.7 mm (0.5 inch), 7 wire, stress relieved strand (including low relaxation) of 1,201,500 Newtons (270,000 pound strain) grade, ASTM A-416. The minimum number of strands shall be eight (8) strands.

1.2.2.4 Spiral Reinforcement

Steel wire spiral reinforcement shall conform to ASTM A-82 and shall be of minimum diameter 0.150". The pitch of the spiral reinforcement shall be on 2" centers for the first and last 3' of the pole, and 6.5" centers for the remaining portion of the pole. These requirements are more stringent than AASHTO.

1.2.2.5 Hardware

All structural steel shall conform to ASTM A-36 and be hot-dip galvanized per ASTM A-123. Hand hole frames and covers and all inserts shall be zinc alloy AC41A, ASTM B-240. All bolts, nuts, washers and other fasteners shall be stainless steel or be hot-dip galvanized per ASTM A-153.

1.2.3 Manufacturing

All manufacturing tolerances, details of reinforcement and finishes shall be in accordance with the latest specification for pre-stressed concrete poles, as published in the "Journal Of The Pre-Stressed Concrete Institute".

All poles shall be pre-stressed and be manufactured by the centrifugal spinning process using a mold. The purpose of this requirement is to insure a minimum twenty-eight (28) day compressive strength of 8,500 psi, and to provide the densest possible surface finish.

Forms shall be designed to provide a continuous outside taper of 0.180" per foot of length. Forms shall also provide a minimum of 1" of concrete cover over the pre-stressing strands.

Poles shall have a smooth, natural form finish, concrete soft gray in color (no dyes or stains).

Poles shall be round in cross section, with a hollow center and shall be of one piece construction.

All excess concrete shall be removed from inside of pole before delivery.

Poles shall not have any exposed steel at either top or the butt end. Steel strands, both top and butt end, shall be burned back a minimum of 0.75" and the resulting hole shall be completely sealed with epoxy.

Pole bottom ends shall be plugged with 12" of concrete at the butt end, which shall also have a 2" diameter drain hole through that plug.

1.2.4 Pole Features

Contact the Traffic Signal & Systems Engineer at (803) 737-1050 for: "Standard Drawing 675-115-02" for the height and compass orientation of pole features; and "Typical Concrete Pole Orientation" for intended usage.

– Standard Drawing 675-115-02. <http://www.scdot.org/doing/technicalPDFs/standardDrawings/675-000-00.pdf>.

Each pole shall include the features listed below.

1.2.4.1 Pole Cap

Each pole shall be supplied with a pole cap or top, which shall be made of plate aluminum. (Galvanized steel is NOT acceptable.)

1.2.4.2 Wire Support

A wire support consisting of a diametric reinforcing bar shall be cast inside the pole about 6" from the top. This bar can also be used to anchor the pole cap if necessary.

1.2.4.3 Upper Hand hole

A reinforced hand hole frame, complete with flush cover, with a minimum size of 3.5" x 8", shall be cast into pole approximately (1'-2") from the top of pole at 270°. (Orientate counter-clockwise)

1.2.4.4 Couplings

For weather head installation and entrance of the electrical cables, two (2) 2" I.D. conduit couplings shall be cast into the pole at 0° and 90° (orientate counter-clockwise) approximately (1'-2") from the top of pole and one (1) 2" I.D. conduit coupling (2'-10") from the top of the pole at 0°.

1.2.4.5 Through-Holes

Through-holes, for attaching steel span cable using appropriate through-bolt hardware, shall be at 0°, 90°, 180°, and 270°. The upper holes should be approximately (1'-10") from the top of pole and the lower holes should be approximately (2'-4") from the top of the pole. **NO PVC** (Polyvinyl chloride) is required in holes so that each level of span wire through bolt hardware can be used in multiple directions.

1.2.4.6 Grounding

A No. 4 AWG stranded copper ground wire shall be cast into each pole and be attached to the pre-stressed steel by bonding connectors. The embedded ground wire shall be terminated near the top of the pole and at a point near the bottom, approximately 9" below the ground line. Both terminations shall be made to a "copper tank ground" which provides a 0.5" tapped insert on the pole face for grounding attachment to spans wires at the top and to the driven ground rod at the base.

1.2.4.7 Pedestrian Features

For possible pedestrian signal head assembly, each pole shall have four (4) 1" holes for wiring the signals that will be banded onto the pole at a height 10' above the ground line at 0°, 90°, 180°, and 270°.

For possible pedestrian push buttons, each pole shall have four (4) 1" holes for wiring a push button that will be banded onto the pole at a height 3.5 feet above the ground line at 0°, 90°, 180°, and 270°.

1.2.4.8 Pole Labeling

Every pole shall have an embedded "Builders Plate" (name plate) of brass or aluminum with raised or stamped letters stating the manufacturer, the date of manufacture, lot number, the length and diameter of the pole and the ultimate ground line moment capacity. The name plate shall be cast into the outside pole wall about 5' above the ground line.

1.2.4.9 Rouosting Holes

A 1.5" "CANT" hole, completely through the pole and lined with PVC conduit shall be cast into each pole at a height 4' above ground line. The purpose shall be to permit inserting a pry-bar to turn the pole for proper orientation with the intersection.

There shall also be a Pick-Up point hole at the defined distances from the top of the pole found on the "Concrete Pole Openings, Thru-Bolts & Couplings".

1.2.4.10 Lower Hand Hole

The compass location of the hand hole defines the zero (0) degree point. Each pole for traffic signal support shall have a reinforced hand hole frame, complete with flush cover, with a minimum size of 3.5" x 8.5", shall be cast into the pole approximately 1.5 feet above the ground line.

1.2.4.11 Pole Mounted Cabinet

For possible controller cabinet installation, (2) 3" I.D. conduit couplings shall be cast into the pole at 90° and 270° 1.5 feet from the ground line. **(Note: These couplings flank the lower hand hole)**

1.2.4.12 Underground Conduit Entrance

In each signal pole, there shall be cast in two (2) rectangular underground cable entrance openings (conduit entry hole) at 0° and 270° minimum size of 4" x 10", the top of which shall be located 1.5 feet below the ground line.

1.2.4.13 Pull Rope/Wire

The manufacturer shall furnish inside each pole a nylon or polypropylene rope or stainless steel wire so electrical wires may be pulled in installed pole. The rope or wire shall extend from the conduit opening near the base to the top of the pole.

Other Materials

Other materials shall meet the following requirements:

1.2.5.1 Concrete

The concrete used to embed the pole shall conform to the requirements of SCDOT STANDARD SPECIFICATIONS, Section 701, 702, 703, and 704. The concrete shall be Class 3000 and installed in ONE MONOLITHIC POUR, with VIBRATION.

1.2.5.2 Conduit Elbow

Conduit elbows shall be in accordance with furnish and install electrical conduit. Conduit elbows in pole bases shall be PVC of the size and type shown on the plans. If no other conduit is shown as a minimum, there shall be at least one (1) 2 inch PVC conduit elbow placed in each pole base.

1.2.5.3 Ground Rod

Ground rod(s) shall be 16 mm by 2.4 meters (5/8 inch by 8 feet) (minimum) copper clad. A No. 6 AWG bare stranded copper wire shall be used in the ground connection. **EACH STRAIN POLE SHALL HAVE AT LEAST ONE (1) GROUND ROD.**

1.2.5.4 Miscellaneous

All other hardware or components shall be made of a non-corrosive material or be of the same material as the item being installed.

1.2.5.5 Reinforcing Steel

Not usually needed for a concrete pole.

1.2.5 *Design and Drawings*

Prior to being approved for fabrication, the Contractor shall furnish from the manufacturer to the Engineer, complete stress computations, calculations, pole design details and design drawings in sufficient detail for complete evaluation and comparison with these Specifications. These submittals shall indicate the dimensions and shape of all individual structural and electrical features, their relative location on each pole and their relationship with each other. Drawings shall be made as close to scale as possible and with all details large enough to be self-explanatory. Any exceptions to these Specifications must be stated in writing. When computer programs have been used during the design process, the printouts of the programs or a copy thereof shall be provided to the engineer.

1.2.6 *Certification*

CATALOG CUTS ARE REQUIRED

The Vendor or Manufacturer shall provide documentation stating the permeability and/or water absorption of their concrete pole.

The Vendor shall provide a written certification from the intended manufacturer that all components of strain poles provided under this item have been designed and manufactured in complete accordance with these specifications and the approved design drawings, including the strength of the concrete. The certification letter shall be signed by an officer of the company.

Poles must be manufactured within the United States at a facility solely owned by a company incorporated in the United States. **The manufacturer must have a minimum of ten (10) years' experience in the design and production of centrifugally spun concrete poles shall have a full time registered professional engineer on staff.** Steel used shall comply with current Federal laws limiting foreign steel.

1.2.7 *Quality Control, Testing, Certification*

Where required, materials must be in full compliance with AASHTO and ASTM in effect on the date of advertisement.

By furnishing poles for SCDOT, the manufacturer implicitly grants the right of entry and inspection of the manufacturing facility to the Engineer (or designated representative) of SCDOT. If requested, each of the component materials involved in the production of these poles must be sampled, tested and approved by the SCDOT Materials Laboratory prior to the start of production. In addition the total production process, including curing, shall be subject to inspection and approval.

SCDOT, at the discretion of the Engineer, may direct that one (or more) randomly chosen poles shall be shipped directly to a testing facility other than the depot. This may be one of the SCDOT Materials Laboratories or an independent testing facility. There, the pole may be tested to destruction. This "test pole" shall be paid for at the contract unit price.

The Vendor shall furnish a Certification from the Manufacturer or Vendor, that the Steel Cable has been tested to meet or exceed the required tensile strength.

1.2.8 *Delivery*

SCDOT or Contractor pickup from Vendor or Supply Depot is an option and will be specified at the time of the order.

Shipment for the poles shall be made via open-bed truck to facilitate unloading. Delivery may be made to the SCDOT Supply Depot, 1418 Shop Road, Columbia, SC or any location specified in the state of South Carolina. Notice shall be given to the supervisor at the supply depot (803-737-6631) at least two working days in advance, as to the date of shipment, and expected delivery date to the supply depot. **Logistics for direct deliveries to locations other than the Supply Depot will be the responsibility of the vendor.**

Concrete strain poles shall be delivered to a location specified at the time of ordering. Delivery time shall be no later than thirty (30) calendar days. Any material received that does not meet these specifications will be returned at the expense of the vendor or manufacturer.

1.2.9 Manufacturer/Supplier

Poles must be manufactured within the United States at a facility solely owned by a company incorporated in the United States. Steel used shall comply with current Federal laws limiting foreign steel.

1.2.10 Warranty

The Manufacturer or Vendor shall warrant the poles and all associated hardware to be free from defects in material and workmanship for a period of two (2) years from date of shipment. Any defects within this period shall be repaired or replaced by the Manufacturer or Vendor, at total cost to the Manufacturer or Vendor, including labor, parts and transportation.

1.3 Measurement

Furnishing Concrete Strain Poles will be measured by EACH of the length specified. This shall include pole cap and all miscellaneous hardware as required.

1.4 Payment

Furnishing Concrete Strain Poles accepted and measured as above, will be paid for at the contract unit price.

35' CONCRETE PRE-STRESSED POLE ASSEMBLY	EA
40' CONCRETE PRE-STRESSED POLE ASSEMBLY	EA
45' CONCRETE PRE-STRESSED POLE ASSEMBLY	EA
ALUMINUM POLE CAP	EA
HAND HOLE COVERS	EA

M688.7 CONTROLLER AND CABINET ASSEMBLY

Item	Description	Unit	Estimated Quantity
1	Controller Model 2070 Controller	Each	500
2	Cabinet Assembly (larger) Model 332A	Each	350
3	Cabinet Assembly (smaller) Model 336S	Each	100
4	Conflict Monitor Model 2018 ECL-ip	Each	250
5	Conflict Monitor Model 2010 ECL-ip	Each	250
6	Red Enable Board	Each	200
7	Load Switch Model 200 (SSS-87IO)	Each	2500
8	DC Isolator EDI Model 242	Each	350
9	Flash Transfer Relay Model 430	Each	350
10	Loop Detector Amplifier , LCD Enhanced/Intelligent	Each	500
11	Loop Detector Amplifier Model 222	Each	500
12	Surge Protection for Twisted-Pair Communications	Each	75
13	Flasher Load Switch Model 204	Each	110
14	Cabinet Power Supply Model 206L	Each	75
15	Power Strip	Each	150
16	#2 Lock and Key Set	Each	200
17	Aluminum Extender Base for Cabinet Assembly	Each	200
18	Low Voltage Protection	Each	100
19	2070-7A Card	Each	25
20	Conflict Monitor Tester ATSI Model 8000	Each	20
21	Suitcase Tester for 170 and 2070 controllers	Each	20
22	Cabinet Assembly Display Unit	Each	20
23	Evaluation of Equipment for Repair outside Warranty Period	Each	140
24	Repair Equipment outside Warranty Period	Hours	250
25	SCDOT Signal Cabinet Training	Each	15
26	Conflict Monitor Training	Each	15

EQUIPMENT SPECIFICATIONS

SCDOT's current equipment specifications are included. All equipment supplied under this contract shall meet or exceed these specifications. Include with your proposal detailed information on all products to be supplied. Identify any areas where products fail to meet these specifications as well as any features that exceed SCDOT's current specifications.

The following specifications state the minimum acceptable requirements, materials, and workmanship for traffic signal control equipment to be supplied to SCDOT. These are SCDOT specific requirements that extend or modify the California Department of Transportation (CALTRANS) Specification.

Further, equipment shall conform to the applicable requirements of Underwriter's Laboratory Incorporated (UL); the Electronic Industries Association (EIA); the National Electric Code (NEC); the American Society for Testing and Materials (ASTM); the American National Standards Institute (ANSI); and other applicable standards and specifications.

Described below:

- **EQUIPMENT DETAILS**
- **DELIVERY**
- **WARRANTIES AND SERVICE**
- **DOCUMENTATION**
- **EQUIPMENT DETAILS**

Item 1 Controller Model 2070 Controller

This item consists of furnishing Model 2070 Standard, single port, non-switch, RJ45, Ethernet controller. The controller shall also be digital, solid-state, micro-processor based, keyboard (push-button) programmable, and in accordance with the Network Services Security Policy for Network Attached Devices included in this solicitation. Units shall conform to CALTRANS Transportation Electrical Equipment Specifications (TEES), dated July 21, 2008 except as required herein. Provide model 2070 Controllers composed of the unit chassis and at a minimum, the following modules, assemblies, and software:

- Model 2070-4B Power Supply Module, 3Amp
- Model 2070-3B Front Panel Module
- Model 2070 1B CPU Module, single board
- Model 2070-2A Field I/O Module
- Model 2070-7A Asynchronous Serial Com Module (price as an optional or add on item)
- Controller must be able to accept and operate fully with Apogee firmware version 65 and 76 and shall be able to communicate with central ATMS.NOW software.

Item 2 Cabinet Assembly (larger) Model 332A

A complete operating Cabinet Assembly containing the standard CALTRANS equipment complement with/including: one (1) Conflict Monitor, twelve (12) Load Switches, two (2) DC Isolators, Fourteen (14) Flash Programming Sockets, Seven (7) Flash Transfer Relays, and eight (8) LCD Enhanced Loop Detectors. The 332A Cabinet Assembly shall NOT include a 2070 Controller.

The Model 332A Cabinet Assembly (66" x 24" x 30") shall be as specified in the CALTRANS Specifications. This Cabinet shall incorporate an INPUT TERMINATION PANEL. The Cabinet shall be base mounted. 332A Cabinet Assembly shall be configured for eight (8) vehicle phases, four (4) pedestrian phases and shall include an AUXILIARY MODEL 420 OUTPUT FILE, for six (6) overlap phases. The Auxiliary Output File shall house three (3) Flash Transfer Relays and six (6) Flash Programming Sockets. The Auxiliary Output File shall be wired to ensure that all six (6) phases flash correctly during flashing operation where 18 channels are being used, no dark signals shall be allowed during the flashing operation. See additional requirements for all cabinet assemblies following this detail.

Item 3 Cabinet Assembly (smaller) Model 336S

A complete operating Cabinet Assembly containing the standard CALTRANS equipment complement with/including: one (1) Conflict Monitor, eight (8) Load Switches, two (2) DC Isolators, eight (8) of Flash Programming Sockets, four (4) Flash Transfer Relays, and six (6) LCD Enhanced Loop Detector. The 336S Cabinet Assembly shall NOT include a 2070E Controller.

The Model 336S Cabinet Assembly (46" x 24" x 22") shall be as specified in the CALTRANS Specifications. The Cabinet shall be capable of side-pole mounting, as well as base mounting. See additional requirements for all cabinet assemblies following this detail.

The 336S Cabinet shall NOT have an AUXILIARY OUTPUT FILE. Additionally, Auxiliary Output files will not be added to a 336S Cabinet Assembly, therefore the additional wiring necessary to add an Auxiliary Output file shall not be installed. All assemblies in the 336S Cabinets shall be installed in the upper most position so that free space at the bottom of the cabinet is maximized. See additional requirements for all cabinet assemblies following this detail.

Items 2, 3 Cabinet Assemblies

The equipment to be furnished shall be in accordance with CALTRANS Transportation Electrical

Equipment Specifications (TEES), dated July 21, 2008 except as required herein. Further, the equipment shall meet the special SCDOT requirements, as stated in the following Specifications. In case of conflict, SCDOT Specifications shall govern. In addition to meeting the CALTRANS specifications, **Item 2** and **Item 3** shall also meet the following:

Cabinet structure details

- Front and back door switches shall be fully insulated against water intrusion and located on the bottom door hinge.
- Railroad inputs shall be easily accessible for input installations.
- A Fellowes 99111, or equivalent, power strip shall be installed along the wall on the high voltage side of the cabinet and plugged in to a non-GFI switch on the back of the cabinet power supply.
- Nylon card-guides shall be integrated into the cabinet assemblies where all Load Switch, Flasher, Input File and Power Supply Hardware may be installed. The card guide slots shall be of sufficient depth to support pluggable devices when they are not fully inserted into the electrical receptacles, and the installation or removal of pluggable devices shall not require excessive force.
- AC Service terminal blocks shall be a minimum of 6" from base of the rack-supports.
- To prevent accidental, electrical contact between the Cabinet Assembly and Conflict Monitor Unit, the entire side panel within the output file that is directly adjacent to the solder-side of the Conflict Monitor Unit shall be insulated with non-conductive sheeting, including covering screw heads, rivets, etc. This sheeting shall not degrade over time and shall remain attached to the output file throughout the life of the Cabinet Assembly. This sheeting shall be of minimal thickness as to not impede the insertion and/or removal of the Conflict Monitor Unit.
- Four (4) support braces (two (2) installed on each side) for the rack assembly shall be welded, with a continuous seam, directly under the rack assembly uprights.
- A Nylon Sleeved cable shall be hard wired directly to the cabinet on one end, and have a plugin adapter for the conflict monitor on the other end for monitoring the absence of red. The pin assignments of the Nylon Sleeved cable shall be provided with the Cabinet plans. The Nylon Sleeved cable connection for the conflict monitor shall be physically "keyed" to prevent the cable from being plugged in incorrectly. The Nylon Sleeved cable shall be latched to the conflict monitor. The Nylon Sleeved cable shall be attached to the cabinet so it has to be unplugged before the Conflict Monitor can be removed.
- The 206L Power supply in all Cabinet Assemblies shall be provided with a device that would prevent the power supply from being removed unintentionally. This device must be strong enough to support the weight of the power supply and shall be accessible from the FRONT of the Cabinet Assembly. The insertion or removal of the 206L Power Supply and security device shall not require the use of any tool. The shipping wing nut must be removed.

Internal Cabinet Requirements

- Furnish two (2) sets of non-fading cabinet diagrams and schematics that are to be placed in a clear, sealable, water tight, plastic bag and stored within the front-door-mounted laptop shelf/storage compartment. See "Laptop Shelf" requirements later in this specification.
- Furnish two (2) Model 242 DC Isolators with all 332A and 336S Cabinet assemblies. These items are to be installed within the cabinet input file, in the pedestrian input slots.
- Furnish eight (8) Enhanced LCD Loop Detectors with all 332A Cabinet Assemblies. These are to be installed in the first eight (8) slots of the upper input file assembly. See LCD Detector requirements later in this specification.
- Furnish six (6) Enhanced LCD Loop Detectors with all 336S Cabinet Assemblies. These are to be installed in the first four (4) slots of the input file assembly. See LCD Detector requirements later in this specification.
- Furnish twelve (12) PDC 200 (SSS-87IO), or equivalent, Load Switches with all 332A Cabinet Assemblies. These are to be installed in the following output file channels: 1, 2, 4, 5, 6, 8, 13, 14, 15, 16, 17, and 18. See for Load Switch requirements later in this specification. All load switch locations in the Output file and Auxiliary output file shall be clearly labeled with permanent screening, with the default CALTRANS phase assignment, in all 332A Cabinet Assemblies.
- All terminations to output files shall be soldered to the back side of the panels.

- Furnish eight (8) PDC Model 200(SSS-87IO), or equivalent Load Switches with all 336S Cabinet Assemblies. These are to be installed in the following output file channels: 2, 4, 6, 8, 13, 14, 15, and 16. See Load Switch requirements later in this specification. All load switch locations in the Output file shall be clearly labeled with permanent screening, with the default CALTRANS phase assignment, in all 336S Cabinet Assemblies.
- Furnish two (2) Model 204 Flasher Load Switches with all 332A and 336S Cabinet Assemblies. These are to be installed in the flasher slots within the Power Distribution Assembly (PDA). See Flasher requirements later in this specification.
- Load Switches and Flashers are to be secured within their respective slots for shipment, with 1/2" string-reinforced tape as a minimum.
- Furnish a Thermostat-controlled, dual-fan (100CFM minimum rating per fan) ventilation system in all 332 series Cabinet Assemblies.
- Furnish a Thermostat-controlled, single-fan (100CFM minimum rating) ventilation system in all 336S Cabinet Assemblies.
- 332A and 336S Cabinet Assemblies shall NOT utilize a Mercury Contactor switch. A field-proven solid-state device or equivalent shall be used.
- The Flash Sense/Stop Time terminations in the Input File Assembly shall be wired such that a DC Isolator will not be required for implementation of these functions by the Conflict Monitor Unit.

Power Supply

- The Power Supply furnished in all 332A and 336S Cabinet Assemblies shall be the EDI 206L Switching Power Supply, or equivalent.

Conflict Monitor

- The Conflict Monitor shall be an EDI Model 2018 ECL-IP Conflict Monitor with absence of red monitoring.
- The Conflict Monitor Unit shall contain a 10/100 Ethernet port on the front panel for the uploading of alarms and/or event logs with a standard laptop computer. This port shall also allow for future communication within an Ethernet-based infrastructure.
- The Nylon Sleeved cable shall be routed internally or between the rack assembly and cabinet wall. The cable shall be anchored to the front of the output file so that the Conflict Monitor Unit cannot be removed with the cable attached.

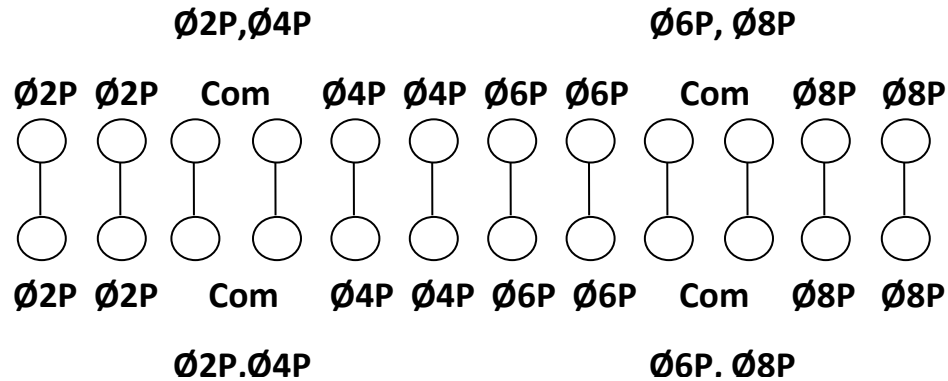
Thermostat

- Cabinet Thermostat to be factory-set to 90 degrees in all Cabinet Assemblies.
- Cabinet Thermostat and thermostat temperature setting shall be easily accessible and adjustable from the front of all 332A Cabinet Assemblies.
- Cabinet Thermostat and thermostat temperature settings shall be easily accessible and adjustable from the rear of all 336S cabinet assemblies.
- Cabinet Thermostat terminals shall be insulated to prevent accidental electric shock.

Pedestrian Button and Loop Detection Inputs

- All Vehicle and Pedestrian terminals on the Loop Input Termination Panel shall be clearly labeled with permanent screening, with the default CALTRANS phase assignment, in all 332A and 336S Cabinet Assemblies.
- "Ped-Yellows" shall be provided with "dummy loads" consisting of load resistors rated at 5 Watts minimum. The impedance of the load resistors shall be such that the Conflict Monitor Unit does NOT see a false indication for the yellow output of the pedestrian channels.
- The 332A Cabinet Assembly shall include additional terminations for Pedestrian Pushbutton inputs. A Minimum of twenty-four (24) extra terminals (12-position, dual-bus terminal strip) shall be provided, allowing sixteen (16) additional termination points for four (4) Pedestrian Phases. The remaining eight (8) termination points shall be for the shared or "common" input for the adjacent Pedestrian Phase terminations. These are to be wired in parallel with the standard input file terminations and surge protection. This termination panel shall be easily accessible, clearly labeled with permanent screening and may be placed in any available space on the side panel containing the

standard Loop and Pedestrian input terminations. The required configuration is shown here:



- The 332A and 336S Cabinet Assemblies shall have a ‘Detector Test Panel’ installed above the Controller Unit. The panel shall be installed within the rack assembly and will have eight (8) 3-position mini-toggle switches, symmetrically spaced and horizontally arranged for placing calls to the Controller Unit. 3-position On-Off-On switches shall activate inputs. Upward motion of the switch shall lock into place and shall place a vehicle call to the Controller Unit until the switch is manually returned to center position. The center position of the switch shall not inhibit normal detector operation. Downward motion of the switch shall place a momentary closure vehicle call and will allow the intersection to resume normal detector operation when released. This panel shall be clearly labeled with permanent screening beneath each switch. The labeling shall identify each detector switch and default phase assignment for phases 1 through 8. The panel should also be titled “Vehicle Call Panel” and shall include a legend for switch operation: “On, Auto, Pulse”. The panel shall be wired as follows:

336S Cabinet		332A cabinet	
Detector Switches	Terminal	Detector Switches	Terminal
Phase 1	I1-F	Phase 1	I1-W
Phase 2	I2-F	Phase 2	I4-W
Phase 3	I3-F	Phase 3	I5-W
Phase 4	I4-F	Phase 4	I8-W
Phase 5	I5-F	Phase 5	J1-W
Phase 6	I6-F	Phase 6	J4-W
Phase 7	I7-F	Phase 7	J5-W
Phase 8	I8-F	Phase 8	J8-W

Key Sets and Doors

- Front and rear doors of all cabinet assemblies shall implement a #2 Corbin Locking assembly. Two (2) BRASS keys are to be included with each Cabinet Assembly.
- The front and rear door locks for all Cabinet Assemblies shall have a minimum of 1 mm (0.03937”) clearance between the edge of each side of the lock bolt and the cabinet’s latch cam assembly.
- Both doors shall be ventilated and are to include disposable filters that are secured in place, yet easily removed or re-installed for replacement.
- Front and rear door handles for all cabinet assemblies shall turn away from the door lock/key to open the cabinet door.

Cable

- Appropriate Red, Yellow or Green color-coding shall be used for all Load Switch input and Load Switch output wiring within the Output and Auxiliary Output Files.

- Applicable 170-style cabling shall be included in all 332A and 336 S Cabinet Assemblies.

Police Panel/Button

- Police panel door shall be insulated to prevent water from entering the cabinet assembly. The insulation material used and its ability to resist water-penetration shall not degrade over time.
- The Police panel assembly shall have a drain to prevent water from collecting within the assembly. Per CALTRANS, the drain shall be channeled to the outside of the cabinet. There shall be no additional holes within the police panel.
- The protective cover for the police panel key opening shall be snug with the police panel door and shall not move freely. However, this protective cover shall be easily opened without having to use any tool.
- Manual Control cord shall be permanently hard-wired into the Police panel assembly to prevent removal.
- Manual Cord shall be anchored to the inside of the cabinet chassis to prevent over-extension and/or damage to the Police Panel terminations when the cord is extended for use.
- For storage, the Manual Control cord should be fed into the cabinet assembly through a grommet opening at the top of the police panel. The location of the opening shall not allow water to enter the cabinet. Additionally, the cord shall be fed for storage into an area where there is no risk of 'snagging' the cable when it is extended for use. The storage area shall be sealed completely to prevent water from entering the cabinet when the police panel door is open.
- For additional security, a quick-connect/quick-disconnect, molex-style connector shall be used for the Police Panel wiring inside the Cabinet Assembly. This connector shall NOT be accessible from the Police Panel and should be easily accessible from inside the cabinet. The wiring of this connector shall be such that, when disconnected, the Manual Control Enable/Advance Enable function on the Police Panel, as well as the Interval Advance/Advance function on the manual cord cannot be applied to the Controller Unit.
- The Police panel shall be wired such that the Interval Advance/Advance function cannot be applied to the Controller Unit when the Manual/Auto switch is in the Auto position.
- Each 332A and 336S Cabinet Assembly shall be provided with a manual police push button on an insulated cord allowing the operator to stand a minimum of 6' from the Cabinet Assembly, permanently mounted in conjunction with a manual/auto switch. When placed in the manual position, Manual Control Enable or Advance Enable shall be applied to the Controller, and Minimum Recall shall be applied to all used phases. Activation of the push button shall apply the Interval Advance or Advance input to the Controller Unit. Manual advancement will be prohibited in the minimum green, and clearance timing intervals.

Laptop Shelf

- For all 332, 332A and 336S Cabinet Assemblies, a hinged, aluminum shelf and integrated storage compartment shall be installed on the front door, inside the Cabinet Assembly. The hinge, shelf, or shelf parts shall not come off or interfere with closing the shelf or the cabinet door.
- To allow better ventilation throughout the cabinet and rack, a sliding shelf/drawer within the rack assembly will not be permitted.
- The shelf shall have a smooth, non-slip surface, sufficient for use as a writing platform and of sufficient size and rigidity to support any laptop computer when extended for use.
- This shelf shall have rounded or insulated edges that do not have the potential to physically harm the user.
- The shelf shall lock into place when folded for storage.
- Locking the shelf for storage and/or extending for use shall not require the use of any tool.

Cabinet Lighting

- Each Cabinet shall include two (2) LED lighting fixtures with the switch built-in.
- One mounted inside the top-front portion of the Cabinet and one mounted inside the top-rear portion of the cabinet.
- Both shall illuminate equivocally to a 15-watt, cool white fluorescent light fixture and shall include an easily accessible on-off switch.

- Door-actuated switches shall be installed to turn on the cabinet lights when either the front or rear door are opened.

Mounting

- Each 336S Cabinet shall be supplied with a removable base plate. Two (2) pole mounting brackets shall be attached to each 336S cabinet.
- Install an aluminum plate for reinforcement of the pole-mounting brackets. This plate shall be installed inside the 336S Cabinet Assembly and shall utilize threaded Penn Engineering & Manufacturing Corporation (PEM) nuts or self-clinching fasteners for simple installation and removal of exterior pole-mount bracket bolts without the use of any tool, inside the Cabinet Assembly.
- For 336S and 332A Cabinet Assemblies, the base mounting anchor-bolt pattern shall be as specified in the CALTRANS Specifications.

Surge Protection

- Cabinet assemblies shall include the Emerson (Edco) SHA-1250 Surge Protection device or equivalent, and shall be a plug-in type installation, or shall be integrated onto a plug-in style panel for simple replacement. This assembly should be easily accessible within the Cabinet Assembly shall be mounted a minimum of 6" from base of the rack-supports and secured to prevent unintended removal.
- Removal/replacement of the surge suppressor or manufacturer-designed panel assembly shall not require the connection or disconnection of any wiring within the cabinet and shall be a simple procedure for one (1) technician.
- Each 336S and 332A Cabinet shall be provided with devices to protect the control equipment from surges and over voltages. This shall include incoming power lines, the Input File, the Output File (load switch-packs), and communication lines.
- For any existing on-street twisted-pair communication, an Emerson (Edco) PC642 surge protection device and applicable 170-style cabling shall be included in 332A and 336S Cabinet Assemblies.
- The surge protection for the Input File shall be in accordance with the assignment of the slots of a standard 336S Cabinet assembly. Surge protector termination panels shall be provided, attached to the Cabinet rack assembly. AC isolation terminals shall be on the same side of the Cabinet as the AC service inputs. DC terminals and loop detector terminals shall be installed on the opposite side of the Cabinet from the AC power lines, to reduce electromagnetic induction. The surge protector panels shall be designed to allow for adequate space for a wire connection and surge protector replacement. Surge protection shall be provided for the full capacity of the Cabinet Input File.
- It is the intent of SCDOT to require surge protection on each CALTRANS defined input; that is, full protection. For example, on the 336S Cabinet, Vehicle Loop Detector Surge Protection would be required on two (2) channels each, of Slots 1 to 8 of the Input File. In addition, on the remaining Slots 9 to 14, Pedestrian surge protection; plus Auxiliary (pre-emption) protection as defined.
- On the 332A Cabinet, full protection is desired on both Input Files. For example, Vehicle Loop Detector Surge Protection would be required on two (2) channels each, of Slots 1 to 8 of BOTH INPUT FILES I AND J; together with pedestrian and auxiliary protection on both racks.
- For the 332A Cabinet, appropriate input surge protection shall be mounted on the INPUT TERMINATION PANEL. For the 336S Cabinet, appropriate input surge protection shall be mounted on a FOLD-DOWN TERMINATION PANEL on the rear of the cabinet assembly. This fold-down panel shall not obstruct the Output File Field wiring when in the closed position and shall utilize thumb-screws to secure the panel under normal operating conditions. The fold-down portion of this panel shall be easily accessible and shall be mounted to the rack assembly.
- Under no circumstance (normal operation or short-circuit condition) shall the ampacity of the internal wiring and printed circuit board traces be less than the protecting threshold of circuit breakers and surge protectors provided.

Power Distribution Assembly

- The Power Distribution Assembly of each Controller Cabinet shall include a surge protective device (SPD) on the AC Service Input. It shall be capable of reducing the effect of lightning transient voltages applied to the AC line. The protector shall be a two-stage series/parallel device, and shall be an Emerson (Edco) SHA-1250 or equivalent. The SPD shall meet or exceed the following

requirements:

- Maximum AC line voltage: 140 VAC
- Twenty pulses of peak current, each of which will rise in 8 μ s and fall in 20 μ s to one-half the peak: 20,000 A
- The protector shall be provided with the following terminals:
 - Main line (AC Line first stage terminal)
 - Main Neutral (AC Neutral input terminals)
 - Equipment Line Out (AC Line second stage output terminal, 10 A).
 - Equipment Neutral Out (Neutral terminal to protected equipment).
 - Ground (Earth connection)
- The Main AC line in and the Equipment Line out terminals shall be separated by a 200 Micro Henry (minimum) inductor rated to handle 10 A AC Service.
- The first stage clamp shall be between Main Line and Ground terminals.
- The second stage clamp shall be between Equipment Line Out and Equipment Neutral.
- The protector for the first and second stage clamp shall have a Metal Oxide Varistor (MOV) or similar solid-state device rated at 20 KA; and be of a completely solid stage design (i.e. no gas discharge tubes allowed).
- The Main Neutral and Equipment Neutral Output shall be connected together internally, and shall have an MOV (or similar solid state device, or gas discharge tubes) rated at 20 KA between Main Neutral and Ground terminals.
- Peak clamp voltage: 250 V at 20 KA. (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together).
- Output voltage shall never exceed 280 volts.
- The Protector shall be epoxy-encapsulated in a flame retardant material.
- Continuous service current; 10 A at 120 VAC RMS.
- The Equipment Line Out shall provide power to the Controller, and to the 24 V power supply.

Inductive Loop Detector Inputs

- Each inductive loop detector input channel shall be protected by an external, surge protective device which shall be an Emerson (Edco) SRA-6LC-6 or equivalent. The SPD shall meet or exceed the following requirements:
 -
 - It shall be a three-terminal device, two of which shall be connected across the signal inputs of the detector. The third terminal shall be connected to chassis ground to protect against common mode damage.
 - It shall instantly clamp differential mode surges (induced voltage across the loop detector input terminals) via a semiconductor array. The array shall be designed to appear as a very low capacitance to the detector.
 - It shall clamp common mode surges (induced voltage between the loop leads and ground) via solid state clamping devices.
 - It shall meet or exceed the following requirements:

Peak Surge Current:	250A
Differential Mode:	400 A (8x20 μ s)
Common Mode:	1000 A (8x20 μ s)
Estimated Occurrences:	500 @ 200 A
Response Time:	40 ns
Input Capacitance:	35 pf typical
Temperature:	-40 degrees to +85 °C
Mounting:	No. 10-32 x 3/8" bolt
Clamp Voltage:	130VDC
@400 A Differential Mode	30 V maximum
@1000 A Communication Mode	30 V maximum

Signal Load Switches (Switch-Packs)

- The outputs of each switch-pack in the output file shall be provided with a surge protective device comprised of metal oxide varistors (MOVs) which shall be a V150LA20A or equivalent. The SPD shall meet or exceed the following requirements:

Communication Inputs

- Each low voltage communication input shall be protected as it enters the cabinet with a modular type surge protective device comprised of three-stage hybrid technology protection consisting of gas discharge tubes (GDT), silicon avalanche diodes (SAD) and positive temperature coefficients (PTC), which shall be and Emerson (Edco) PC642C Series or equivalent. The SPD shall meet or exceed the following requirements:
 - US 497B Listed
 - Operating current: 0.15A
 - Peak surge current: 10kA
 - Frequency range: 0 to 20MHz
 - Insertion loss: <0.1 dB at 20 MHz

Low Voltage DC Inputs

- Each DC Input channel shall be protected by an external, surge protective device which shall be an Emerson (Edco) SRA64-030N or equivalent. The SPD shall meet or exceed the following requirements:
 - It shall be a five terminal device. Two terminals shall be connected to the line side of the low voltage pair, two terminals shall be connected to the Input File side, and the fifth terminal shall be connected to chassis ground.
 - It shall meet the following minimum requirements:

Peak Surge Current	2000 A 8x20 μs Wave-shape
Occurrences at Peak Current	100 typical
Response Time	5 to 30 nanoseconds
Shock	Withstands 10-foot drop on concrete
Voltage Clamp	30 V
Series Resistance	5 Ohms typical
Temperature	-40 Degrees to +85 °C

Pre-Emption, Interconnect & 115 VAC Signaling Inputs

Each pre-emption, interconnect, or AC signaling input channel shall be protected by an external surge protective device, which shall be an Emerson (Edco) PC642 Series or equivalent. The Emerson (Edco) PC642 shall use a PCB 1B base for quick changeability.

Items 4-22 are individual replacement parts or optional items. These items must meet the specifications of the equipment to be included in the cabinet or otherwise described. There is no guarantee on the quantity of these items.

Item 4	Conflict Monitor Model 2018 ECL-ip
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The Conflict Monitor shall be an EDI Model 2018 ECL-IP Conflict Monitor with absence of red monitoring. The Conflict Monitor Unit shall contain a 10/100 Ethernet port on the front panel for the uploading of alarms and/or event logs with a standard laptop computer. This port shall also allow for future communication within an Ethernet based infrastructure.

Item 5	Conflict Monitor Model 2010 ECL-ip
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This is an option for replacement parts only, not to be furnished with the 332A and 336S Cabinet Assemblies for this contract. The Conflict Monitor shall be an EDI Model 2010 ECL-IP Conflict Monitor with absence of red monitoring. The Conflict Monitor Unit shall contain a 10/100 Ethernet port on the

front panel for the uploading of alarms and/or event logs with a standard laptop computer. This port shall also allow for future communication within an Ethernet based infrastructure.

Item 6 Red Enable Board

This is an option for replacement parts only, not to be furnished with the 332A and 336S Cabinet Assemblies for this contract. Red enable board shall implement individual, 2-position Rocker style DIP switches allowing any unused red channel to be tied to AC+. The Red Enable board shall be easily removable and replaceable from the outside of the Output File Assembly. Removal and replacement shall not require the Output File Assembly to be opened. The design shall be such that the board can be easily un-plugged and replaced. During normal operation the board shall be secured to the Output File Assembly.

Item 7 Load Switch Model 200

The Load Switch shall be a PDC MODEL SSS-87PI/O LOAD SWITCH, meeting or exceeding the CALTRANS Specifications.

Item 8 DC Isolator EDI Model 242

The D. C. Isolator unit shall be a EDI MODEL 242 or equivalent as specified in the CALTRANS Specifications.

Item 9 Flash Transfer Relay Model 430

The Flash Transfer Relay unit shall be a MODEL 430 as specified in the CALTRANS Specifications.

Item 10 Loop Detector Rack Mount, LCD Enhanced/Intelligent

The Loop Detector Amplifier Unit shall be an EDI Oracle or Reno A&E Model C Rack Mount Detector Amplifier or equivalent. The Detector shall perform properly when installed in new or existing Cabinet Assemblies in South Carolina.

Item 11 Loop Detector Amplifier Model 222

This is an option for replacement parts only, not to be furnished with the 332A and 336S Cabinet Assemblies for this contract. The Loop Detector Amplifier Unit shall be an EDI MODEL 222, or equivalent, as specified in the CALTRANS Specifications. The detector shall be two (2) channels and shall perform properly when installed in new or existing Cabinet Assemblies in South Carolina.

Item 12 Surge Protection for Twisted-Pair Communications

Surge protection for twisted-pair communication shall be included at SCDOT request when ordering. This device is not standard for all cabinets. The surge protection device shall be an Emerson (Edco) PC642C Series, or equivalent. This shall utilize the PCB1B base.

Item 13 Flasher Load Switch Model 204

The flasher module shall be a PDC MODEL SSF-87P FLASHER, meeting or exceeding the CALTRANS.

Item 14 Cabinet Power Supply Model 206L

The Cabinet Power Supply shall be the EDI Model 206L Power Supply or equivalent. The Power Supply Unit shall incorporate switching design technologies as well as Power Factor Correction.

Item 15 Power Strip

The Power Strip shall be a Fellowes 99111 or equivalent.

Item 16 #2 Lock and Key Set

The #2 Lock and Key Set shall meet the specifications of this contract.

Item 17 Aluminum Extender Base for Cabinet

This item shall be ordered as SCDOT option. For cabinets, an 8” to 12”, aluminum extender base shall be available, manufactured in the shape and dimensions that match the shape, dimensions and bolt-pattern of a Cabinet Assembly. The appropriate stainless steel hardware (nuts, bolts and washers) shall be included with each extender base to sufficiently mount the base to the Cabinet Assembly.

Item 18 Low Voltage Protection

- Each low voltage communication input shall be protected as it enters the cabinet with a surge protection unit which shall be an Emerson (Edco) PC-642C-30-X, or equivalent, that meets or exceeds the following requirements:
 - It shall be a dual pair (four wire) module with a printed circuit board connector, double-sided and gold-plated for reliability.
 - It shall mate and be installed in a ten (10) circuit Buchanan connector PN PCB1B-10A or equivalent.
 - It shall be utilized as two independent signal pairs. The data circuits shall pass through the protection in a serial fashion. It shall be a hybrid two-stage unit.
 - It shall meet the following minimum requirements:

Peak Surge Current	10 KA(8x20 μs, wave shape)
Occurrences at 2000 A	>100
Response Time	<1nanosecond
Voltage Clamp	30
Series Resistance	➤ 15 Ohms per line
Temperature	-40 degrees to +85 degrees C
Primary Protector	Three element gas tube 10KA, 8x20 μs per side
Secondary Protector	Rugged solid state clamps, 1.5 KW minimum

- The line side shall be connected to the Communication field wires.
- The load side shall be connected to the C2 connector of the 170 Controller or the 2070-6B Communication Module of the 2070 Controller.
- The ground terminal shall be connected to chassis ground.

Item 19 2070-7A Card

This is an optional item.

Item 20 Conflict Monitor Tester

The Conflict Monitor Tester shall be the ATSI Model 8000. This shall be a stand-alone portable "Tester", intended for use on a workbench.

Item 21 Suitcase Tester for 2070 controllers

This is an optional item.

Item 22 Cabinet Assembly Display Unit

The unit required for this contract will be used by signal shop technicians during the set up and integration of 336S and 332A Cabinet Assemblies. Via permanent screening, the unit will display a

mock-up of a quad intersection with left turns, to include flashing yellow arrow indications for the left turn phases, and shall implement appropriately arranged and colored AC-driven indications of all channels for eight (8) vehicle phases and four (4) pedestrian phases. The unit shall also have additional indications for six (6) auxiliary vehicle overlaps and four (4) pedestrian yellow channels. The display unit shall include a harness that is a minimum of 10' in length, Termination wires shall be red, yellow, and green color-coded and phase marked for all indications, as well as one (1) white, AC Neutral and one (1) green, Chassis Ground termination. All wires shall have #10 stud spade lugs installed and shall be labeled by phase and color.

The display unit shall provide proper load to accurately simulate on-street, AC signal terminations for testing purposes within a signal shop environment. This unit shall be designed so that it can be placed on top of the Cabinet Assembly, or hung on the inside of the front door of any Cabinet Assembly supplied for this contract.

Item 23	Evaluation of Equipment for Repair outside Warranty Period (Unit is EACH)
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SCDOT shall submit equipment to the vendor for evaluation to determine cost to repair. Cost for repair shall be provided to the requestor within seven (7) days of submission.

Item 24	Repair Equipment outside Warranty Period (Unit is HOURS)
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SCDOT shall have the option to have equipment repaired based on cost determined through evaluation. Repair shall be completed within thirty (30) days of submission.

Item 25	SCDOT Signal Cabinet Training (Unit is EACH)
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SCDOT requires the option of a four (4)-day, formal, "hands-on" classroom-training for traffic signal cabinet assemblies.

The training shall provide a personal "take-home" package of training materials/documentation for each student, as well as a pdf of training materials for SCDOT Headquarters Signals group. Training shall be provided for up to fifteen (15) participants.

The Vendor representing the procurement of Items 1 and 2, Complete Cabinet Assemblies, shall provide training in the design, operation, and maintenance of cabinets and associated equipment; and of cabinet set-up and configuration. The Vendor shall provide all necessary equipment for appropriate demonstration of training. The trainer shall be prepared to present a minimum of eighteen (18) hours of classroom and "hands-on" training.

The Vendor of other, individual items included in this contract shall be prepared to present six (6) hours of classroom and hands-on training for individual bid Items each year. This includes providing appropriate equipment for demonstration and contracting with other vendors as necessary. Details of this training shall be coordinated with SCDOT, and with other Vendors, including subject and materials required.

Sample Training Agenda to include: (Actual training agenda to be at the discretion of SCDOT.)

Day 1: A maximum of fifteen (15) people, would receive "engineering related training", including: Introduction, Equipment description, Operation, and engineer controlled cabinet setup.

Day 2, Day 3: A maximum of fifteen (15) persons would receive "hands-on" training on maintenance and repair of all user serviceable equipment. Maintenance training shall include field level troubleshooting. This training shall be for a minimum duration of two (2) days.

Day 4: The group of fifteen (15) as above shall receive Training on Individual cabinet Items. The subjects shall be coordinated between Vendors, to avoid duplication.

Training classes shall be prepared to start within two (2) months of the receipt of the first shipment of equipment by SCDOT (unless otherwise directed).

Item 26	Conflict Monitor Training (Unit is EACH)
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SCDOT requires the option of a one (1)-day training for conflict monitors and testing.

Vendor shall provide training to include Conflict Monitor Testing and programming, including special functions and flashing yellow arrow programming in accordance to SCDOT design guidelines. Vendor shall provide curriculum, three (3) bound copies and a pdf, to SCDOT prior to training. Training shall be provided for up to fifteen (15) participants.

DELIVERY

Direction concerning delivery is for **Items 1-22** is listed below:

- Time
 - Vendor to be prepared to provide these items immediately after award. The maximum delivery time permitted will be SIXTY (60) DAYS from the date of the Purchase Order.
- Packaging
 - Equipment shall be appropriately boxed or crated for shipment, to prevent physical damage. The Vendor shall make shipments using the minimum number of containers consistent with the requirements of safe transit, available mode of transportation, and routing. The boxes or crates shall be sealed in 3 mil thick polyethylene plastic sheeting for outdoor storage. Complete Cabinet Assemblies shall be shipped as one unit. Items of equipment packed inside the Cabinet shall be protected and secured for shipment.
- Pallets
 - Cabinet(s) shall be bolted to shipping pallets.
- Labeling
 - Each cabinet/box shall be clearly labeled, IN PLAIN ENGLISH as to the contents; for example: "Type 332A Cabinet". All packages shall be identified with the **Local Vendor Name, Manufacturer Name, SCDOT Purchase Order Number and Shipment Date**. Packing lists and EQUIPMENT LABELS shall be glued to every carton showing its contents. A "Certificate Of Compliance" shall be attached to the packing list of each shipment.
- Schedule
 - The deliveries for **Items 1-22** shall be made to the Supply Depot (1418 Shop Road, Columbia, SC 29201-4844) in Columbia or to the District Signal Shops if requested by SCDOT. When purchased as part of a System the delivery shall be made to a District/location near the Site of work if it is deemed necessary.

SCDOT District 1 Signal Shop 803-737-6974 1408 Shop Rd Columbia, SC 29201-4844	SCDOT District 3 Signal Shop 803-241-1117 13 Saluda Dam Rd Greenville, SC 29611-3818	SCDOT District 5 Signal Shop 803-661-4812 3018 East Palmetto St Florence, SC 29506-	SCDOT District 7 Signal Shop 803-395-7188 1768 Charleston Highway Orangeburg, SC 29115-7722
SCDOT District 2 Signal Shop 864-889-8030 510 W. Alexander Avenue Greenwood, SC 29646-4029	SCDOT District 4 Signal Shop 803-581-8551 1143 SCDOT Rd Chester, SC 29706-6393	SCDOT District 6 Signal Shop 843-740-1668 6355 Fain Blvd N. Charleston, SC 29406-4907	

- Special Orders
 - The Vendor shall follow the shipping instructions as stated on the Purchase Order or attachments.

WARRANTIES, REPAIRS AND SERVICE

- Service - The vendor/manufacturer shall provide services adequate for the operation, repair, and replacement for each item. Adequate service will apply to reasonable response provided by technical personnel experienced with each item.
- Repair Parts – The Vendor shall be able to ship to the Department within three (3) business days, any component parts required to maintain this equipment.
- Maintenance and Repair Services – Complete data on maintenance and repair services shall be available, for the convenience of the Department, in the post-warranty period as listed below.
- This maintenance data shall include location of the service facility, services offered, turn-around

- time, and estimated repair costs.
- Warranty Period
 - The Vendor shall fully guarantee all items, services, equipment and materials provided under this contract. If the equipment Vendor is other than the Manufacturer, then the Vendor shall be fully responsible for all warranties and requirements of this Specification. The duration of the warranty or guarantee shall be the standard of the industry, with a minimum period of twenty-four (24) months from the date of shipment to the SCDOT. The warranty shall cover all Manufacturer's defects, including parts, labor, and shipping costs. Any item found not in accordance with this Specification will be rejected, and returned to Vendor at the Vendor's expense for immediate replacement. A second occurrence of this infraction will be sufficient reason for total rejection of the contract for that item.
 - Repair
 - The vendor shall have an office and/or authorized factory representative within 150 miles of Columbia, SC and be able to perform on-site warranty repair or replacement of items purchased from this contract, within two (2) business days after receiving complaint. The authorized factory representative shall have a permanent office located within the state of South Carolina. This office shall have a permanent street address, Air Conditioning and Heat, a permanent indoor restroom, a listed voice number, and computer/internet access with a valid e-mail address. Warranty repairs are to be performed at no additional cost.
 - Extension
 - Following warranty repair or replacement, the warranty period (for that item or module), shall be extended for an additional period of one (1) year.
 - Required Equipment Submittals:
 - One each of the exact cabinets, FULLY OPERATIONAL WITH REQUIRED EQUIPMENT, WIRING, LABELING, ETC., the Vendor intends to supply, INCLUDING PACKAGING, (one 336S and one 332A) for inspection before the contract is awarded.

DOCUMENTATION – (This Section supersedes the CALTRANS Specification.)

- Cabinet Assemblies
 - The Vendor of COMPLETE CABINET ASSEMBLIES shall be responsible for providing with each and every Complete Assembly Cabinet, two (2) complete Cabinet Wiring Diagrams
- Other Equipment
 - Documentation is also required for each auxiliary piece of equipment in the Cabinet Assembly. The intent is to require documentation sufficient for operation and maintenance of each item to the satisfaction of SCDOT. All documentation shall be prepared in a clear, concise manner; with appropriate illustrations, tables, and cut-away drawings, and voltage/waveform reference pictures.
- Binding
 - The documentation shall be adequately BOUND, for protection and to prevent loss of pages. Binding should consist of two heavy-duty staples, with binding tape; or plastic spiral binding. Fonts and sizes shall be per CALTRANS Specifications.
- Contents
 - The vendor shall provide ten (10) sets of documentation material as described below at the request of SCDOT.
 - The documentation material shall include, but not be limited to, the following:
 - General description.
 - Installation procedure.
 - Operating procedure.
 - Theory of operation, voltages, wave forms.
 - Maintenance and troubleshooting procedures.

- Schematic diagrams of circuits and IC boards.
- Pictorial layout of IC board components.
- Parts list including description, reference symbol, part number and location.

M688.9 SOLAR POWERED FLASHER ASSEMBLY

1.1 Description

This specification describes requirements for furnishing a Solar Powered Flasher Assembly.

1.2 Materials

1.2.1 24/7 Single Solar 24 Hour Flashing Beacon

1.2.1.1 Overview

This specification is for the Single Beacon Solar 24 Hour Flashing Beacon. Each unit shall consist of a solar engine, LED signal module and signal housing, and mounting hardware. The system shall conform to all provisions of the MUTCD, Chapter 4K, and Flashing Beacons.

1.2.1.2 Mechanical Specifications

The solar engine shall be vented to provide cooling of the battery and electronic system. Venting shall be covered by wire mesh to prevent intrusion of insects. The unit shall have the provision to mount a external device for remote activation. System must have capability to power such device.

1.2.1.3 Solar / Battery System

The solar engine shall have a field replaceable sealed lead acid battery or batteries. Solar panel and battery system shall be 12 Volt DC.

The solar panel or panels shall meet the design qualification and type approval of photovoltaic modules in accordance with IEC 61215. This specification includes radiation testing, thermal testing, and mechanical testing for environmental conditions such as UV-exposure, thermal cycling, as well as degradation of maximum power output.

Battery shall be mechanically secured into the housing. System shall have an auxiliary 12 VDC power output to power third party devices such as wireless radios or sensing equipment.

1.2.1.4 Signal Housing

The signal housing shall meet the equipment standard of the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2.

1.2.1.5 LED Signal Module

The LED signal module shall conform to the mandatory specifications of: Light Emitting Diode (LED) Circular Signal Supplement as required by the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1.

1.2.1.6 Operational Specifications

The system shall conform to all standards for flashing beacons as required in the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1 or current version.

- The beacon shall flash at a rate set by MUTCD.
- The beacon shall have a minimum operating autonomy of 30 days.
- The beacon shall automatically reduce light output in case of low battery situations, reducing risk that the beacons will fail entirely under conditions of poor solar insolation.

1.2.1.7 Activation

The beacon shall operate continuously when the battery is connected. The beacon shall have the option to be turned on by a third party switch or third party device with a compatible contact closure output.

1.2.2 24/7 Single Compact Solar 24 Hour Flashing Beacon

1.2.2.1 Overview

This specification is for the Single Beacon Compact Solar 24 Hour Flashing Beacon.

Each unit shall consist of a self-contained solar engine, LED signal module and signal housing, and mounting hardware such that the entire assembly mounts to the top of the pole. The solar engine shall contain all electronics, batteries & solar panels. No additional cabinet is required. The system shall conform to all provisions of the MUTCD, Chapter 4K, and Flashing Beacons. See Diagrams 1a and 1b.

**Diagram 1a.
Single Beacon
Compact – Pole
Mount
(Square/Round)**



**Diagram 1b.
Single Beacon
Compact – Top of
Pole Mount
(4 1/2” Round)**



1.2.2.2 Mechanical Specifications

The Solar panel shall be mounted to the solar engine. All batteries and electronics shall be mounted in the solar engine, with no external control cabinet or battery cabinet required. The solar engine shall be vented to provide cooling of the battery and electronic system. Venting shall be covered by wire mesh to prevent intrusion of insects.

The solar engine shall have the provision to mount an external device for remote activation. System must have capability to power such device. Solar engine must contain sufficient space to house third party device inside a sealed enclosure located inside the solar engine.

The entire system must be delivered as a complete unit ready to install and requiring no assembly.

1.2.2.3 Solar / Battery System

The solar engine shall include a minimum 10-watt solar panel. The solar engine shall house a field replaceable sealed lead acid battery or batteries. Solar panel and battery system shall be 12 Volt DC.

The solar panel shall meet the design qualification and type approval of photovoltaic modules in accordance with IEC 61215. This specification includes radiation testing, thermal testing, and mechanical testing for environmental conditions such as UV-exposure, thermal cycling, as well as degradation of maximum power output.

The solar panel shall consist of a solar panel or panels, mounted to the solar engine.

Battery or batteries shall be mechanically secured into the housing. Battery bracket shall enclose the battery in a manner to restrict the thermal expansion of the battery.

System shall have an auxiliary 12 VDC power output to power third party devices such as wireless radios or sensing equipment.

1.2.2.4 Signal Housing

The signal housing shall meet the equipment standard of the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2.

The signal head shall be mounted below the solar engine.

1.2.2.5 LED Signal Module

The LED signal module shall conform to the mandatory specifications of: Light Emitting Diode (LED) Circular Signal Supplement as required by the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1.

1.2.2.6 Operational Specifications

The system shall conform to all standards for flashing beacons as required in the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1 or current version.

- The beacon shall be flash at a rate of set by MUTCD.
- The beacon shall have a night dimming feature.
- The beacon shall have a minimum operating autonomy of 30 days.
- The beacon shall automatically reduce light output in case of low battery situations, reducing risk that the beacons will fail entirely under conditions of poor solar insolation.

1.2.2.7 Activation

The beacon shall operate continuously when the battery is connected. The beacon shall have the option to be turned on by a third party switch or third party device with a compatible contact closure output.

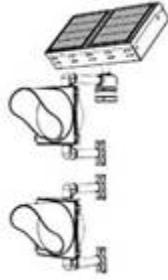
1.2.3 *Dual 24 Hour Solar Powered Flashing Beacon*

1.2.3.1 Overview

This specification is for the solar powered 24 hour flashing beacon. Each unit shall consist of a self-contained solar engine, two LED signal modules and signal housings, and mounting hardware to fit the

installation. The solar engine shall connect to two 12" yellow or red LED lens. The solar engine, mounting hardware, and signal heads shall be available in black, yellow, and green. See Diagrams 2.

**Diagram 2.
Dual Beacon
Compact – Top of
Pole Mount
(4 1/2" Round)**



1.2.3.2 Mechanical Specifications

The weight of the solar engine shall not exceed 52 pounds. The solar engine must be able to rotate 360 degrees and tilt for maximum solar energy collection. Batteries shall be field replaceable.

1.2.3.3 Signal Housing

The signal housings shall be constructed of polycarbonate material, and must be adjustable independent from the bracket for lens alignment. The signal housings shall meet the equipment standard of the Institute of Transportation Engineers Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2. The lenses shall be ITE compliant 12" yellow LED lenses.

1.2.3.4 Standards

The system shall conform to all standards for flashing beacons as required in the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1 or current version. These include complying with the VTCSH specifications.

- The flash rate shall be MUTCD compliant.
- The beacons shall have a night dimming feature.
- The beacons shall have a minimum operating autonomy of 30 days
- The beacons shall automatically reduce light output in case of low battery situations, reducing risk that the beacons will fail entirely under conditions of poor solar insolation.

1.2.4 *Dual Solar Powered School Flashing Beacon*

1.2.4.1 Overview

This specification is for the solar powered school flashing beacon. Each unit shall consist of a solar engine, two LED signal modules and signal housings, and mounting hardware with timing device. The system shall conform to all provisions of the MUTCD, Chapter 4K, and Flashing Beacons.

1.2.4.2 Mechanical Specifications

The solar engine shall be vented to provide cooling of the battery and electronic system. Venting shall be covered by wire mesh to prevent intrusion of insects. The solar engine shall have the provision to

mount an external device for remote activation. System must have capability to power such device. Unit must provide a cabinet or contain sufficient space to house third party device inside a sealed enclosure.

1.2.4.3 Solar / Battery System

The solar engine shall have a field replaceable sealed lead acid battery or batteries. Solar panel or panels and battery system shall be 12 Volt DC.

The solar panel or panels shall meet the design qualification and type approval of photovoltaic modules in accordance with IEC 61215. This specification includes radiation testing, thermal testing, and mechanical testing for environmental conditions such as UV-exposure, thermal cycling, as well as degradation of maximum power output.

Battery or Batteries shall be mechanically secured into the housing.

System shall have an auxiliary 12 VDC power output to power third party devices such as wireless radios or sensing equipment.

1.2.4.4 Signal Housing

The signal housings shall meet the equipment standard of the Institute of Transportation Engineers Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2.

1.2.4.5 LED Signal Module

The LED signal module shall conform to the mandatory specifications of: Light Emitting Diode (LED) Circular Signal Supplement as required by the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1.

1.2.4.6 Standards

The system shall conform to all standards for flashing beacons as required in the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1 or current version.

- The flash rate shall be MUTCD compliant.
- The beacons shall have a minimum operating autonomy of 30 days
- The beacons shall automatically reduce light output in case of low battery situations, reducing risk that the beacons will fail entirely under conditions of poor solar insolation.

1.2.4.7 Activation

The beacon shall operate continuously when the battery is connected. The beacon shall have the option to be turned on by a third party switch or third party device with a compatible contact closure output. A timer shall be included in this as an option.

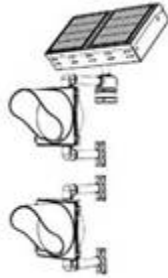
1.2.5 *Dual Compact Solar School Zone Flasher*

1.2.5.1 Overview

This specification is for the Dual Compact Solar School Zone Flasher.

Each unit shall consist of a self-contained solar engine, two LED signal modules and signal housings, and mounting hardware such that the entire assembly with the exception of the bottom LED mounts to the top of the pole. The solar engine shall contain all electronics, batteries & solar panels. No additional cabinet is required. The system shall conform to all provisions of the MUTCD, Chapter 4K, and Flashing Beacons. See Diagram 3.

Diagram 3
Dual Beacon
Compact School
Zone Flasher



1.2.5.2 Mechanical Specifications

The Solar panel shall be mounted to the solar engine. All batteries and electronics shall be mounted in the solar engine, with no external control cabinet or battery cabinet required. The solar engine shall be vented to provide cooling of the battery or batteries and electronic system. Venting shall be covered by wire mesh to prevent intrusion of insects.

The solar engine shall have the provision to mount an external device for remote activation. System must have capability to power such device. Solar engine must contain sufficient space to house third party device inside a sealed enclosure located inside the solar engine.

The overall weight of the assembly, including mounting hardware, signal housing, LED module, and solar engine shall not exceed 55 lbs.

1.2.5.3 Solar / Battery System

The solar engine shall include a minimum 10-watt solar panel. The solar engine shall house a replaceable sealed lead acid battery or batteries. Solar panel and battery system shall be 12 Volt DC.

The solar panel shall meet the design qualification and type approval of photovoltaic modules in accordance with IEC 61215. This specification includes radiation testing, thermal testing, and mechanical testing for environmental conditions such as UV-exposure, thermal cycling, as well as degradation of maximum power output.

The solar panel shall consist of one single solar panel, mounted to the solar engine.

Battery shall be mechanically secured into the housing. Battery bracket shall enclose the battery in a manner to restrict the thermal expansion of the battery.

System shall have an auxiliary 12 VDC power output to power third party devices such as wireless radios or sensing equipment.

1.2.5.4 Signal Housing

The signal housing shall meet the equipment standard of the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2.

The signal head shall be easily removable from the assembly. The signal housing must be adjustable independent from the bracket for lens alignment.

1.2.5.5 LED Signal Module

The LED signal module shall conform to the mandatory specifications of: Light Emitting Diode (LED) Circular Signal Supplement as required by the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1.

1.2.5.6 Operational Specifications

The system shall conform to all standards for flashing beacons as required in the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1 or current version.

The beacon shall be flash at a rate set by MUTCD. The illuminated period of each flash shall not be less than one-half and not more than two-thirds of the total cycle.

- The beacon shall have a night dimming feature.
- The beacon shall have a minimum operating autonomy of 30 days.
- The beacon shall automatically reduce light output in case of low battery situations, reducing risk that the beacons will fail entirely under conditions of poor solar insolation.

1.2.6 Warranty

The Vendor shall furnish SCDOT with any warranties on equipment and materials that are provided by the Manufacturer or Vendor as normal trade practice.

1.3 Measurement

Furnishing a Solar Powered Flasher Assembly shall be measured by EACH and shall include all electrical connections and all required mounting and incidental hardware.

1.4 Payment

Furnishing a Solar Powered Flasher Assembly, accepted and measured as provided above, will be paid at the contract unit price bid for:

FURNISH SINGLE BEACON/COMPACT/MODEL R247C (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH SINGLE BEACON/STANDARD/MODEL R247 (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH DUAL BEACON COMPACT/MODEL R247 DUAL (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH DUAL BEACON STANDARD/MODEL R829 (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH DUAL BEACON COMPACT/MODEL R829C (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH DUAL BEACON COMPACT/MODEL R829C-D4 (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA

FURNISH DUAL BEACON COMPACT/MODEL R820C (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH DUAL BEACON STANDARD/MODEL R820 (INCLUDES ALL ASSOCIATED HARWARE FOR A COMPLETE AND OPERATIONAL ASSEMBLY)	EA
FURNISH TIME CLOCK/CONNECTOR/MODELAP22-503544	EA
FURNISH TIME CLOCK SO'WARE KIT/MODELAP22-KIT	EA
FURNISH 12" YELLOW LED/MODEL 47553	EA
FURNISH 12" RED LED/MODEL 48820	EA
FURNISH 1 SECTION SIGNAL HEAD/MODEL CAMSIG	EA
FURNISH SOLAR FLASHER SCHOOL ZONE SOFTWARE/CPK	EA
FURNISH EMERGENCY MANAGEMENT SYSTEM/MODEL 46319	EA
FURNISH 12V DC SEALED BATTERY/MODEL 37912	EA
FURNISH LED HARNESS 15'/MODEL 48901	EA
FURNISH LED HARNESS 36 ' ./MODEL 48902	EA
FURNISH LED HARNESS 75 ' ./MODEL 56928	EA
FURNISH FIXED WEDGE TOP PLATE/BASE ASSEMBLY/WEDGE	EA
FURNISH COMMUNICATION CABLE/SZ FLASHER/MODEL COMSCH	EA
FURNISH UPLOAD HOUSING KIT/MODEL 48941	EA
FURNISH HOUSING BOX FOR TIME SWITCH/MODEL 47256	EA
FURNISH MANUAL ON/OFF SWITCH HARNESS/MODEL47223	EA
FURNISH TOP PLATE WEDGE/MODEL 50571	EA
FURNISH 2" SQUARE POLE MOUNT(C BRACKET)/MODEL47362	EA
FURNISH SLIP FILLER, 1&2 WAY/MODEL SE-3302-P29	EA
FURNISH SIDE-OF-POLE ASSEMBLY/MODEL SP-5641-P29	EA
FURNISH SIDE POLE W/HUB PLATE/MODEL SP-5641-P29	EA
FURNISH 1-WAY TRI-STUD MOUNTING/MODEL SE-0567-P29	EA
FURNISH UPPER/LOWER ARM ASSEMBLY/MODEL SE-3148-P29	EA
FURNISH 1 WAY ASTRO-BRAC ASSEMBLY/MODEL AB-0125-96	EA
FURNISH SPAN WIRE HANGAR/MODEL SP-1004SC-P29	EA
FURNISH HORIZONTAL MOUNT SOLAR ENGINE SUPPORT ARM/MODEL 46560	EA
FURNISH PIPE ADAPTOR FOR WEDGE/MODEL 47504	EA
FURNISH 8' 4 1/2" ALUMINUM PED POLE/MODEL PB-5100-8	EA
FURNISH 10' 4 1/2" PED POLE/MODEL PB-5100-10	EA
FURNISH 12' 4 1/2" PED POLE/MODEL PB-5100-12	EA
FURNISH 15' 4 1/2" PED POLE/MODEL PB-5100-15	EA
FURNISH DOUBLE PUSH BUTTON STATION/MODEL SE-6042	EA
FURNISH ALUMINUM SQUARE PED BASE /MODEL PB-5335-1S	EA
FURNISH PED BASE COLLAR/MODEL PB-5325	EA
FURNISH 2" SQUARE POST MOUNT SINGLE W/SIGNAL/LED/2SQ	EA
FURNISH SOLAR ENG 10W/MODEL R247ENGINE ONLY 10	EA
FURNISH SOLAR ENG 20W/MODEL R247ENGINE ONLY 20	EA
FURNISH SOLAR ENG 10W/SCHOOL/R829ENGINE ONLY10	EA

FURNISH SQUARE WOOD POST MOUNT W/WEDGE/MODEL SWP	EA
FURNISH TOP POLE MOUNT W/WEDGE/MODEL 45RS	EA
FURNISH TOP POLE MOUNT W/WEDGE/MODEL 45RDV	EA
FURNISH TOP POLE MOUNT W/WEDGE DUAL HORIZONTAL/45RDH	EA
FURNISH SIDE POLE MOUNT W/WEDGE/MODELSPS	EA
FURNISH SIDE POLE MOUNT W/WEDGE/DUAL/MODEL SPD	EA
FURNISH MAST ARM MOUNT W/WEDGE/SINGLE/MODEL MAMS	EA
FURNISH MAST ARM MOUNT W/WEDGE/DUAL/MODEL MAMD	EA
FURNISH CPR/AP22 COMMUNICATION CENTRAL/MODEL 501638R	EA
FURNISH CPR2102 UPDATE/MODEL 500900	EA
FURNISH CPR2102 TIME CLOCK/MODEL 503602-D	EA
FURNISH CPR2102 VERIFY UNIT/MODEL 503600-D	EA
FURNISH MASTER RADIO UNIT/POWER SUPPLY/MODEL 503646	EA
FURNISH CPR INTERNAL RADIO/MODEL 503645	EA
FURNISH CPR EXTERNAL RADIO/MODEL 503645E	EA
FURNISH CPR SOLAR REPEATER STATION/MODEL 503649F	EA
FURNISH CPR AC REPEATER STATION/MODEL 503649FAC	EA
FURNISH CPR RADIO REPEATER W/PS/MODEL 503647	EA
FURNISH CPR PROGRAMMING KIT/MODEL 501662NB	EA
FURNISH 10db YAGI ANTENNA/MODEL 503525Y	EA
FURNISH 6db OMNI ANTENNA/MODEL 503525OMNI	EA
FURNISH 11db OMNI ANTENNA/MODEL 505472-11db	EA
FURNISH DISC ANTENNA/MODEL 503544	EA
FURNISH TABLE TOP ANTENNA/MODEL 503501M	EA
FURNISH 25 ' ANTENNA LEAD/CPR RADIO/505472L-25	EA
FURNISH 50 ' ANTENNA LEAD/CPR RADIO/505472L-50	EA
FURNISH 100' ANTENNA LEAD/CPR RADIO/505472L-100	EA
FURNISH 150' ANTENNA LEAD/CPR RADIO/505472L-150	EA
FURNISH CPR RADIO/TIME SWITCH CONVERTER/503648C	EA
FURNISH CPR 2101 TIME SWITCH/503645W	EA
FURNISH 3db WI-FI ANTENNA W/3' LEAD/504413WF	EA
FURNISH WI-FI to TIME SWITCH CONVERTER/503485	EA
FURNISH WI-FI TRANSCEIVER/MODEL 501680	EA
FURNISH ANTENNA BRACKET/MODEL 502356	EA
FURNISH CPR DISPLAY TERMINAL/MODEL 502620	EA
FURNISH CPR AUDIO VISUAL ALARM/MODEL 503626	EA

General Provisions For Traffic Signals

SCDOT Designation: SC-M -675 (01/18)

1.1 Turn Key Project

- Unless noted otherwise on the plans or in the Special Provisions this is a “turn-key” project, with the contractor furnishing and installing all equipment, complete and operational to the satisfaction of the Engineer. The Contractor shall install the traffic signal(s) to provide a complete modern and operational installation.
- The PLANS are schematic in nature, showing what is generally expected at each intersection. The Contractor must devise/refine the final details, working within the Specifications, the Standard Drawings, and with the Engineer.
- Deviations from the Plans must be approved by the Engineer.
- After the completion of the project, the Contractor shall furnish to the District Traffic Engineer, three (3) "red-lined" sets of "as-built" plans detailing deviations from the plans and showing the exact locations and sizes of all conduits, poles, pedestals, splice boxes, detectors, and the routing and destination of all wires leaving the control cabinets.

1.2 Temporary Items / Temporary Adjustments

If Plans or Engineer indicates temporary items or adjustments are necessary, the contractor shall perform as indicated below:

- Provide new equipment that is to be removed after the signal work is complete,
- Relocate existing signs or equipment, as necessary, to approved locations,
- Shift existing signs or equipment slightly for work zone setups.
- Any new equipment will be paid using the appropriate furnish and install pay item based on the quantity installed. The items installed become the property of SCDOT. If Engineer indicates temporary items are to be removed at the end of the contract, Contractor shall deliver these items to the appropriate signal shop. Remove and Salvage of temporary items shall be included in Remove and Salvage pay item in accordance with **688.1 Removal, Salvage and Disposal**.
- Relocated items will be paid using the appropriate install pay items based on the quantity installed.
- Shifting signal heads and/or signs along the existing span wire or mast arm shall be incidental to the work required for continuity of operations.
- Use fully reliable, fully functional temporary equipment of with no visible defects or damage..
- Install temporary signals in accordance with SCDOT specifications.
- Relocated or adjusted signal equipment are considered “temporary”, unless specified otherwise on the Plans. The Contractor shall plan and stage the work so that the result is a traffic signal installation conforming to the plans and using all NEW equipment.
- Signal heads shall be shifted side-to-side to be over traffic lanes as the traffic lanes are opened or closed to traffic.
- The location of temporary and final signal poles will be approved by the Engineer. The Contractor shall furnish the temporary and final wood poles as necessary for Continuity of Operation. Provide back guys for wood poles, sufficient to keep the pole vertical.
- Contractor may re-use minor equipment in temporary adjusted configurations, but not in the final configuration. This includes steel cable, electrical cable, conduit, pedestrian buttons and signs, and splice boxes not utilized in the new signalization. The Contractor shall furnish sufficient steel cable and electrical cable to provide Continuity of Operation.
- Contractor shall coordinate and cooperate with any utility owning joint use poles in order to maintain signal continuity.
- Transfer highway signs on existing steel cable (span wires) to the adjusted spans, and place in the same physical alignment. (Ground mounted signs are covered in Section 107.11 of the STANDARD SPECIFICATIONS.)
- The Contractor shall install temporary electric service(s) as necessary to operate the signal(s). Coordinate with the local power company.

1.3 Transfer of Operations (Continuity of Operations) from existing to temporary or from temporary to final)

- Provide Full Continuity of Operation; Transfer operation to the new or temporary controller, simultaneously turning off the old controller.
- The Maintenance of Traffic (as provided in the Traffic Control Plan), and the SAFETY OF TRAFFIC is of prime importance. Continuous Operation of traffic signals enhances safety. Contractor shall NOT arbitrarily turn off signals for convenience. Construct the adjusted, temporary or new signal and smoothly transfer operation to that signal. When allowed by the Engineer to briefly turn off a signal, provide complete intersection control using a flagger and/or Police traffic direction.
- Existing traffic signals shall REMAIN IN OPERATION until the new/modified installation has been satisfactorily tested, and placed in operation. Accomplish the testing without hazard to the traveling public and while the signal heads are suitably BAGGED WITH BURLAP or alternative approved by the Engineer.
- Cover all signal heads in place, but not in use, with BURLAP or alternative approved by the Engineer. Adjustments in the existing equipment made necessary by the new installation are incidental to the signal construction.
- Upon approval from the Engineer, switch the new signal heads into service during that controller phase being displayed by the existing equipment; turn off the existing equipment simultaneously. After the new signal equipment has been made operational, immediately turn off the existing signal heads, and remove.
- The Contractor shall completely coordinate work between sub-contractors, and shall carefully stage the project to minimize the impact to traffic.

1.4 Operations during Construction

- The Contractor shall be responsible for the operations of all existing and newly installed signals from the notice to proceed of the project until final acceptance of the project.
- There is no separate pay item for operations during construction; Operations is considered incidental to the construction process.
- Fixed time operation of signals is unacceptable. Maintain detection for the life of the project. Install and operate the temporary actuation devices; transfer operation to the temporary devices prior to demolition of the existing loop detector systems.
- If detection is damaged and cannot be immediately repaired or temporary lane configurations are required, Contractor shall provide temporary equipment to provide operational detection during the life of the construction project, using video detection or other approved detection method.
- It is not permissible to adopt "uncoordinated" operation of adjacent signals; if damage to the existing interconnection cable has been broken, Contractor shall repair it immediately. If the installation of a new signal within or adjacent to an existing signal system occurs, provide interconnection to the new signal as soon as it is operational. Ensure appropriate communications is available to communicate with the signal system.
- The Engineer will provide temporary controller time settings for changing traffic conditions during construction. These temporary time settings may occur throughout the project life; Contractor shall implement these timings as directed by the Engineer; this work is incidental to the contract.
- Plan the work to cause minimum interference with any existing signal operation.
- The Contractor shall not change the phasing or other operation of a signalized intersection without the approval of the Engineer.
- Ensure the signal controller has the correct settings on the time clocks to local legal time, where needed.

1.5 Maintenance / Repairs

- The Contractor shall be responsible for the daily maintenance and repairs and emergency repairs for all existing, temporary and any newly installed signals in the project from the notice to proceed until final acceptance of the project. The Contractor is responsible and liable for proper and safe operation of each signal. The Contractor shall perform EMERGENCY REPAIRS AND SERVICES as required, to ensure continuity of operation of listed traffic signals and associated equipment. This shall include replacement of malfunctioning LED modules.
- Contractor and Engineer shall perform a walk thru of all signals to determine if any repairs are needed prior to the contractor assuming maintenance responsibility. After the contractor assumes maintenance responsibility, the contractor also assumes financial responsibility for repairs until final acceptance.
- The Contractor shall retain ownership of the materials and equipment provided in the project until Final Acceptance (see Final Inspection & Final Acceptance) has been made by the Engineer, when it then becomes SCDOT property.
- There is no separate pay item for maintenance during construction; maintenance is simply part of the construction process and is considered incidental to the work.
- The Contractor shall provide at least one (1) qualified LOCAL signal technician, subject to on-call at all times, to provide emergency services as required to assure continuous and efficient operation of signal installations and systems. This shall include non-business hours, weekends, and holidays. The Technician shall be fully qualified to trouble-shoot, service, repair and/or replace traffic controllers and components, both electro-

mechanical and solid-state. At the PRE-CONSTRUCTION CONFERENCE, the Contractor shall furnish the RCE with a LIST OF THE SIGNAL TECHNICIANS who will be responsible for performing the emergency service, and the LOCAL PHONE NUMBER(S) of the Contractor's agent(s) (answering service, etc.), who will receive emergency calls during and after the Contractor's normal business hours.

- The Contractor shall be ON-SITE of the malfunctioning signal for emergency service within the maximum time listed in the following schedule-

<u>Weekdays or Saturday</u>	<u>Maximum Time</u>
1. 6 AM to 6 PM	1 hour
2. 6 PM to 6 AM	4 hours

<u>Sundays or Holidays</u>	
1. Day or Night	4 hours

- Once the Contractor has started repair work/emergency service the Contractor shall restore a malfunctioning signal to normal phase operations uninterrupted.
- The Contractor shall maintain a LOG of all trouble calls received, the response time, and the corrective action taken. The records and logs shall be available to Department personnel for review during normal working hours. All records and logs shall be turned over to the Department at FINAL ACCEPTANCE.
- In the event the Contractor fails to perform in accordance with requirements and schedules of this Specification, the Department reserves the right, without notice to the Contractor, to engage a Third Party to perform the maintenance and emergency service necessary to assure continuous traffic signal operation. Further, all expenses incurred by the Department in implementing this option, shall be deducted from the payment due the Contractor. In addition the Contractor shall pay liquidated damages to SCDOT in the amount of **ONE THOUSAND, FIVE HUNDRED (\$1500) DOLLARS FOR EACH OCCASION, FOR EACH DAY (UNTIL CORRECTED).**

1.6 Utility Coordination

- The Contractor, prior to the beginning of any construction activity, shall coordinate as necessary with the Utility Company to provide power and any necessary attachment agreements as well as ensuring all utilities are identified and avoided during construction.

1.7 Contract Schedule

- Unless noted otherwise in the *Special Provisions*, the **Contractor** shall furnish the Engineer with a **WEEKLY SCHEDULE** for the **TRAFFIC SIGNAL CONSTRUCTION** work, each Friday, for the week to come, listing the location and date of each intended activity. This will permit scheduling signal inspection personnel. Deviation from this schedule may cause the Department to delay Inspection and Payments.
- Any work performed without notification of the proper parties in the Department, will be treated as unauthorized work (see Section 105.11 of the Standard Specifications), and could result in nonpayment to the Contractor for that work.

1.8 Permits, Codes, Licenses, & Abilities

- Perform all work in a safe and workmanlike manner, to meet the highest industry standards, in accordance with the requirements of the latest editions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the Illuminating Engineering Society (IES), the American National Standards Institute (ANSI), the National Electrical Manufacturer's Association (NEMA), and the regulations and standards of the local power company.
- The prime contractor or subcontractor responsible for the performance of the work must be licensed by the SC Licensing Board For Contractors and possess a Journeyman Card issued by the South Carolina Municipal Association or as required by the city in which work occurs at the time work is performed.
- Further, at least one 'ON-SITE' field supervisor shall have LEVEL II or higher, Traffic Signal Certification by the International Municipal Signal Association (IMSA). Photo copies of the license and certificate (for both above) shall be submitted before work commences. The Contractor shall retain employee(s) holding the above certificate for the duration of the project; and the employee(s) shall be present DAILY and at the FINAL INSPECTION.
- The Contractor shall employ persons capable of programming traffic signal controllers of the type used by this project. The Contractor shall possess both a desktop and a portable (laptop) computer, and be capable of using them to upload and download signal operating parameters.

1.9 Integration

- Integration will be performed by SCDOT or local government signal maintenance staff; contractor shall coordinate with SCDOT to determine project schedule and time frame for integration. Contractor shall not expect SCDOT or local government signal maintenance staff to provide integration without 2 weeks' notice and mutually agreed upon schedule of completion, including time frame for cabinets/controllers/conflict monitors to be provided at the signal shop; if signal maintainers have any issues with equipment provided,

they will contact contractor to inform them to replace said equipment within reasonable time frame and to meet project schedules.

1.10 Equipment

- SCDOT Supplied Equipment - The Department will not furnish signal equipment, unless noted otherwise in the Special Provisions or on the Plans.
- Contractor Supplied Equipment - The Contractor shall furnish all **new** equipment (submittal of invoices required), including incidental items; used, refurbished equipment or any equipment with less than 80% of the warranty remaining at installation will not be accepted.
- Compatibility
 - a. If additional equipment is required during the life of this contract due to a Change Order or Extra Work, Contractor shall purchase equipment from the same manufacturer as the original item, to ensure compatibility.
 - b. When installing equipment such as signal heads or pedestrian equipment, where some existing equipment is being retained, the contractor shall provide the same type of equipment, as is remaining, for visual compatibility.
- The Contractor shall submit for approval a list of equipment including make, model number, manufacturer serial numbers, warranty information, purchase invoice, and purchase date. Documentation must be submitted for the furnish items required for this contract. At the time of such submission, the Contractor shall provide a copy of the Transmittal Letter, to SCDOT.
- The Contractor shall submit for approval, catalog descriptions and documentation--THREE (3) COPIES--for each class of signal equipment and materials furnished by the Contractor. They are to be submitted a minimum of TWO WEEKS PRIOR TO INSTALLATION to the RCEFOR APPROVAL. At the time of such submission, the Contractor shall provide a copy of the Transmittal Letter, to the RCE.
- Equipment substitutions in the life of the contract are only allowed if the contractor can show a valid hardship in remaining with the originally submitted equipment. A valid hardship may include non-availability of type of equipment due to unforeseen delivery or material shortages (contractor ordering equipment late does not apply), vendor going out of business. SCDOT may allow equipment substitutions if product is determined by SCDOT to be of better quality than originally submitted or if contractor is replacing non-QPL items with QPL or SCDOT Equipment Contract items, or if equipment is experimental in nature and SCDOT wants to test said equipment.
- SCDOT will not pay for furnish and/or installation costs of any materials installed without prior approval and acceptance.
Contractor shall provide letter from the manufacturer of the cabinet and from the manufacturer of the controller indicating the equipment provided is the SCDOT QPL qualified equipment; Contractor shall ensure all warranties, serial numbers, documentation, and receipts are provided with cabinet assembly and controller delivery.

1.11 Inspection

- Quality Acceptance and Inspection is the responsibility of SCDOT. SCDOT will designate those individuals responsible for inspection. For signals located within a local government with which SCDOT has a signal maintenance agreement, the inspection personnel may include local government personnel.
- The Contractor is advised that in any dispute between the Contractor and the Manufacturer, concerning the operation/maintainability/reparability of any piece of equipment, THE DECISION OF THE DEPARTMENT SHALL BE FINAL.
- SCDOT's designated inspector will provide a punch list of outstanding items to be addressed prior to Final Inspection.

1.12 Final Inspection & Final Acceptance

- The contractor shall not request a final inspection until the punch list items are complete.
- The Contractor shall request the Final Inspection a minimum of one week prior to the desired day of inspection. Confirmation to the Resident Construction Engineer shall be provided forty-eight (48) hours prior to Final Inspection, that the project is on schedule and ready for inspection.
- **Burn In** Upon completion of the Final Inspection and correction of any deficiencies, the work will be subject to a **sixty (60) day operational test (burn in), during which the contractor remains responsible for any maintenance or repairs of any deficiencies.** If during this period, a problem arises a **NEW sixty (60) day test** period shall begin. Prior to Final Acceptance, if the materials or equipment are damaged or are in disrepair, the Contractor shall be responsible for repair or replacement.
- **Final Acceptance:** Final Acceptance occurs after 60 days of trouble-free operation (Burn In). At Final Acceptance, contractor will officially transfer all equipment, including warranties to SCDOT. SCDOT will become responsible for signal operations and maintenance upon Final Acceptance of the entire project. .

1.13 Mobilization

- Section 103.10, 103.11 of the STANDARD SPECIFICATIONS is amended as indicated below:
- For traffic signal projects, payment for 1031000 (LS) Mobilization includes all the signals and signal related work in the contract.
- For traffic signal projects, payment for 1031010 (EA) Mobilization will be paid per traffic signal (Each) or per ¼ mile for fiber installation (Each).
- These prices shall include demobilization.

1031000	MOBILIZATION	LS
1031010	MOBILIZATION	EA

- For traffic signal projects, payment for Mobilization of Material pay item addresses payment for moving large items furnished by SCDOT, such as concrete poles, requiring special equipment such as boom trucks, to the project site from a location designated by SCDOT.

9610021	MOBILIZATION OF MATERIAL PER WORK ORDER, 1-100 MILES FROM LOCATION TO WORKSITE	EA
9610022	MOBILIZATION OF MATERIAL PER WORK ORDER, 101-250 MILES FROM LOCATION TO WORKSITE	EA
9610023	MOBILIZATION OF MATERIAL PER WORK ORDER, 250+ MILES FROM LOCATION TO WORKSITE	EA

1.14 Payment for Materials on Hand

Section 109.7 of the STANDARD SPECIFICATIONS is amended to include the following paragraphs.

When permitted by the Engineer, partial payment will be made for major traffic signal items that are being furnished by the Contractor. Certain items such as wooden poles, and other very heavy units not readily movable or vandalized, may be stored in un-secured locations either ON- or OFF-SITE. Other items such as signal heads, detector amplifiers, controllers, cabinets, and certain other major items may be stored in a secured/protected location either ON- or OFF-SITE. The equipment shall be labeled stating SCDOT, and the Project Name. Other requirements of Paragraph 109.8 remain applicable. Payment shall be in accordance with the following criteria: The Contractor may be paid at FIFTY (50%) PERCENT of the contract unit price of item, not to exceed the paid invoice amount.

1. Only items measured by 'EACH' shall be eligible.
2. Only items with a unit price exceeding \$1500 shall be eligible.

1.15 Maintenance of Traffic (Traffic Control)

- The Contractor shall execute the item of Traffic Control as required by the Standard Specifications, the plans, the Standard Drawings For Road Construction, these supplemental specifications, the MUTCD, and the Engineer.

Supplemental Technical Specification for

Electrical Conduit

SCDOT Designation: SC-M-675-1 (01/18)

1.1 Description

This work shall consist of furnishing and installing Electrical Conduit and fittings of the types and sizes specified herein, at locations shown on the Plans, or as established by the ENGINEER in accordance with these Specifications.

1.2 Materials

- Use rigid, heavy-wall, galvanized steel conduit, meeting the requirements of Federal Specification WW-C-581, and American Standards Association Specifications USAS C-80.1-1966.
- Use sunlight resistant PVC (Polyvinyl chloride) Conduit SCHEDULE 80, meeting the requirements of National Electrical Manufacturing Association (NEMA) Specification TC-2 and Underwriter Laboratory (UL) standards UL-514; and/or ASTM D-1784. Fittings shall meet NEMA TC-3 and UL-514.
- Use SCHEDULE 80 HDPE (High Density Polyethylene) Rolled Conduit.
- Use Flexible Weather-Tight Steel Conduit consisting of flexible single strip, helically wound, interlocking galvanized steel. Ensure the steel conduit is made liquid-tight using an extruded polyvinyl chloride jacket and that it meets the requirements of UL-360.
- Use fittings that are made of the same material and quality as the conduit run, including conduit bodies, 90° bends, weatherheads, elbows, nipples, couplings, and other hardware.
- Use Conduit Junction Boxes that are non-metallic PVC molded junction box with a weather tight screw-down cover, of nominal size 6"W x 6"L x 4"D.
- Use threaded Grounding Bushings made of malleable iron, galvanized steel, or brass; and shall have an insulating plastic insert, and lay-in lugs to hold No. 6 AWG copper wire.
- Use a Pulling Line made of Polypropylene Rope, having a minimum tensile strength of 240 pounds.
- Use Underground Warning Tape that is Heavy duty B-720 polyethylene, 0.89 mm (3.5 mils) thick, by 76 mm (3 in) wide, with APWA color RED, for electric lines.
- Use minimum 14 Ga. Tracer Wire

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Electrical Conduit.
- Install conduit as Riser, or Underground.
- Install Underground Conduit as Trenched, Bored and Jack or Directional Bored in accordance with the plans and Standard Drawings.
- Concrete used for patching pavement shall be DOT STANDARD SPECIFICATION CLASS X according to Sections 701,702,703, and 704.
- Bituminous Concrete for patching pavement shall be DOT STANDARD SPECIFICATIONS, Section 400 and 403.
- All materials will be subject to inspection for condition by the ENGINEER, just prior to incorporation into the work.
- Use standard bends, elbows, or by bending the steel conduit to make changes in direction of conduit. Steel conduit, if bent, shall have a uniform radius which will fit the location, with a minimum radius of six (6) times the internal diameter of the pipe. Sharp kinks in the conduit or the substitution of unlike materials will not be permitted.
- Use standard manufactured conduit bodies, condulets, weatherheads, elbows, nipples, tees, reducers, bends, couplings, unions, etc., of the same materials and treatment as the straight conduit, as required throughout the conduit line. Tightly connect all fittings to the conduit. Use a SOLVENT-WELD CEMENT suitable for bonding for fitting connections with PVC conduit. Where steel conduit mates PVC, use an adapter coupling and waterproof seal.

1.3.2 *Riser*

- Use nipples to eliminate cutting and threading where short lengths of conduit are required. Where it is necessary to cut and thread steel conduit, no exposed threads will be permitted. All conduit fittings shall be free from burrs and rough places; and all cut conduits shall be reamed before fittings and cables are installed. All conduit runs ending in a junction box, hand box, or other approved junction point, shall be provided with a bushing to protect the cable from abrasion. Cap future use conduit.
- Attach conduit risers to wood poles; or where specified, to the outside of steel poles. Use stainless steel bands for steel poles. Use conduit clamps/straps and galvanized screws on wood poles. Attachment shall be in accordance with the plans or Standard Drawings. Furnish each Riser with a weatherhead, which shall not be measured.

1.3.3 *Trenched*

- Unless shown otherwise, place conduits at a minimum depth of 18 inches below surface grade, and slope at a minimum rate of 6 inches per 100 feet of length, to a splice box/junction box hole or drain. Clean and swab all conduit runs before installing cables. Use DUCT-SEAL in poles, cabinets, and buildings to seal the opening.
- Where conduit passes under a curb, cut an 'X' in the curb, over the conduit. Where there is no curb, drive a stake in the ground at the end of the conduit to mark its location. Cut an 'X' to indicate the side the conduit enters, where conduit is placed in a signal pole foundation for future use.
- Restore all cuts, trenches, and openings to the original condition. Replace grass surfaces with pre-grown, cut turf (sod), in existing lawns. Rake, seed and fertilize other dirt areas. Replace any damaged trees and shrubs.

1.3.2.1 Trenching (Non-Paved Surface)

- Excavate the trenches to such depth as necessary to provide 18 inches minimum cover over the conduit. Cinders, broken concrete, or other hard abrasive materials will not be permitted in the back-filling. Clear the trench of such materials before placing the conduit. No conduit shall be placed prior to inspection by the ENGINEER. Compact the back-fill and restore the surface.

1.3.2.2 Trenching (In Paved Surface)

- Cleanly saw cut trenches across driveways or streets about 6 inches wide. Place the conduit and compact the back-fill. Provide and install the patch of like material and thickness as was removed. NO additional payment shall be made for the bituminous or concrete patching material, unless a pay item has been established for such.

1.3.2.3 Bored and Jack (Pushing)

- If pay item is provided, place steel conduit under existing roadways, driveways, sidewalks or other paved surfaces by Bore and Jack method. Such conduit shall be placed by jacking, boring, pushing, or other means approved by the ENGINEER, without cutting or removing pavement. For connecting HDPE conduit to PVC conduit at termination points, use one of the following, or equal coupling as approved by the ENGINEER:
 - Shur-Lok Couplings: 2" Model SL602C200, 3" Model SL602C300
 - ComFit PushLock Couplings: 2" Model 1-908353

1.3.2.4 Trenchless (Directional Bored)

- If pay item is provided, place Schedule 80 PVC or Schedule 80 HDPE conduit under existing roadways, driveways, sidewalks or other paved surfaces by directional bore method. Conduit shall be buried at a minimum of 36 inches. Payment will not be made for damaged or crumpled conduit. An acceptable alternative material can be **SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)**.

1.3.2.5 Placed Before Pouring

- Install PVC conduit w/ Flexible Weather Tight conduit firmly attached to the bottom reinforcement bar mat or to the bottom wire mat, using plastic tie-wraps every 2 feet, at locations where conduit is placed before concrete placement in a bridge deck. At expansion joints, use 4 feet (typical) of Flexible Weather Tight steel conduit to accommodate movement. Install to NEC standards for concrete structural installations and usage, including any recommended lubricants and sleeves. Plug all conduit ends to prevent concrete penetration. When used on a bridge, provide a splice-box(es) near the center line, and terminate the conduit in hand-boxes at each end.

1.3.2.6 Open Cuts in Roadway

- Open cuts are typically not allowed, and every effort to bore under roadways and driveways shall be attempted. If utility conflicts require open cuts for installation of conduit, and where approved by the Engineer, conduit may be placed in an open cut and open cuts shall be repaired in accordance with the SCDOT Utility Accommodations Policy.

1.4 Measurement

- Electrical Conduit will be measured by LINEAR FEET, for the type, size, and method of installation specified, along the center line of the conduit from end to end, including trenched, risers, and bored-and-jacked.
- Conduit bends, conduit bodies, (condulets), 90° bends, elbows, conduit junction boxes for detector loops, miscellaneous fittings, couplings, weatherheads, adapters, bushings, locknuts, and other items shall be incidental to conduit installation and shall NOT be measured.
- Unless otherwise specified, trenching, back-filling, and patching will NOT be measured for payment.
- If more than one conduit is installed within a directional bore, payment will be made for the directional bore from box to box. The additional runs of conduit will be paid per LF of additional conduit (pay item 675027Z) from box to box.
- F&I Encased Conduit work includes all equipment, manpower and materials to furnish and install conduit in an open cut paved area within a travel way; this work is paid by linear feet (LF):

1.5 Payment

For conduit either Trenched or Riser:

6750005	FURNISH & INSTALL 1.0" GALVANIZED RIGID CONDUIT	LF
6750015	FURNISH & INSTALL 2.0" GALVANIZED RIGID CONDUIT	LF
6750025	FURNISH & INSTALL 3.0" GALVANIZED RIGID CONDUIT	LF
6750181	FURNISH & INSTALL 1.0" ALUMINUM CONDUIT	LF
6750275	FURNISH & INSTALL 1.0" SCHEDULE 80 PVC CONDUIT	LF
6750278	FURNISH & INSTALL 2.0" SCHEDULE 80 PVC CONDUIT	LF
675027C	FURNISH & INSTALL 3.0" SCHEDULE 80 PVC CONDUIT	LF

For bored and jacked:

6750078	FURNISH & INSTALL 1.0" GALVANIZED RIGID CONDUIT (BORED AND JACKED)	LF
6750085	FURNISH & INSTALL 2.0" GALVANIZED RIGID CONDUIT (BORED AND JACKED)	LF
6750090	FURNISH & INSTALL 3.0" GALVANIZED RIGID CONDUIT (BORED AND JACKED)	LF

For high accuracy directional boring:

675027S	FURNISH & INSTALL 2.0" SCHEDULE 80 PVC CONDUIT (DIRECTIONAL BORED)	LF
675027V	FURNISH & INSTALL 3.0" SCHEDULE 80 PVC CONDUIT(DIRECTIONAL BORED)	LF
675027Y	FURNISH & INSTALL 4.0" SCHEDULE 80 PVC CONDUIT(DIRECTIONAL BORED)	LF
675027Z	FURNISH ADDITIONAL CONDUIT WITHIN DIRECTIONAL BORE	LF
6760050	FURNISH & INSTALL 1" SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)	LF
6760060	FURNISH & INSTALL 2" SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)	LF
6760070	FURNISH & INSTALL 3" SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)	LF
6760080	FURNISH & INSTALL 4" SCHEDULE 80 HDPE CONDUIT (TRENCHLESS)	LF

For flexibility:

6750175	FURNISH & INSTALL 1.0" FLEXIBLE GALVANIZED STEEL CONDUIT - WEATHER TIGHT	LF
6750179	FURNISH & INSTALL 2.0" FLEXIBLE GALVANIZED STEEL CONDUIT - WEATHER TIGHT	LF
675017D	FURNISH & INSTALL 3.0" FLEXIBLE GALVANIZED STEEL CONDUIT - WEATHER TIGHT	LF

Open Cut:

6750262	FURNISH & INSTALL ENCASED CONDUIT (2-2" PVC, SCHEDULE 40)	LF
6750263	FURNISH & INSTALL ENCASED CONDUIT (3-2" PVC, SCHEDULE 40)	LF

Supplemental Technical Specification for

Electrical Cable

SCDOT Designation: SC-M-677-1 (01/18)

1.1 Description

This work shall consist of furnishing and installing traffic signal, loop lead-in, pedestrian signal, and pedestrian push button Electrical Cable of the size and type shown on the Plans or detailed in the Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Electrical Cable.

1.3.2 Field Wiring

- Install SPLICE-FREE cable runs. Make all connections at terminal blocks, or in the controller cabinet.
- Install all field wiring in accordance with applicable Electrical Codes--National, State, and Local. Where required, arranging for PERMITS and/or electrical INSPECTION is the responsibility of the Contractor.
- Provide at least 3 feet of cable slack at each splice box, strain pole base, and cabinet. Neatly coil and bind the slack with a nylon tie.
- At the cabinet end, label each cable, using nylon cable markers, and indelible pen, indicating the Phase and/or Approach (NB, EB, etc.).
- Cabinet connections shall correspond to the COLOR-CODE shown on the Standard Drawing 675-110-00 TYPICAL WIRE & CABLE USAGE sheet; (green wire to green signal circuit, etc.).
- Replace the entire length of cables damaged during installation, without further cost to the Department.
- All electrical cable installed in conduit shall be drawn in place, free from electrical and mechanical injury. When a lubricating agent is needed, use a wire pulling compound compatible with the cable insulation.
- Install in conduit any vertical cable runs mounted on the outside of poles as shown on the plans or in the Standard Drawings.
- Use weather service heads wherever electrical cable directly enters a strain pole or a vertical conduit run.
- Provide drip loops of at least 8 inches at all overhead entrance points such as signal heads, strain poles, or weather heads.
- If any splices in homerun cables are detected, all work will cease by the contractor in that district until new wire is pulled to replace the spliced joint.

1.3.3 Traffic Signal Wiring

- Install each cable run with the number of conductors indicated in the Standard Drawing 675-110-00 Typical Wire and Cable Usage. These include the provision of spare conductors. The substitution of additional cables to attain the required number of conductors shall not be permitted.
- Run a separate cable for each phase or approach in accordance with Standard Drawing 675-110-00 Typical Wire and Cable Usage.
- The list below is a guide to general usage--

Signal: Jumpers	4 pair (8 conductor) BLACK
Signal: To Each Approach	4 pair (8 conductor) BLACK

Loop lead-in Wiring

- Install each cable run with the number of conductors indicated in the Standard Drawing 675-110-00 Typical Wire and Cable Usage. These include the provision of spare conductors. The substitution of additional cables to attain the required number of conductors shall not be permitted.
- Run a separate cable to each corner of the intersection in accordance with Standard Drawing 675-110-00 Typical Wire and Cable Usage.
- The list below is a guide to general usage--

Loop: To Each Corner	4 pair (8 conductor) GRAY
Loop Lead-in	2 pair (4 conductor) GRAY

1.3.4 Pedestrian Signal Head Wiring

- Install each cable run with the number of conductors indicated in the Standard Drawing 675-110-00 Typical Wire and Cable Usage. These include the provision of spare conductors. The substitution of additional cables to attain the required number of conductors shall not be permitted.
- Run a separate cable for each phase or approach in accordance with Standard Drawing 675-110-00 Typical Wire and Cable Usage.
- The list below is a guide to general usage--

Pedestrian Signal	2 pair (4 conductor) BLACK
Pedestrian Push Button	2 pair (4 conductor) GRAY
Loop Lead-in	2 pair (4 conductor) GRAY

1.3.5 Push Button Wiring

- Install each cable run with the number of conductors in accordance with Standard Drawing 675-110-00 Typical Wire and Cable Usage. These include the provision of spare conductors. The substitution of additional cables to attain the required number of conductors shall not be permitted.
- A separate cable should be run for each phase or approach in accordance with Standard Drawing 675-110-00 Typical Wire and Cable Usage.
- The list below is a guide to general usage--

Pedestrian Push Button	2 pair (4 conductor) GRAY
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1.3.6 Electrical Conduit

All conduit and elbows shall be installed as described in the appropriate Specification.
See 675.1 ELECTRICAL CONDUIT.
See 688.7 CONTROLLERS AND 332/336 CABINETS.
See 688.5 STEEL STRAIN POLE AND FOUNDATION.

1.4 Measurement

- With the exception of the electrical service cable, electrical cable lengths of the size and numbers of conductors specified, shall be measured by LINEAR FEET as actually furnished and installed, completely in place and accepted, with each size cable being a separate pay item.

1.5 Payment

6770388	FURNISH & INSTALL NO. 14 COPPER WIRE, 4 CONDUCTOR - BLACK	LF
6770389	FURNISH & INSTALL NO. 14 COPPER WIRE, 4 CONDUCTOR - GRAY	LF
6770393	FURNISH & INSTALL NO. 14 COPPER WIRE, 8 CONDUCTOR - BLACK	LF
6770394	FURNISH & INSTALL NO. 14 COPPER WIRE, 8 CONDUCTOR - GRAY	LF

Supplemental Technical Specification for

Fiber Optic Cable

SCDOT Designation: SC-M-677-3 (01/18)

1.1 Description

This work shall consist of furnishing and installing single-mode fiber optic (SMFO) cable in conduit and risers or overhead lashed to new messenger cable.

1.2 Materials

Acceptable single-mode fiber optic (SMFO) cable shall meet all requirements stated in RUS-90 and shall be an accepted product of the United States Department of Agriculture Rural Utility Service as meeting the requirements of RUS-PE-90. The cable shall be new, unused, and of current design and manufacture. More information concerning these industry standards can be found on the SCDOT website, 677.3 *Fiber Optic Cable Industry Standards*, http://www.scdot.org/doing/publications_Traffic.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Fiber Optic Cable.
- The CONTRACTOR shall furnish all materials and attachment hardware and installation guides necessary to install the fiber optic cable in accordance with Standard Drawing 675-125-00 Interconnect. Install fiber optic cable where, and in the manner indicated on the Plans, or as needed to maintain communications in an existing fiber network, in accordance with the standard drawings.
- The CONTRACTOR shall order cable in reel lengths that are of sufficient length to require no intermediate splicing of the cable.
- Prior to installation, the CONTRACTOR SHALL PROVIDE certified TEST RESULTS from the manufacturer showing the cable furnished has been tested and meets Industry Standards, 677.3 Fiber Optic Cable.
- The CONTRACTOR shall take every precaution to ensure the fiber optic cable is not damaged during storage and installation. Do not step on the fiber optic cable or run over the fiber optic cable by any vehicle or equipment. Do not pull the fiber optic cable along the ground or over or around obstructions.
- Ensure the fiber optic cable is packaged on wooden reels. These reels shall not contain imperfections such as broken flanges or nails that may cause damage to the cable as it is unreeled.
- Each cable reel shall have a durable weatherproof label that shows the actual length of cable on the reel.
- The CONTRACTOR shall coordinate his overhead and underground construction activities on a continuing basis with each of the utility agencies which have facilities in the immediate vicinity.

1.3.2 Bends and Tensioning

- During installation, the CONTRACTOR shall provide cable blocks at least every 50 feet to guide the cable and reduce pulling tension. All pulling equipment and hardware that will contact the cable during installation must maintain the minimum bend radius of the fiber optic cable as listed in Table 1. Corner blocks, appropriately sized to ensure that the minimum bending radius of the cable is maintained, shall be provided whenever fiber optic cable must be pulled around a corner.

Table 1 Fiber Optic Minimum Bend Radius Chart

Nominal Cable Diameter		Minimum Bend Radius (No Tension) Installed		Minimum Bend Radius (Under Tension)	
Millimeters	Inches	Centimeter s	Inches	Centimeter s	Inches
6.0 – 10.0	(1/4 – 3/8)	10.0	(4.0)	15.0	(6.0)
10.1 – 15.0	(4/10 – 6/10)	15.0	(6.0)	22.5	(9.0)
15.1 – 20.0	(10/16 – 8/10)	20.0	(8.0)	25.0	(10.0)
20.1 – 23.0	(13/16 – 9/10)	23.0	(9.0)	25.0	(10.0)

23.1 – 25.0	(15/16 – 1.0)	25.0	(10.0)	30.0	(12.0)
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- Fiber optic cable shall not be pulled through any intermediate junction box, manhole, pull box, pole base or any other opening in the conduit unless specifically required by the ENGINEER in specific facilities. The necessary length of cable to be installed shall be pulled from one junction box, manhole, pull box, pole base, or cabinet to the immediate next downstream manhole, box, pole base, or cabinet. The remaining length of cable to be installed in the next conduit shall be carefully stored in a manner that is not hazardous to pedestrian or vehicular traffic yet ensures that no damage to the cable shall occur. The cable shall be stored in a manner that shall allow that length of cable to be safely pulled into the next conduit. The ENGINEER shall approve the storing methods to be used.
- Cable reel lagging shall remain on the cable reels until they arrive at the pulling site. If the lagging has been removed, the CONTRACTOR shall securely fasten the cable ends to avoid damage during transit.
- If the cable must be unreeled during installation, use the “figure-eight” configuration to prevent kinking or twisting of the fiber optic cable. The preferred size of the “figure-eight” is 15 feet with each loop about eight (8) feet in diameter. The fiber optic cable shall not be coiled in a continuous direction except for lengths of 100 feet or less.
- The CONTRACTOR shall not increase the tension on the messenger cable to which the fiber optic cable has already been lashed.
- At the completion of a day’s installation, the CONTRACTOR shall protect the cable from moisture by placing a cable cap and/or several wraps of tape on the tip of the cable.
- The CONTRACTOR shall record the cable meter marks at every other pole location and at the fiber splice points on a set of as-built plans. Two (2) copies of the plans showing the meter marks shall be provided to the ENGINEER. The meter marks are most easily obtained while forming drip loops.
- The CONTRACTOR shall route the fiber optic cable on the inside of messenger intersections at dead ends and crossovers.

1.3.3 Aerial Installation

- Where the plans call for aerial installation, the CONTRACTOR shall furnish new messenger cable (see 682.3 Steel Cable) and shall lash the fiber optic cable to the new messenger.
- Install aerial cable either manually or by using the moving reel method. If the CONTRACTOR proposes to use the moving reel method, the CONTRACTOR shall submit to the ENGINEER the cable manufacturer’s recommended procedures for this installation technique at least seven (7) days prior to beginning the installation of the fiber optic cable.
- Maintain the required clearances between the fiber optic cable and the utility features as follows unless otherwise noted on the PLANS:
 - 4 inches minimum vertical clearance and 12 inches minimum total (diagonal) separation to the telephone and/or cable vision facilities.
 - 40 inches minimum vertical clearance to all electrical transformers.
 - 40 inches minimum vertical clearance to all electric lines (including street light circuits).
- Where called for on the PLANS or as directed by the ENGINEER, furnish fiberglass extension arms and utilize to install the new fiber optic cable. Provide MIF PH6-2 fiberglass extension arms or approved equal.
- Where called for on the PLANS, the CONTRACTOR shall install down guys, sidewalk guys, and aerial guys in accordance with 682.2 Back Guy and as shown in the standard drawings.
- The CONTRACTOR shall use a Kellems® (or approved equal) grip wire mesh pulling grip and swivel to prevent damage to the cable during cable pulls.
- The CONTRACTOR shall provide drip loops for the fiber optic cable at all utility poles to which the fiber optic cable is attached. The drip loops must be of the “smooth-curve” type and shall be at least of the recommended dimensions for a drip loop in the typical details. Form drip loops by hand or by using an expansion loop-forming tool. Support the cable with straps and spacers in the absence of lashing wire support and to hold the cable bundles together. Install the strap and spacer no closer than 4 inches to the first bend in the drip loop.
- Where called for on the PLANS, the CONTRACTOR shall install backlashes in the Fiber Optic cable as necessary. The CONTRACTOR shall utilize 16 inch Fiber Optic Strand Storage Bracket (Multilink model number 2116-SSPTB or approved equivalent) which are also known as “Fiber Optic Sno Shoes”. All hardware necessary for the installation of the backlash including the “Fiber Optic Sno Shoes”, and lashing of the additional cable shall be incidental to the cost of Furnishing and Installing the Fiber Optic cable.
- The straps and spacers used for drip loops and other fiber optic cable handling purposes shall be hand-tight only. The strap and spacer must be loose enough to allow longitudinal travel by the

cable, but tight enough to prevent the strap and spacer from moving on the messenger cable.

- Over lash the fiber optic cable to the messenger cable (See 682.3 Steel Cable - 1/4" galvanized steel cable). Use aluminum wrapping tape spaced at intervals not exceeding 380 mm or with 1.5 mm (minimum) diameter galvanized steel spiral cable wrap for lashing. Wrapping tape, if used shall be 1.3 mm x 7.6 mm. Use at least 4 turns. Accomplish the lashing in the manner that results in the wire and the cable appearing to be an integral part of the support cable. Install fiber optic cable without loose lashing, twisting or weaving along the messenger.
- The CONTRACTOR shall terminate the lashing wire with a lashing wire clamp as the cable run is lashed up, span-by-span. Terminate the lashing wires as follows:
 - 1) Place a cable spacer between the fiber optic cable and the messenger.
 - 2) Locate lashing wire clamp 2 inches from strap and spacer. Pull enough lashing wire out of lasher to terminate into the lashing wire clamp.
 - 3) Wrap the lashing wire 3 times around only the messenger between the lashing wire clamp and the planned location of the first wrap around both the strand and fiber optic cable.
 - 4) Secure the lashing wire as shown in the typical details.

1.3.4 Underground Installation

- Where shown on the PLANS, install the fiber optic cable in new underground conduit and risers.
- Seven (7) days prior to the installation of fiber optic cable in conduit is performed, the CONTRACTOR shall provide the ENGINEER with 4 copies of the cable manufacturer's recommended and maximum pulling tensions and a list of the cable manufacturer's approved pulling lubricants. Only use those lubricants in the quantity recommended by the fiber optic cable manufacturer.
- When installing the cable in underground conduit, the maximum allowable pulling tension for the cable installation by the CONTRACTOR shall not exceed 70 percent of the manufacturer's maximum pulling tension. If the cable is pulled by mechanical means, use a dynamometer (clutch device) approved by the ENGINEER to ensure that a maximum allowable pulling tension is not exceeded at any time during installation.
- Fiber optic cable shall not be pulled over edges or corners, over or around obstructions or through unnecessary curves or bends. Use approved cable guides, feeders, shoes and bushings to prevent damage to the cable during installation.
- Use sealing bushings rather than weather heads on all risers containing fiber optic cable. The sealing bushings shall conform to the typical detail shown.
- Ensure conduit bends and cabinet entrance fittings used by the fiber optic cable network are designed to accommodate the bending radius limitations of the fiber optic cable used.

1.3.5 Splice

Splice the fiber optic cable only at those points shown in the PLANS. The designated splices proposed for installation in each controller cabinet consist of one of the following:

- Fibers Interconnect Centers – This splice in the cabinet shall be installed in accordance with 677.4 Fiber Interconnect Center
- The CONTRACTOR shall pull an adequate amount of fiber optic cable into the controller cabinet to perform splicing and to provide approximately 50 feet of slack cable (approximately 25 feet from the entering and 25 feet from the exiting cable). After the fiber optic cable has been spliced, the cable shall be neatly coiled (with tie-wraps placed on the cable) and placed on top of the fiber interconnect center or on the bottom of the cabinet. The cable shall be readily accessible to enable maintenance personnel to perform splicing of the cable in a vehicle located near the controller cabinet.
- Factory Terminated Patch Panel – This aerial splice and plug into cabinet shall be installed in accordance with 677.6 Factory Terminated Patch Panel
- Fiber optic cable runs shall be continuous between allowable splice points. The CONTRACTOR shall carefully determine the length of fiber optic cable necessary to reach from termination point to termination point. Splicing of fiber optic cable in conduit, pole bases, manholes, or pull boxes shall not be permitted.

1.3.6 Utilities

- Relocation of overhead utilities will be made by others and is not a part of this Contract.
- Where fiber optic cable is to be installed on overhead poles, the CONTRACTOR shall exercise care in temporary placement of installation equipment to provide safety to the public and to prevent damage to existing facilities. Should the CONTRACTOR cause damage to any existing cables and/or equipment, the CONTRACTOR shall immediately notify the ENGINEER and the affected owner and the CONTRACTOR shall repair or have the repair made at no additional cost.

1.3.7 Grounding and Bonding

- All metal conduits shall be grounded.

- All conduit, terminal cabinets, anchor bolts and reinforcing bar cages shall be made mechanically and electrically secure to form a continuous system and shall be effectively grounded. Use #6 AWG bare stranded copper wires for the grounding or bonding conductor.
- Bonding of metallic conduit in pull boxes and other installations, where the conduit is not coupled, shall be coupled with metallic conduit ground bushings having smoothly rounded molded insulated inserts and bonding jumpers.
- The CONTRACTOR shall furnish and install all grounding facilities.

1.3.8 Fiber Optic Cable Tests

- Continuity - Prior to the installation of any fiber optic cable, the CONTRACTOR shall test the continuity of each fiber using an Optical Time Domain Reflectometer (OTDR). The test shall be conducted while the fiber is still on the reel and the test results shall be provided to the ENGINEER.
- Contractor shall provide documentation indicating that all optic fibers have been proof tested by the fiber manufacturer at a minimum load of 50 kpsi.
- Contractor to provide documentation that all optical fibers have been 100% attenuation tested by the manufacturer. The attenuation of each fiber shall be provided with each cable reel.
- Splice Loss - After the installation of the fiber optic cable, the CONTRACTOR shall test the dB loss for every splice of the fiber optic cable in accordance with procedures established in the OTDR operator's manual. The testing may be done in conjunction with the splicing of the cable. Any splice that has a splice loss >0.09 dB shall be re-spliced.
- The CONTRACTOR shall provide hardcopy test results to the ENGINEER that identify the location of the splice (Intersection name, splice tray #), the fiber (by buffer tube and fiber color), and the splice loss in dB.
- Connector/End Splice Testing - The CONTRACTOR shall test each connector/end splice loss in one (1) direction using an OTDR in accordance with procedures established in the OTDR operator's manual. The average mated connector/end splice loss shall be <0.5 dB. Individual mated connector pair/end loss shall be <0.7 dB. Any connector/end splice with a loss greater than 0.7 dB shall be replaced, by the CONTRACTOR. Any replacement connectors/ends shall also be tested.
- End-to-End Attenuation Testing - The CONTRACTOR shall perform end-to-end testing of each fiber between each place point at 1310 nm and 1550 nm in one (1) direction in accordance with EIA/TIA 526-7.
- The CONTRACTOR shall provide hardcopy test results to the ENGINEER that identify the two (2) ends of the test site, the fiber tested, the wavelength tested, the reference power output, and the system attenuation in dB.
- The CONTRACTOR shall provide OTDR Signature traces of all fibers between all intersections for system documentation and restoration purposes.

1.4 Measurement

- Fiber optic cable, of the type and size specified will be measured by linear feet of cable actually furnished and installed, completely in place and accepted, using an "OTDR" (optical time-domain reflectometer). Such payment shall be full compensation for furnishing all material, labor, hardware, equipment and incidentals necessary for furnishing and installing communications cable and completing the work as specified.
- Note that electrical conduit, splice boxes, splice cabinets, and steel span wire are listed elsewhere as separate pay items.

1.5 Payment

6770470	FURNISH & INSTALL 12 STRAND FIBER OPTIC CABLE – SINGLE MODE	LF
677046D	FURNISH & INSTALL SELF SUPPORTING 12 STRAND FIBER OPTIC CABLE - SINGLE MODE	LF

Supplemental Technical Specification for

Fiber Interconnect Centers

SCDOT Designation: SC-M-677-4 (01/18)

1.1 Description

This work shall consist of furnishing and installing a Fiber Interconnect Center, including splicing the fiber optic cable and all necessary material to accomplish this work in accordance with this specification and standard drawings.

1.2 Materials

- The Fiber Interconnect Center shall include ST adapter panel, strain relief hardware, be rack mountable, have the capacity for 4 Fusion Splice Trays and termination/connection capacity for 24 fibers in 4 modules. The Center shall be a Systimax 600G2-1U-UP-SD or approved equivalent.
- The interconnect center shall be equipped with 2 fiber optic modular connector panels with 24 factory-installed interconnection sleeves. The modular interconnection panels shall be clearly labeled (transmit/receive). The interconnection sleeves shall be types ST compatible, with ceramic insert, and composite housing for single-mode fiber optic cable. These shall be Systimax MODG2-6ST-SM-PT-A and MODG2-6ST-SM-PT-B or approved equivalent.
- Each interconnect center shall be furnished with 3 Fusion Splice Trays. The trays shall be capable of accepting 12 fusion and 6 mechanical splices. The tray shall be a Systimax RS-2AF-16SS or approved equivalent.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Fiber Interconnect Center.
- Multiple splices may be required to connect all incoming fibers to traffic signal network.

1.3.2 Cabinet

- Install the Fiber Interconnect Center in the controller cabinet. Place the Fiber Interconnect Center in the cabinet such that the slack fiber optic cable stored on top of the fiber interconnect center (in accordance with 677.3 Fiber Optic Cable) can be easily removed (along with the fiber interconnect center) from the cabinet and taken to a maintenance vehicle for splicing.
- Provide all necessary materials and hardware including furnishing and installing splice trays, interconnection sleeves, jumpers, and connectors needed for connecting the fiber optic cable to the signal communications network.

1.3.3 Splicing Methods

- Use the fusion-splice technique to perform all splicing, which induces less than 0.3 dB attenuation, unless noted otherwise in the special provisions. Recoat bare fibers with a protective RTV gel or similar substance prior to application of the sleeve or housing to protect the fiber from scoring, dirt, or microbending. Package each spliced fiber in a heat shrink protective sleeve or housing. Perform all splices in accordance with the cable manufacturer's and the splice manufacturer's recommendations. During splicing, the CONTRACTOR shall maintain the continuity of the buffer tube and fiber color.
- Provide incoming fibers with 5 feet of coiled slack and splice to a pigtail of the same type fiber. Pigtails shall have a minimum length of 5 feet and shall have a factory-installed ST compatible connector. The pigtails shall have an attenuation of less than 0.3 dB. The ST connector shall mate with the connector panels installed in the fiber interconnect center.
- Protect unused optical fibers with sealed end caps.
- The CONTRACTOR shall record the meter marks on the cable sheath at each splice point. Provide these marks to the Engineer as part of the as-built system plans at the completion of the project.

1.3.4 Jumpers

- The CONTRACTOR shall furnish and install 2 single-mode fiber optic cable assemblies with connectors factory-installed on each end (jumpers). These assemblies will be used to connect the fiber optic

modem to the connector panel. These jumpers will not be paid for directly but shall be considered incidental to the item Furnish and Install Fiber Optic Modem.

1.3.5 Future Applications

- The fiber optic communications network shall accommodate future applications. As shown in the standard drawings, fusion splice all six fibers in one buffer tube of the entering cable through to the six fibers in one of the buffer tubes leaving the cabinet. Maintain the continuity of the buffer tube and fiber color. Splice these fibers in a separate splice tray. The cable entering and exiting the cabinet will contain another buffer tube that contains six fibers. Fusion-splice three of the incoming and three of the outgoing fibers to pigtail assemblies with factory-installed type ST compatible connectors. Place these six splices in a second splice tray. Fusion-splice the remaining three incoming and three outgoing fibers to pigtail assemblies with factory-installed type ST compatible connectors and placed in a third tray. Connect all pigtail assemblies to the connector panels installed in the Fiber Interconnect Center. Clearly label the Transmit and Receive designations of each fiber pair on the front of the connector panel. Test each fiber termination/connection for attenuation.

1.3.6 Fiber Optic Cable Tests

- Continuity - Prior to the installation of any fiber optic cable, the CONTRACTOR shall test the continuity of each fiber using an Optical Time Domain Reflectometer (OTDR). Conduct the test while the fiber is still on the reel and provide the test results to the ENGINEER.
- Splice Loss - After the installation of the fiber optic cable, the CONTRACTOR shall test the dB loss for every splice of the fiber optic cable in accordance with procedures established in the OTDR operator's manual. The testing may be done in conjunction with the splicing of the cable. Any splice that has a splice loss >0.09 dB shall be re-spliced.
- The CONTRACTOR shall provide hardcopy test results to the ENGINEER that identify the location of the splice (Intersection name, splice tray #), the fiber (by buffer tube and fiber color), and the splice loss in dB.
- Connector/End Splice Testing - The CONTRACTOR shall test each connector/end splice loss in one (1) direction using an OTDR in accordance with procedures established in the OTDR operator's manual. The average mated connector/end splice loss shall be <0.5 dB. Individual mated connector pair/end loss shall be <0.7 dB. Replace any connector/end splice with a loss greater than 0.7 dB. Test any replacement connectors/ends.
- End-to-End Attenuation Testing - The CONTRACTOR shall perform end-to-end testing of each fiber between each place point at 1310 nm and 1550 nm in one (1) direction in accordance with EIA/TIA 526-7.
- The CONTRACTOR shall provide hardcopy test results to the ENGINEER that identify the two (2) ends of the test site, the fiber tested, the wavelength tested, the reference power output, and the system attenuation in dB.
- The CONTRACTOR shall provide OTDR Signature traces of all fibers between all intersections for system documentation and restoration purposes.

1.4 Measurement

- This item shall include the labor, equipment, and materials necessary to furnish and install the fiber optic interconnect centers in accordance with the PLANS and Standard Drawings. This item shall be measured by the number of each installed, which shall be full compensation for furnishing and installing the fiber interconnect centers into the signal controller cabinets and making the necessary connections. The fusion splicing of the cable, furnishing and installing the splice trays, pigtail assemblies, connector panels and interconnection sleeves shall be considered incidental to this item and will not be paid directly.
- Pay item 6770486 may be used to pay for additional fiber splices required if more than one fiber trunk is to be interconnected at signal. This pay item includes all necessary items needed to provide this interconnection.

1.5 Payment

6770476	FURNISH & INSTALL FIBER OPTIC INTERCONNECT CENTER	EA
6888092	INSTALL FIBER OPTIC INTERCONNECT CENTER	EA
6770486	FIBER OPTIC REPAIR SPLICE OH/UG	EA

Supplemental Technical Specification for

Factory Terminated Patch Panel

SCDOT Designation: SC-M-677-6 (01/18)

1.1 Description

This work shall consist of furnishing and installing a Factory Terminated Patch Panel, including splicing the fiber optic cable and all necessary material to accomplish this work in accordance with this specification and standard drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Factory Terminated Patch Panel.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice.
- Multiple splices may be required to connect all incoming fibers to traffic signal network.

1.3.2 Cabinet

- The factory terminated patch panel shall be installed by the CONTRACTOR between the controller cabinet and the overhead fiber optic cable run. The factory terminated patch panel shall be located in the cabinet such that the slack fiber optic cable is safely stored (in accordance with 677.3 Fiber Optic Cable).
- Provide all necessary materials and hardware including furnishing and installing interconnection sleeves, jumpers, and connectors needed for connecting the fiber optic cable to the signal communications network.

1.3.3 Splicing Methods

- When using a preterminated, molded patch panel unit that serves as the drop cable and fiber interconnect center (patch panel/fusion splice containment) the free end shall be spliced to the trunk fiber optic cable in an approved aerial enclosure according to the splice plan. The overhead splice and enclosure and all necessary materials and hardware is incidental and should be included in pay item.
- Use the fusion- splice technique to perform all splicing, which induces less than 0.3 dB attenuation, unless noted otherwise in the special provisions. Recoat bare fibers with a protective RTV gel or similar substance prior to application of the sleeve or housing to protect the fiber from scoring, dirt, or microbending. Package each spliced fiber in a heat shrink protective sleeve or housing. Perform all splices in accordance with the cable manufacturer's and the splice manufacturer's recommendations. During splicing, the CONTRACTOR shall maintain the continuity of the buffer tube and fiber color.
- Protect unused optical fibers with sealed end caps.
- *The CONTRACTOR shall record the meter marks on the cable sheath at each splice point.* Provide these marks to the Engineer as part of the as-built system plans at the completion of the project.

1.3.4 Jumpers

- The CONTRACTOR shall furnish and install 2 single-mode fiber optic cable assemblies with connectors factory-installed on each end (jumpers). These assemblies will be used to connect the fiber optic modem to the Factory terminated patch panel. These jumpers will not be paid for

directly but shall be considered incidental to the item Furnish and Install Factory terminated patch panel.

1.3.5 Future Applications

- Splice all fiber strands and connect to accommodate future applications.

1.3.6 Fiber Optic Cable Tests

- Continuity - Prior to the installation of any fiber optic cable, the CONTRACTOR shall test the continuity of each fiber using an Optical Time Domain Reflectometer (OTDR). Conduct the test while the fiber is still on the reel and provide the test results to the ENGINEER.
- Splice Loss - After the installation of the fiber optic cable, the CONTRACTOR shall test the dB loss for every splice of the fiber optic cable in accordance with procedures established in the OTDR operator's manual. The testing may be done in conjunction with the splicing of the cable. Any splice that has a splice loss >0.09 dB shall be re-spliced.
- The CONTRACTOR shall provide hardcopy test results to the ENGINEER that identify the location of the splice (Intersection name, splice tray #), the fiber (by buffer tube and fiber color), and the splice loss in dB.
- Connector/End Splice Testing - The CONTRACTOR shall test each connector/end splice loss in one (1) direction using an OTDR in accordance with procedures established in the OTDR operator's manual. The average mated connector/end splice loss shall be <0.5 dB. Individual mated connector pair/end loss shall be <0.7 dB. Replace any connector/end splice with a loss greater than 0.7 dB. Test any replacement connectors/ends.
- End-to-End Attenuation Testing - The CONTRACTOR shall perform end-to-end testing of each fiber between each place point at 1310 nm and 1550 nm in one (1) direction in accordance with EIA/TIA 526-7.
- The CONTRACTOR shall provide hardcopy test results to the ENGINEER that identify the two (2) ends of the test site, the fiber tested, the wavelength tested, the reference power output, and the system attenuation in dB.
- The CONTRACTOR shall provide OTDR Signature traces of all fibers between all intersections for system documentation and restoration purposes.

1.4 Measurement

- The bid for the Factory terminated patch panel shall include the cost of furnishing and installing the Factory terminated patch panel into the signal controller cabinets, splicing into fiber trunk overhead and making all the necessary connections.
- The fusion splicing of the cable, pigtail assemblies, connector panels and interconnection sleeves shall be considered incidental to this item and will not be paid directly.
- This item shall include the labor, equipment, and materials necessary to install the Factory terminated patch panel in accordance with the PLANS and Project Special Provisions. This item shall be measured by the number of each installed.
- Pay item 6770486 may be used to pay for additional fiber splices required if more than one fiber trunk is to be interconnected at signal. This pay item includes all necessary items needed to provide this interconnection.

1.5 Payment

6888082	FURNISH & INSTALL FACTORY TERMINATED PATCH PANEL	EA
6888093	INSTALL FACTORY TERMINATED PATCH PANEL	EA
6770486	FIBER OPTIC REPAIR SPLICE OH/UG	EA

Supplemental Technical Specification for

Wireless Network Communications Link

SCDOT Designation: SC-M-677-7 (01/18)

1.1 Description

This work shall consist of installing a Wireless Network Communications Link with all necessary hardware in accordance with the plans and standard drawings to provide a data link between field devices (i.e. Traffic Signal Controllers).

1.2 Materials

Wireless Communications Equipment provided by others (generally SCDOT). Cable shall be as follows or equal:

Superior Essex	Cabling	CAT 5e Ethernet cable
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1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Wireless Network Communications Link.
- The Contractor shall furnish the ENGINEER with any warranties on materials provided by the Manufacturer or Vendor as normal trade practice.
- A Wireless Network Communications Link is used to network two Traffic Signal Cabinets together. Each link consists of Master ODU (Out Door Unit, *Antenna*) connected to a data switch within one of the signal cabinets and a Slave ODU connected to a data switch within the other signal cabinet. Each ODU is aligned to face the opposing ODU. The cable length between the ODU and its associated data switch may not exceed 300 feet.
- Wireless Network Communications Link components at each of the linked traffic signal cabinets includes an ODU, a LPU (Lightning Protection Unit), power supply mounting hardware, and CAT 5e cabling. The ODU is pole mounted per manufacturer's specifications. The LPU and power supply are mounted within the traffic signal cabinet. CAT 5e cable is installed between the ODU and LPU.

1.3.2 Site Survey

- **Perform a radio path Site Survey test before installing any equipment.** For the applicable frequency spectrum of the radios being deployed, perform a spectrum analysis to ensure no competing equipment in the area. Ensure the radio path site survey test is performed using the supplied brand of radio equipment to be deployed. Typically, if the ODUs can be mounted with clear line of sight between them, this is sufficient to ensure proper operation. If this is not possible, it may be determined that a repeater station is necessary to complete the intended link. Provide the test results to the ENGINEER for review and approval. Submit copies of the test results and colored copies of the frequency spectrum scan along with an electronic copy of this information. The ENGINEER will approve final locations of the ODUs and any necessary repeater stations.

1.3.3 Antenna

- Install each ODU in such a manner that avoids conflicts with other utilities (separation distances in accordance with the guidelines of the NESC) and as specified in the ODU manufacturer's recommendations. Secure the ODU mounting hardware to the pole and route the CAT 5E cable such that no strain is placed on the RJ-45 connectors. Align each antenna/radio to be perpendicular to the ground (using bubble level) and to face the opposing radio

1.3.4 Cable

- Install Cat 5E cable between the ODU and the LPU. Terminate each end with compatible RJ-45 connector. Perform end-to-end continuity test and 1 GigaBit/sec transmission tests using Ethernet Twisted Pair test gear. Provide test results to ENGINEER.
- Lightning Protection Unit (LPU)- Install LPU in Signals cabinet per manufacturer's instructions. Connect CAT 5e cable to LPU

1.4 Measurement

- Pay Item 677048B INSTALL WIRELESS NETWORK COMMUNICATIONS LINK BETWEEN TWO TRAFFIC SIGNALS is measured as EACH unit. This pay item includes furnishing mounting hardware and cable for ODU, installing ODU and cable, installing cabinet equipment, and adjusting ODU as needed for optimum communications for both ends of the link (Master ODU at one signal and Slave ODU at the other signal. Actual ODUs and associated equipment provided by others (generally SCDOT).

1.5 Payment

677048B	INSTALL WIRELESS NETWORK COMMUNICATIONS LINK BETWEEN TWO SIGNALS	EA
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Supplemental Technical Specification for

Detector Loop

SCDOT Designation: SC-M-678-1 (01/18)

1.1 Description

This work shall consist of furnishing and installing a Detector Loop within and alongside the roadway, at the locations shown on the Plans, and in accordance with Standard Drawing 675-120-00. A Detector Loop installation shall consist of: installing the required conduit runs; making the pavement saw cut; placing the required number of turns of loop wire in the saw cut; creating a twisted pigtail; splicing the pigtail to the shielded, twisted pair lead-in cable; connecting the lead-in cable to the back-panel terminals at the controller cabinet; verifying proper detection of traffic; and sealing the saw cut. Several items used to create a complete detector installation are specified elsewhere. They are: FURNISH AND INSTALL ELECTRICAL CONDUIT; and FURNISH AND INSTALL SPLICE BOXES/ JUNCTION BOXES. The "junction point" referred to in the specifications below, is defined to be a splice box, or a conduit junction box as specified on the Plans.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.2 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Detector Loop.
- The LOCATION and SIZE of each loop shall conform to the Plans and to the Standard Drawings.
- The front of each loop shall typically located 12 to 36 inches in front of the Stop Line, however, the final location will be determined by the ENGINEER based on field conditions.
- Center loops in the traffic lane in accordance with the Standard Drawings and as shown on the Plans.
- Stage loop installation so that each entire loop installation (from saw cut to sealing) is completed within the same working day with minimum blockage of traffic.
- Cut all presence loops, left turn lanes and side streets, in a quadrupole design, in accordance with the standard drawings.
- Provide a 5-year workmanship warranty for the loops following Final Acceptance. The CONTRACTOR will return to repair or replace any loops rising up or pulling from the pavement or not functioning within warranty period at no additional cost.

1.3.2 Saw Cuts

- Prior to cutting, mark the intended saw cut using paint or chalk on the pavement and obtain approval from the ENGINEER.
- The Contractor shall slot the roadway using a diamond or abrasive rotary power-saw with a blade approximately 3/8 INCH IN WIDTH.
- Use a power-driven walk-along model saw, not a hand-tool.
- The MINIMUM DEPTH of each Saw cut shall be:
 - 2 INCHES DEEP in CONCRETE; and
 - 2-1/2 INCHES DEEP in BITUMINOUS pavement; and
 - 3 INCHES DEEP for any Quadrupole loop or loop with 4 turns.
- Cut the corners diagonally to prevent sharp edges in accordance with the standard drawings. Extend the saw cuts to provide full-depth.
- Wash out and blow dry saw cuts to ensure the cut is free from dust, grit, oil and moisture before the placement of wire. Use compressed air to blow dry.
- If the Engineer gives written approval, the curb and gutter may be saw cut. If saw cutting of curb and gutter is not permitted, drill a 1 1/2-inch hole under the curb at a 45 degree angle.
- Avoid pavement seams or cracks. However, when it is necessary to traverse a crack, drill a 2-inch diameter hole at least 3 inches deep, and provide slack in the loop wire to allow for expansion and contraction.

1.3.3 Loop Wire

- Install each loop wire in a continuous and splice-free manner.
- Do not install provide any wire with cuts, breaks, or nicks in the insulation. The Engineer will not accept damaged loop wire.
- Wire all loops in one direction, counter-clockwise only.
- Each loop shall have the number of turns shown below, or as indicated on the Plans.
 - 6' x 6' , 6' x 10' – 4 turns
 - 6' x 15', 6' x 20', 6' x 30', 10' x 20', 10' x 30' – 3 turns
 - 6' x 40', 6' x 50', 10' x 40' – 2 turns
 - Quadrupole loops shall have twice the turns in the middle cut, and be wired in a figure eight pattern, counter-clockwise only
- Form each Detector Loop by installing one continuous length of single conductor (loop) wire in a separate saw cut, from the nearest approved "junction point", around the loop the specified number of turns, then back to the "junction point".
- Place the wire in the cut so that there are no kinks or curls, and no straining or stretching of the insulation around the corner of the slot, or at the junction.
- Press the wire to the bottom of the saw cut slot, using a roller or a blunt-stick (similar to a paint stirrer), to seat the loop wire at the bottom of the slot or channel. Do not use a screwdriver or similar sharp tool as this may damage the loop wire insulation.
- After placing the wire in the slot, recheck it for slack, raised portions, and tightness.
- Use 1 INCH LENGTHS of 1/2 inch closed-cell foam-plastic (BACKER-ROD) at 2 foot spacings, to hold the wire at the bottom of the slot. DO NOT use backer-rod around the entire perimeter!
- Form the "pigtail" by twisting together the two ends of the loop wire from the corner of the loop to the "junction point"; Twist the two ends with a pitch of 15 TURNS PER YARD;
- Enclose the loop wire pigtail in conduit from the roadway edge to the "junction point".
- TEST each loop BEFORE SEALING, to ensure inductance is in the range of 50 to 2500 micro-Henrys. Ensure the insulation resistance measured to earth ground is greater than 100 megohms at 500 volts DC. Provide MEGGER TEST and INDUCTANCE TEST before and after sealing, and provide a written record of the test to the ENGINEER on company letterhead.

1.3.3 Lead-In Cable

- Install the lead-in cable in a continuous run, splice-free, and free from cuts or nicks in the insulation.
- At the specified "junction point", splice the twisted "pigtail" from the loop wire to the shielded, (twisted-pair) lead-in cable that runs from the "junction point" to the controller cabinet (terminal).
- Provide an electrically permanent and waterproof seal at the "junction point" splice. Remove 1-1/2 inches of insulation from each wire. Use either a crimped-on or twisted and soldered splice. No wire nuts are allowed. Waterproof seal the entire splice using a method described below:
 - a. Normal Splice – Splice each individual pair (pair of twisted loop wires meeting pair of loop lead-in wires), by using either a crimp-on or a soldered joint. Seal the junctions in a low-voltage, waterproof splice kit. Install the splice kit per the manufacturer's instructions.
 - b. Underwater Splice - Where required on the Plans, install an underwater splice kit according to the manufacturer's instructions.
- The ENGINEER must be present to witness the splicing. Any splices made without the presence of the ENGINEER are unacceptable, and shall be re-spliced.
- Leave sufficient slack in both the lead-in cable and the loop wire, to allow movement of 3 feet from the front of the "junction point". Neatly coil and nylon-tie the slack after completion of the splice.
- In the controller cabinet, label the lead-in cable on an insulated, preprinted-sleeve, slipped over the wire before attachment of a spade-lug connector. Crimp on a spade-lug connector onto each loop lead-in wire.
- In the controller cabinet, do not connect the ground (drain) wire from each lead-in cable; instead, cut it off at the cable sheath, and leave it floating.
- Run the lead-in cable in conduit (in accordance with 675.1 Electrical Conduit) from the "junction point" to the nearest signal pole, or directly to the cabinet if in the same quadrant.
- Run the lead in cable inside a conduit (riser) or metal pole, across span wires, and then down inside a conduit (riser) or metal pole, to the cabinet.
- Install one of the following for the conduit for lead-in cable required to be installed under sidewalks and curbs
 - Rigid Galvanized Steel Conduit
 - SCHEDULE 80 PVC Conduit

- SCHEDULE 80 HDPE Rolled Conduit
- Flexible Weather-Tight Steel Conduit

1.3.4 Sealant

- Use QPL approved Loop Sealant in all loops unless specified by the ENGINEER.
- Mix and apply Loop Sealant according to the manufacturer's directions.
- Do not pour Loop Sealant into saw cuts during precipitation of any kind, or at temperatures below 10° C (50° F).
- Completely fill the saw cut and drilled holes with Loop Sealant; do not allow bubbles below the surface; do not over fill the cut, ensuring only a minimum spillover along the joint. Use Duct-Seal to prevent sealant from flowing into conduit ends.
- When the sealant hardens, ensure there is neither a bulge nor depression, but rather a smooth road surface. Ensure the sealant is not over-poured, preventing bulges or bumps higher than the surrounding surface of the roadway. Wipe the area smooth with a squeegee.
- Ensure the sealant has hardened before allowing traffic to move over the area.

1.4 Measurement

- Detector loops shall be measured by LINEAR FEET of: loop wire, lead-in cable, and saw cut as actually placed, including sealant, electrical connections, testing, and incidental hardware. Note that conduit and splice boxes are measured elsewhere as separate items.

1.5 Payment

Loop Wire:

6770413	FURNISH & INSTALL NO. 14 COPPER WIRE, 1-CONDUCTOR FOR LOOP WIRE	LF
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Loop Lead-in cable:

See 677.1 Electrical Cable

6770389	FURNISH & INSTALL NO. 14 COPPER WIRE, 4 CONDUCTOR - GRAY	LF
6770394	FURNISH & INSTALL NO. 14 COPPER WIRE, 8 CONDUCTOR - GRAY	LF

Saw Cut:

6780495	SAWCUT FOR LOOP DETECTOR	LF
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Supplemental Technical Specification for

Wireless Vehicle Detection System

SCDOT Designation: SC-M-678-2 (01/18)

1.1 Description

This work shall consist of furnishing a Wireless Vehicle Detection System to detect vehicles on a roadway by using battery-powered magnetometer-type SENSORS that communicate their detection data by RADIO RECEIVER &/OR REPEATERS to a CABINET INTERFACE before the data is relayed to a local traffic controller and, optionally, a central software system or a data server, or interface to such, as may be desired.

1.2 Materials

1.2.1 Overview

- The Wireless Battery-Powered Magnetometer Vehicle Detection System shall consist of one or more SENSORS installed in each traffic lane where presence detection is required, avoiding sources of magnetic noise such as underground power cables, overhead high tension power cables, light rail or subway tracks, and power generation stations and sub-stations. The SENSORS shall be located as specified by the intersection plans, with each SENSOR'S supporting CABINET INTERFACE or REPEATER installed as necessary to provide communications. Each SENSOR in an installation shall be capable of being individually configured with its own sensitivity level. A single SENSOR shall be capable of being configured with a sensitivity level that approximates the detection zone of a standard 6' x 6' inductive loop. Each SENSOR shall be capable of being configured with relatively higher or lower sensitivity levels as may be required to detect bicycles, motorcycles, or light rail. As an option as directed by the plans, up to two SENSORS properly configured shall be capable of detecting motorcycles in a standard traffic lane and bicycles in a designated bicycle lane. A CABINET INTERFACE shall support the relay of SENSOR detection data through several interfaces as required by the application.
- Communications between a SENSOR and RADIO RECEIVER can be direct, via a single REPEATER, or via two REPEATERS operating in tandem. Communications between the SENSORS and the RADIO RECEIVER or REPEATER and between the REPEATER and RADIO RECEIVER or another REPEATER shall be via radio. Detection data shall be relayed from each CABINET INTERFACE to a local traffic controller for real-time vehicle presence detection using contact closure signals or serial communication interface.
- As an option, data shall be capable of being relayed from each CABINET INTERFACE to a central software system or central server over standard IP (Internet Protocol) networks. An option to provide data via a web page interface may be required.

1.2.2 Radio Link

The radio links between each SENSOR and RADIO RECEIVER or REPEATER and between each REPEATER and RADIO RECEIVER or each REPEATER and REPEATER shall conform to the following requirements.

- The physical layer of the radio links (i.e., the over-the-air data rate(s), modulation type(s), forward error correction, bit interleaving, channel coding, and other aspects of the transmitted signal) shall conform to published standards (e.g., IEEE, ITU-T, etc.).
- The center frequencies, bandwidths, and transmit power levels of the radio links shall allow operation in an unlicensed frequency band.
- Frequency channels shall be employed by the SENSORS, CABINET INTERFACE, and REPEATERS to avoid interference with other devices operating in the unlicensed band.
- Either user-configurable frequency assignments or frequency hopping technology shall be provided. If frequency channels are user-configurable, at least 16 frequency channels shall be supported. If spread-spectrum/frequency hopping technology is provided ensure technology can address potentially interfering radio transmissions in the unlicensed band.

- The link budget (i.e., transmit power plus transmit antenna gain plus receive antenna gain minus receive sensitivity, where receive sensitivity shall assume a 1% packet error rate) for all radio links shall be 93 dB or greater.

1.2.3 Components

The Wireless Vehicle Detection System shall consist of one or more of the following:

- **SENSORS** - installed in-pavement in each traffic lane.
- **RADIO RECEIVER** - mounted on the side of the roadway.
- **CABINET INTERFACE**- CABINET INTERFACE located in traffic signal cabinet will provide SENSOR information processing and support the interface between a RADIO RECEIVER and a standard traffic controller using contact closure signals or standard serial communication interface such as NEMA TS2 Port 1.
- **EXTENSION MODULE** - to provide additional detector outputs to a traffic controller.
- **REPEATER/ANTENNAS** - Wireless REPEATERS/ANTENNAS mounted on the side of the roadway, either at the intersection or adjacent to set back sensors, serving to extend the radio range of a RADIO RECEIVER.
- EPOXY, CAT5 / ETHERNET CABLE, ELECTRIC CABLE , SOFTWARE (Incidentals)

1.2.4 SENSOR

- Each SENSOR shall detect a vehicle by measuring changes in the earth's magnetic field near the SENSOR as caused by a stopped or passing vehicle (i.e., magnetometer-type detection). The SENSOR shall sample the earth's magnetic field at a rate of 128 Hz. The SENSOR shall communicate time-stamped ON and OFF vehicle detection events. Each SENSOR shall automatically recalibrate in the event of a detector lock. Each SENSOR shall communicate by radio to a nearby RADIO RECEIVER or REPEATER RADIO. Each SENSOR shall transmit its detection data within 150 ms of a detected event. Each SENSOR shall automatically re-transmit a detected event if no acknowledgement is received from the access point. Each SENSOR may stop retransmission after 8 attempts. Each SENSOR shall transmit a unique identifying code. Each SENSOR shall respond within 100 seconds when the access point is powered on and transmitting. When no RADIO RECEIVER or REPEATER is present or powered on and transmitting, the SENSORS are not required to detect vehicles.
- All SENSOR components shall be contained within a single housing. The SENSOR housing shall conform to NEMA Type 6P and IEC IP68 standard. The SENSOR components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The SENSOR housing shall be capable of being installed in a 4 to 4.5 inch diameter hole with a minimum 2.25 inches. A SENSOR shall operate at temperatures from -37°F /-38.3°C to +176°F / +80°C. A SENSOR shall be battery-powered with an average lifetime of ten (10) years when the SENSOR is configured for and operating under normal traffic conditions.

1.2.5 RADIO RECEIVER (AT INTERSECTION)

- A RADIO RECEIVER shall support at least 48 SENSORS with 0.125 second latency. A RADIO RECEIVER shall meet the temperature and humidity requirements of section 2.1.5 of NEMA Standard TS2-2003. All RADIO RECEIVER components (not including antennas) shall be contained within a single housing. The RADIO RECEIVER housing shall conform to NEMA Type 4X and IEC IP67 standards. A RADIO RECEIVER shall be no larger than 12"H x 8"W x 7"D.
- The RADIO RECEIVER shall communicate to the CABINET INTERFACE utilizing a standard CAT5e or higher Ethernet cable. The RADIO RECEIVER shall have a weatherproof Ethernet connector on the bottom. The Ethernet connector shall be shipped with a cover firmly attached to provide protection from the elements prior to cable connection. The weatherproof connector shall not require any specialized tools for installation.
- A means shall be provided for surge suppression and isolation between the radio receiver and the cabinet interface for a wired connection. Electrical isolation of 1000V or greater and transient / surge protection shall be provided for the interface between the Cabinet Interface and Radio Receiver. This may be provided integral to the devices or as a separate unit, or combination thereof.

1.2.6 CABINET INTERFACE

- Detection data shall be communicated to a standard roadside traffic controller via a CABINET INTERFACE capable of being installed in a standard 170 cabinet. Type 170, Type 2070 and ATC controller types shall be supported. As an option, detection data shall be communicated over TCP/IP via an integrated 10Base-T Ethernet interface or a NEMA TS2-2003 Port 1 serial interface. The CABINET INTERFACE shall be

capable of simultaneously communicating detection data via the contact closure interface and other interfaces.

- Each CABINET INTERFACE shall be capable of communicating with at least 2 RADIO RECEIVERS. EXTENSION MODULES shall provide additional contact closures (user configurable from 1 to 4 outputs each). The CABINET INTERFACE shall provide all the higher level processing and interface functions of the system. Each CABINET INTERFACE shall provide detector data as contact closure signals to the traffic controller or via a serial communications interface. A CABINET INTERFACE shall connect to standard 170/2070 input files or NEMA detector racks. One or more EXTENSION MODULES shall provide up to 64 channels of detection data from a single CABINET INTERFACE's supported SENSORS, where each channel comprises an optically isolated contact closure relay and, if configured for TS2 operation, an additional output meeting TS2 requirements, to indicate the channel status. Each CABINET INTERFACE and EXTENSION MODULE shall be configurable. A CCI card shall provide contact closure signals in either presence or pulse mode. A CCI card shall provide up to 31 seconds of delay timing. A CCI card shall provide up to 7.5 seconds of extension (carryover) timing. The CCI and EXTENSION MODULE front panel shall provide status LEDs to monitor Detection channel status, and Faults. The CCI and EXTENSION MODULE front panel shall be either software or via front panel switches configurable to provide Presence or pulse mode, Delay timing and Extension timing.
- A CABINET INTERFACE or EXTENSION MODULE shall be powered by the input file/detector rack backplane via an 11- 26 VDC input. Power Consumption for a CABINET INTERFACE (without optional cellular interfaces) shall be under 5 watts. An EXTENSION MODULE shall be surge protected to GR-1089 standards. A CABINET INTERFACE and EXTENSION MODULE shall meet the requirements of NEMA TS2-2003, section 2.1.5 Temperature and Humidity, and section 2.1.7 Transients, Input-Output Terminals.

1.2.7 EXTENSION MODULE

- An EXTENSION MODULE shall be available to allow additional detector outputs to be interfaced to the traffic controller. When interfacing through the detector card rack, the extension module shall allow up to four detector outputs to be interfaced to detector card slot(s).

1.2.8 REPEATER/ANTENNA

- A REPEATER/ANTENNA radio communicating directly to a CABINET INTERFACE shall support at least 10 SENSORS. A REPEATER/ANTENNA communicating to a CABINET INTERFACE via an intermediate REPEATER (i.e., tandem operation) shall support at least 6 SENSORS. A REPEATER/ANTENNA shall be battery-powered, solar powered or a combination of the two. The REPEATER/ANTENNA battery shall be long-term (5+ years) and field replaceable. A REPEATER/ANTENNA shall meet the requirements of NEMA TS2-2003, section 2.1.5 Temperature and Humidity. All REPEATER/ANTENNA components shall be contained within a single housing.

1.2.9 Epoxy

- The epoxy shall be a two part poly-urea based joint sealant. It shall have self-leveling characteristics. The surface the epoxy will be bonding to shall be free of debris, moisture and anything else which might interfere with the bonding process. The epoxy shall be approved by the manufacturer of the detection system. Epoxy is an incidental item to be included in installation of SENSORS.

1.2.10 Software

- Each SENSOR, access point contact closure, RADIO RECEIVER and REPEATER/ANTENNA shall be capable of accepting software and firmware upgrades. The Wireless Battery-Powered Magnetometer Vehicle Detection System shall provide software operating on conventional notebook/portable PCs or utilize a standard web browser program to support configuration of a SENSOR, to support configuration of an access point, to support configuration of a REPEATER, to store and retrieve detection data.

1.2.11 Certification

- The Contractor SHALL FURNISH, the design details and drawings prior to installation in sufficient detail for complete evaluation and comparison with these Specifications.

1.2.12 Warranty

- Performance shall be warranted for a period of **60 months** of the date of purchase and shall include repair or replacement of any component of the Wireless Vehicle Detection System. Failure due to workmanship, materials, and manufacturing defects shall be warranted for repair or replacement of the first 60 months of the date of purchase. The vendor shall replace any failed components within 30 calendar days of notification.

- During the warranty period, technical support shall be available from the supplier via telephone within 2 business days of the time a call is made by a user, where this support shall be provided by factory-authorized personnel or factory-authorized installers.
- During the warranty period, standard updates to the software shall be available from the supplier without charge.

1.3 Construction

- Install wireless detection system in accordance with manufacturer's instructions.
- Install wireless detectors using coring and fill hole with epoxy to obtain flush mounted installation
- Install overhead receivers/ repeaters to ensure proper communications with detectors
- Coordinate with manufacturer or their representative to ensure proper system installation

1.4 Measurement

Pay Item 677049C, 677049D, 677049E, and 677049F includes furnishing and installing all necessary hardware, software, mounting hardware, equipment, cables, and components required to obtain detection zones complying with this specification and as shown on the plans or listed in the special provisions. Such payment shall be full compensation for installing all equipment, labor, and incidentals necessary to complete the work as specified. The other pay items listed below are specifically for furnishing and installing that item, and include any necessary mounting hardware, cable and other incidental items necessary for installation of that item.

1.5 Payment

677049C	FURNISH WIRELESS DETECTION SYSTEM W/O SENSORS (INC SETBACK DETECTION CAPABILITY FOR 2 DIRECTIONS)	EA
677049D	FURNISH WIRELESS DETECTION SYSTEM W/O SENSORS (INC SETBACK DETECTION CAPABILITY FOR 3 DIRECTIONS)	EA
677049E	FURNISH WIRELESS DETECTION SYSTEM W/O SENSORS (INC SETBACK DETECTION CAPABILITY FOR 4 DIRECTIONS)	EA
677049F	FURNISH WIRELESS DETECTION SYSTEM W/O SENSORS (w/o SETBACK DETECTION CAPABILITY)	EA
677049G	FURNISH MANUFACTURER TECHNICIAN ASSISTANCE	HR
6770494	FURNISH & INSTALL FLUSH MOUNTED WIRELESS SENSOR INC EPOXY	EA
6887961	INSTALL FLUSH MOUNTED WIRELESS SENSOR	EA
6887962	REMOVE FLUSH MOUNTED WIRELESS SENSOR	EA
6887963	INSTALL SET BACK LOOP EQUIPMENT	EA
6887964	INSTALL CABINET EQUIPMENT	EA

Supplemental Technical Specification for

Electric Service

SCDOT Designation: SC-M-680-1 (01/18)

1.1 Description

This work shall consist of furnishing and installing an Electric Service to provide electric power to traffic signals, at locations shown on the Plans, and in accordance with the Standard Drawings and Power Company procedures.

1.2 Materials

- All materials shall be NEC compliant.
- Meter, Meter Box (Pan Type), Hub Access.
- Power Connection – Single-phase, 120/240 Volt, 3-Wire, 60-Hertz alternating current supply.
- Cable - 3-Wire (W, BL, RD), THHN/THWN, No.6 AWG
- Disconnect Switch - NEMA Standard Type 3R, weatherproof, Circuit Breaker Type, with a tab for pad-locking the cover closed, 3-Wire Design (2-circuit), with solid neutral. The panel shall be completely enclosed; there shall be no gaps in the panel with the door shut.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Electric Service.
- Perform all work in accordance with the Plans, the Standard Drawings and the REQUIREMENTS OF THE LOCAL POWER COMPANY. All work shall be in accordance with the National Electric Code (NEC), and applicable local Codes.
- Coordinate with the ENGINEER and the Power Company Representative as necessary to arrange the schedule for power connection.
- The Engineer will provide contact information for the Power Company.
- Make all necessary arrangements with the Power Company to insure having the needed power available at the TIME OF SIGNAL TURN-ON. Immediately report any difficulties in securing the service of the Power Company to the Engineer.
- Coordinate with the Engineer and the Power Company to determine the exact location of the electric service. The Electric Service is generally located as indicated below:
 - a) Overhead service drop to controller pole;
 - b) Overhead service drop to service pole, then underground to controller cabinet (isolated);
 - c) Underground Power Company feed, to service on the back of controller cabinet.
- The CONTRACTOR shall obtain all ELECTRIC PERMITS required; and shall arrange for INSPECTION at completion.
- Use 1-inch diameter SCHEDULE 80 PVC Conduit and Fittings or Rigid Metallic Conduit for the Electric Service; install it to extend from the point of Power Company attachment, through the meter and disconnect assembly, to the controller cabinet, in accordance with 675.1 ELECTRICAL CONDUIT.
- Install a weather head to the above conduit for overhead service connections. Install a strain Clevis, to create a 1 foot minimum drip loop.
- Use rustproof hardware; use stainless steel or galvanized steel parts; use STAINLESS STEEL BANDS for attachment to steel poles.
- Space the bands a maximum of 3 feet and at the top and bottom of the pole.
- When specifically required by the Utility Company or on wood poles, substitute Conduit Clamps/strap, fastened with galvanized screws, for the bands.

1.3.2 Meter

- Provide a Meter for the electric service, unless otherwise directed by the Engineer. Provide the necessary hardware accordingly.
- The CONTRACTOR shall furnish and install the METER BOX (PAN), and the HUB.

- Provide power connection that is a SINGLE-PHASE, 120/240 VOLT, 3-WIRE, 60-Hertz alternating current supply.

Disconnect Switch

- Provide disconnect switch that is NEMA STANDARD TYPE 3R, weatherproof. It shall be CIRCUIT BREAKER TYPE, and have a tab for pad-locking the cover closed. It shall be of 3-WIRE DESIGN (2-circuit), with solid neutral.
- The CONTRACTOR shall twist a No. 6 AWG wire through the padlock tab, to prevent unauthorized entry and until SCDOT installs a padlock.

1.3.3 Electric Service

- Provide electrical service with components having the ratings stated in the following table, to provide a maximum of future flexibility and a minimum of voltage-drop to the lamps:

ITEM		USAGE	
		<i>Flashing Beacons</i>	<i>Traffic Signal</i>
Disconnect Breaker			
	Box Rating (for uniformity):	60 AMP	60 AMP
	Circuit Breaker (one side):	20 AMP	50 AMP
Cable			
	3-Wire (W, BL, RD), THHN/THWN	No.6 AWG	No.6 AWG
Conduit			
	Schedule 80 PVC (Wood Poles)	1 inch	1 inch
	Rigid metallic (galvanized or aluminum) for steel or concrete poles	1 inch	1 inch

- Install Electrical Service Cable (Type THHN/THWN, sized per above table, 3-WIRE, (White, Black, red) 600 Volt, Copper only, stranded, with cable lugs) from the point of Power Company attachment to the Meter. From the meter to the cabinet install white, (black or red) and green. Install Electrical Service Cable in separate conduit from all other Electric Cable that connects to signal heads, pedestrian head or detection. At no place shall the service cable be in the same conduit as signal cables or loop lead-ins.

1.3.4 Ground System

- Ensure the resistivity of the electrical system EARTH GROUND shall be 15 OHMS OR LESS, as measured with an appropriate instrument which was calibrated not more than 60 days prior to the date of performing such tests.
- Ensure the poles, ground rods, ground wires, span wires, etc. forming the traffic signal, form a "GROUNDING ELECTRODE SYSTEM" as defined by Article 250 of the NATIONAL ELECTRIC CODE.
- Provide a 16 mm by 5/8 inch by 8 feet (minimum) ground rod, copper-clad, with brass or bronze ground rod clamp. EXOTHERMICALLY WELD the service ground rod; connect all other ground rods with clamps.
- Provide grounding wire for the service that is No. 6 AWG, Bare, solid or stranded copper wire Exothermically Welded. (Note that this is in addition to the solid grounding wire running down each wooden pole.)

1.4 Measurement

- Complete Electrical Service shall be measured by EACH service installed in place, as shown on the Plans. It shall include all necessary conduit (trenched and/or riser), cable, conduit fittings, hardware, ground rod, banding, clamps, lugs, and all other materials and equipment specified or directed by the ENGINEER or Power Company. (Usually, there shall be no additional measurement of electrical cable used; there shall be no additional measurement of conduit used.) When an "Isolated electric service" is required by the Plans, an item and quantity will have been provided for wooden pole, as required.

1.5 Payment

6800499	FURNISH & INSTALL ELECTRICAL SERVICE FOR TRAFFIC SIGNAL	EA
6800500	MODIFY EXISTING ELECTRICAL SERVICE FOR TRAFFIC SIGNAL	EA

Supplemental Technical Specification for

Splice Box / Junction Box

SCDOT Designation: SC-M-680-2 (01/18)

1.1 Description

This work shall consist of furnishing and installing a Splice Box or Junction Box at the locations shown on the Plans in accordance with these specifications and Standard Drawings 675-130-01, 675-130-03.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Electrical Conduit.
- Provide a Splice Box including a Box and Cover, installed over aggregate, in accordance with the Standard Drawings.
- Install the Splice Box for use as a signal cable electrical enclosure.
- Install the Junction Box, where indicated on plans, for use as a loop detector "junction point". Unless shown mounted on a pole, install the junction box in the dirt, at the depth of the conduit run, and covered with earth.

1.3.2 Splice Box

- Construct the Splice Box in accordance with the Standard Drawings, at locations shown on the Plans.
- Construct the Splice Box such that when the Box and Cover are in place, they are flush with the adjacent pavement, ground, or sidewalk, as shown in the Standard Drawings.
- Place patching Concrete around any Box installed in pavement.
- Place boxes at least 1 foot behind the curb-line or edge of roadway or as shown on the plans.

1.3.3 Placed Before Pouring.

- Where shown on the Plans, place Custom Splice Boxes in roadways or structures, prior to pouring the concrete. Typical usage would be in a bridge deck. Firmly attach the incoming conduit to the bottom reinforcement bar mat, or to the bottom wire-mat, using plastic tie-wraps every 2 feet. CAUTION: COMPLETELY PLUGG/BLOCK/SEAL THE BOTTOM OF THE SPLICE BOX AND THE CONDUIT ENDS TO PREVENT CONCRETE PENETRATION. When used on a bridge, install the Splice Boxes near the center line, and terminate the conduit in Splice Boxes at each end.

1.3.4 Conduit

- Install conduit (in accordance with 675.1 ELECTRICAL CONDUIT) to enter the Box at the bottom and to extend at least 2 inches beyond the inside wall.
- Install conduit to enter from the direction of the run unless otherwise permitted by the ENGINEER.
- Ensure all metallic conduit ends within the Box have grounding bushings with plastic inserts; and ensure they are bonded using #6 AWG bare copper ground wire. Provide end bushings to prevent chaffing in plastic conduits.
- After placing the electrical cable, pack the completed conduit ends with "duct-seal" or other equivalent material to prevent water from entering the conduit. Insert steel wool at conduit ends to prevent rodent/pest intrusion. Cap spare conduit.

1.4 Measurement

- Furnishing and installing Splice Boxes will be measured by EACH Box placed complete, including Box, Cover, aggregate, patching concrete, ground wire, ground bushings, sealing, and all miscellaneous hardware and incidentals required.
- Furnishing and installing Junction Boxes will be measured incidental to the conduit to which it is used with.

1.5 Payment

6800518	FURNISH & INSTALL 13"X24"X18"D.ELEC.FLUSH UNDGRD.ENCLOSURE-(STR.POLY.CONC.) HD	EA
680052C	FURNISH & INSTALL 17"X30"X24"D.ELEC.FLUSH UNDGRD.ENCLOSURE-(STR.POLY.CONC.) HD	EA

6800508	FURNISH & INSTALL 12"X12"X12"D.ELEC.FLUSH UNDGRD.ENCLOSURE-(STR.POLY.CONC.) HD	EA
6888100	INSTALL ELECTRICAL FLUSH UNDERGROUND ENCLOSURE	EA

Supplemental Technical Specification for

Wood Pole / Back Guy Assembly

SCDOT Designation: SC-M-682-1 (01/18)

1.1 Description

This work shall consist of furnishing and installing CCA treated Wood Poles and Back-Guy cable assemblies, of the types and sizes shown on the Plans, in accordance with these Specifications, and in close conformity with the lines shown on the Plans and in accordance with the Standard Drawings, 675-115-01, 675-115-02. Each wood pole installation shall include all related overhead and underground hardware, and back guy assemblies as provided elsewhere.

1.2 Materials

Furnish a wood pole meeting the following requirements:

- Southern Yellow Pine that is cut, stored, seasoned, and manufactured in accordance with specification ANSI 05, 1-19-79.
 - Prohibited defects include:
 - Red heart
 - Shakes in the tops of poles
 - Short crooks
 - Double-sweep
 - Splits or through-checks
 - Nails or spikes
 - Excessive knots
 - Scars deeper than 1 inch or longer than 3 feet
 - Excessive butt-swell
 - More than one twist per pole length
 - Sweep in two planes
 - All poles shall be straight to the extent that a line drawn from the center of the butt end, to the center of the tip end shall lie within the middle two-thirds of the body of the pole at all points.
 - Poles shall also be free from short crooks, in which the surface deviation from straightness in any 5 feet of length exceeds 1.5 inches at any location, as determined by a straight edge.
 - Each pole shall be prepared and pressure-treated in accordance with American Wood Preservers Association (AWPA) Standards C1, C3, C4, and M1. Treatment shall be "SALT TREATED", CCA-CHROMATED COPPER ARSENATE, and shall conform to AWPA Standard P5. The retention of the treatment shall be tested in accordance with AWPA Standard M2. The minimum penetration shall be 3 inches, or 90 percent of the sap-wood. The retention shall be at least 0.60 POUNDS PER CUBIC FOOT, as determined by AWPA Standards.
 - Provide Class II pole in the length specified in pay item.
 - Each pole shall have a "brand" 12 feet above the butt-end, showing the Manufacturer, Plant-location with month and year of treatment, "Southern Pine CCA", and the Pole Class and Length. A Metal Tag showing Pole Length and Class shall be fixed to the butt-end; and the Length and Class shall be stamped on the top-end.
 - Each pole shall have the "Brand Mark" of an inspection-company that has been approved by the Department.
- Furnish Back-Guy Assembly as follows:***
- From the top-down, a Back-Guy Assembly shall consist of: eye-type thru-bolt, guy-hook, strandvise (or 3-bolt clamp), jumper-bonding clamp, the steel cable (3/8-inch guy-cable stranded), another strandvise (or 3-bolt clamp), and a Screw-type guy anchor.

- All parts shall be as shown on the Installation Details or the Standards. All hardware shall be hot-dip galvanized in accordance with ASTM Standard A-153 to ensure rust proof.
- Acceptable parts are:
 - a) Guy Anchors - One piece screw type guy-anchors, shall conform to EEI-TD-2, 1 inch diameter, 8- FEET LONG, thimble eye type. (Joslyn No. J-6550-WCA or approved equal)
 - b) Guy Guards shall conform to REA Item "AT" yellow plastic (PVC) sunlight resistant, 8 feet long.
 - c) Spool Insulators shall conform to REA Item "CM".
 - d) Insulators shall conform to REA Item "W".
 - e) Machine Bolts shall conform to REA Item "C".
 - f) `J' hooks - Reliable No. 5552 (or approved equal).
 - g) Guy and Messenger Cable Dead Ends - Reliable Universal Strandwise (or approved equal)
 - h) Thimbleye Bolts shall conform to EEI-TD-4.
 - i) Thimble Nuts shall conform to EEI-TDJ-5.
 - j) Washers shall conform to EEI-TDJ-10.
 - k) Angle Thimbleye shall conform to REA Item 5.
 - l) Cable- 3/8 INCH DIAMETER CABLE (682.3 STEEL CABLE)
 - m) Cable Clamps: 3-bolt clamps shall conform to EEI-TDJ-23, (4 inch and 6 inch sizes)
 - n) Clevises shall conform to EEI-TD-20.
 - o) Side-walk Bridge-over shall be a stress supporting spreader-type, bolting to the wood pole.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Wood Poles and/or Back-Guy Assemblies.

1.3.2 Utility Poles

- Install poles used for joint-use UTILITIES, in accordance with all local codes, and with the requirements of the Utility Company. Provide Cross Arms if required by the Utility Company.

1.3.3 Location

- Install the pole in the general location shown on the Plans.
- Coordinate with the Engineer to stake the field location of the pole, considering the property lines, underground utilities, and overhead clearances (including the guy anchor assembly).
- Engineer will approve staked locations; however contractor is responsible for locating utilities.
- If utility conflicts are discovered, relocate pole in coordination with the Engineer's approval.
- The pole location may have to be moved based on unmarked utilities.

1.3.4 Hole

- Drill a 6-foot DEEP hole, unless indicated otherwise in standard drawings.
- The diameter of the hole shall be larger than the pole by approximately 4 inches all around.
- Ensure the hole is a uniform diameter, and cleanly augured.

1.3.5 Installation

- Install poles to be vertical; if poles are corner signal poles, RAKE the pole away from the strain, 2 to 4 inches per 10 feet length.
- Install back guy assembly in line with the strain of each span wire.
- After installing, back-fill the hole with clean earth or sand (no rocks or debris), placed in 1 foot layers; moisten and compact each layer.
- Remove excess earth from the site; A 2-inch mound around the pole base is acceptable.

1.3.6 Sidewalk

- When installing the pole in a sidewalk, cleanly cut out the sidewalk 6 inches larger than the pole on all sides.
- Install conduit runs in the cut.
- Install as indicated in 1.3.5 Installation, leaving 4 inches for concrete placement.
- Install expansion joint material around the pole and tack in place, after installation of the pole and back filling the hole.
- Pour concrete around the pole to a depth of 4 inches; neatly troweled level. This work is incidental to pole installation.

1.3.7 Grounding

- Ground each pole in accordance with the Standard Drawings.

- Install a No. 6 AWG, SOLID, bare-copper ground wire (ASTM B2) to run the entire length of wooden poles, and extend 6 inches above the top end.
- Securely attach and bond the ground wire to the pole while it is lying on the ground.
- Ensure the ground wire extends 6 inches above the top end with a 2-foot coil (slack) at the top end, and extends down to the bottom with another 2-foot coil on the bottom end.
- Attach the ground wire (and the coils) using galvanized 1-1/2 inch wire staples, on (2 foot) centers above 14 feet, and on 1 foot centers below 14 feet. (The spacing change will be at 8 feet above grade.)
- Provide Ground Rods that are copper-clad, conforming to EEI-TDJ-30, having a minimum size of 5/8 inch by 8 feet in length.
- Use a ground rod clamp that is heavy-duty bronze or brass.
- Provide a GROUND ROD on one wood pole at each intersection, typically on the pole having the electrical service from the Power Company.
- Drive the ground rod vertically into the earth, until it extends about 2 inches above local grade.
- Use a separate No. 6 AWG bare, STRANDED/SOLID copper wire to bond the electrical service and the overhead cable (and pole ground wire) system to the ground rod, using a grounding clamp.

1.3.8 Back- Guy Assembly

- Back Guy each wood pole used to support signal span wires.
- Install Back-Guy Assemblies on wood poles used to support messenger cables especially at turns, and as directed by the ENGINEER.
- Install sufficient numbers of back-guy assemblies to ensure the stability of wood pole installations. This may include:
 - Double-guying
 - Extra-large anchors
 - Re-guying Utility Company poles.
- Install a Back-Guy Assembly:
 - a) Where shown on the plans;
 - b) In conjunction with installation of Steel Cable as span wire;
 - c) In conjunction with the installation of a wooden pole;
 - d) Where required by the Utility Company to "dress" pole to which signal equipment is attached; or,
 - e) At corner/turning wood poles that are used for messenger cable runs.
- A separate pay item is provided for Back Guy installation
- Inform the ENGINEER when additional back guy assemblies are required.
- Ensure the number and size of Back-Guy assemblies is fully sufficient to anchor every wood signal pole, corner messenger cable pole, and Utility Company pole (where required).
- Stage the installation of the wood pole, Back-Guy Assembly, and the span wire, for the safety of the motorist, pedestrian, and signal construction worker.
- Stretch, adjust, and then RE-ADJUST the span wire and Back-Guy Assembly to produce the specified amount of span wire sag, the proper signal head road-clearance, and still create a nearly vertical wood pole.
- Ensure the Back-Guy Assembly is sufficiently strong to handle the pull of all span wires, considering the earth/soil type into which the ground anchor is buried. Provide EXTRA LARGE ANCHORS and/or MULTIPLE-ANCHOR ASSEMBLIES if needed. Use special anchors for solid rock.
- Where a pedestrian sidewalk is adjacent to a wood pole, furnish a sidewalk "bridge-over" assembly.
- Ensure the compass angle of the Back-Guy is reasonably IN LINE with the strain of the overhead cable: that is, in line with each span wire. For corner signal wood poles, install two (2) Back-Guys, installed at right angles to each other. Using a single diagonal Back-Guy is generally unacceptable, unless approved by the ENGINEER.
- Install the Back-Guy (wherever possible) to provide as a minimum: rise=2 / run=1 (i.e. 2/1). For example, if the Back-Guy is attached at 26 feet, the anchor should be at a minimum of 13 feet from the pole. This corresponds to an angle with the earth of about 60 degrees.
- Perform all work within the public Right of Way, and take particular to assure that the Back-Guy does not extend into private property.
- Install the Back-Guy where it will not interfere with traffic, giving particular attention to private driveways. Where damage is likely (e.g. edge of driveway) install a STEEL GUY GUARD to protect the cable. When shown on the Plans, place a CONCRETE TIRE/WHEEL STOP (curb) at the base of the Back-Guy, anchored/pinned with 2 feet pieces of reinforcement bar.
- Do not splice the steel cable used in the Back-Guy assembly.

1.3.9 Inspection

- The ENGINEER will inspect each installation of wood pole, span wire, signal heads, and Back-Guy, for proper clearance, dress, and tension. At the direction of the ENGINEER, the CONTRACTOR shall re-install or replace improper installations, without further compensation.

1.3.10 Acceptance

- Acceptance of each wood pole shall include checking for the pressure-treatment inspection company Brand Mark, plus visual inspection by the ENGINEER.
- The visual inspection shall be made of the pole, overhead cables, grounding, and back guy assembly.
- The complete installation shall be structurally sound, and the final pole placement shall be vertical, or raked as specified.
- Contractor shall replace any poles NOT meeting this inspection, without further cost to the project.

1.4 Measurement

- Furnishing and installing wood poles, will be measured by EACH, of the Size specified, erected in place as shown on the Plans, including grounding, and all miscellaneous hardware and related work activity as required.
- Furnishing and installing Back-Guy Assemblies, will be measured by EACH, erected in place in accordance with the Specifications and as shown on the Plans, including all miscellaneous hardware as required.
- Additional Back-Guy Assemblies that are installed for reason of situations or conditions that arise during construction, will be paid, and shall be measured by EACH.

1.5 Payment

Wood Pole

6825020	FURNISH & INSTALL 35' WOOD POLE - CLASS II - CCA TREATED(0.60)	EA
6825021	FURNISH & INSTALL 40' WOOD POLE - CLASS II - CCA TREATED(0.60)	EA
6825023	FURNISH & INSTALL 50' WOOD POLE - CLASS II - CCA TREATED(0.60)	EA
6825025	FURNISH & INSTALL 60' WOOD POLE - CLASS II - CCA TREATED(0.60)	EA

Back-Guy Assembly

6825045	FURNISH & INSTALL 3/8" BACK GUY FOR WOOD POLE	EA
6825046	FURNISH & INSTALL 3/8" SIDEWALK GUY	EA
6825047	FURNISH & INSTALL 3/8" AERIAL GUY	EA

Supplemental Technical Specification for

Steel Cable

SCDOT Designation: SC-M-682-3 (01/18)

1.1 Description

This work shall consist of furnishing and installing splice-free lengths of Steel Cable with cable supports, for mounting signal heads, signs, interconnect runs at locations shown on the Plans and in accordance with the Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Steel Cable.

1.3.2 Span Wire

- Install all Span Wire as shown on the plans and in accordance with the Standard Drawings. Note that different methods and materials are required for Wood Poles and Steel Poles.
- Before erecting the Span Wire, the Contractor shall determine the length of cable required to span the distance indicated on the Plans. Allow sufficient additional length to compensate for sag, pole connections, and adjustments, to make the whole assembly consistent with the plans and the Standard Drawings. NO MID-SPAN SPLICES SHALL BE PERMITTED.
- Set the Span Wire so that the height of the installed signal heads, including all hardware, shall conform to the clearances shown on the Standard Drawings.
- Do not permanently "tied-off" the Span Wire until all signal heads, signs, and cables are in place.
- Do not erect any Span Wire which lays on, or is likely to rub a Utility Company's cable. Protect any Span Wire erected within 6 inches of any other cable, wire, or structure with plastic wire-guards.
- When required by the Utility Company, or by the applicable electrical Code, install strain-type fiberglass insulators.
- **Cables from STEEL POLES**
 - a) Steel Poles are essentially electrical conductors.
 - b) Use a Roller Type Pole Clamp attached at the proper height.
 - c) Secure the free-end of the cable with a 6 inch galvanized steel clamp, with 5/8 inch galvanized bolts. Place the clamp approximately 1 foot from the pole. Cable-grips are not permitted.
 - d) Cover the ends of the cable with "servisleeves" to prevent unraveling.
 - e) The SAG shall be 3%, TO 5%, fully loaded.
- **Cables from WOODEN POLES**
 - a) Wooden poles are essentially electrical insulators, and thus require extensive GROUNDING and BONDING procedures, in accordance with the Standard Drawings.
 - b) The SAG shall be typically 5%, fully loaded.
 - c) The height of attachment shall be sufficient to provide the required road-clearance, including sag.
 - d) Shall be installed in accordance with the requirements of the Utility Company.
 - e) May require the installation of a back guy assembly as required in 682.1 WOOD POLE/BACK GUY ASSEMBLY.
 - f) Shall be electrically bonded.

1.3.3 Messenger Wire

- Where Messenger Wire is attached to traffic signal poles, install it in the same manner as specified for span wire, but with relatively little sag.
- Where Messenger Wire is attached to utility poles, install it in accordance with the UTILITY COMPANY'S SPECIFICATIONS.

1.3.4 Tether Wire

- Where Steel Cable is specified to tether signal heads and/or traffic signs, install it in accordance with the Standard Drawings. Galvanized S-hooks should be used at the pole ends to permit "break-away" action.

1.3.5 Cable Supports

- Use Cable Supports to support electrical cables from span wire and messenger wire. Place Cable Supports at 10 INCH INTERVALS.
- When Aluminum Tie-Wraps are used, install by wrapping 3-full turns TIGHTLY around the bundle formed by the steel cable and all electrical cables then cutting off from the tape coil.

1.4 Measurement

- Measure Steel Cable of the SIZE specified by the LINEAR FEET of material as actually placed, which shall include cable supports, clamps, insulators, and all other miscellaneous hardware and fittings. (or other sizes as shown on the plans), and such payment shall be full compensation for furnishing and placing the cable, support rings, clamps, S-hooks, turnbuckles, and other incidentals required to complete the work as specified.

1.5 Payment

6825092	FURNISH AND INSTALL 3/8" GALVANIZED STEEL CABLE (Span Wire)	LF
6825090	FURNISH AND INSTALL 1/4" GALVANIZED STEEL CABLE (Messenger Wire)	LF

Supplemental Technical Specification for

Pedestrian Pole and Base

SCDOT Designation: SC-M-682-4 (01/18)

1.1 Description

This work shall consist of furnishing and installing a Pedestrian Pedestal Pole and Base in accordance with these Specifications and the Standard Drawings (675-105-02, 675-105-03).

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Pedestrian Pole and Base.
- Install Pedestrian Pedestal Poles where shown on the Plans and as needed to accommodate pedestrian movements.
- Mount Pedestrian Pedestal Poles so that no portion of the assembly (including the pedestrian head) is closer than 24" inches to the face of the curb.
- Powder-coating may be required if pay item is provided or if specified in the special provisions or on the signal plans. Perform the powder-coating over the aluminum poles at the factory or during the manufacturing process.

1.3.2 Installation

- Construct the foundation to the dimensions shown on Standard Drawings.
- Capp two 1- inch conduit elbows at both ends and secured in place in the excavation before pouring any concrete. The size and number of elbows shall be that necessary to mate with the incoming runs.
- Ensure all conduit elbows shall extend beyond the side of the finished foundation by approximately twelve inches, in the direction of, and at a depth matching the incoming conduit.
- Set 4 Anchor Bolts using pre-formed templates (wood or metal), to provide a "bolt-circle" in accordance with the Dimension Chart, or with recommendations of the base manufacturer. Leave the templates in place for two days (48 hours) or until the forms are removed.
- Mix, place and test concrete in accordance with applicable portions of SCDOT STANDARD SPECIFICATIONS Sections 701, 702, 703, and 704.
- Fasten the pedestrian pole base to the concrete foundation using appropriate hardware.
- Erect and tightly screw the aluminum pole into the base.
- Tighten the setscrew to prevent counter rotation of the aluminum pole.

1.4 Measurement

- Furnishing and installing pay items include pedestrian pedestal pole, base, and foundation installation by EACH including all required incidental hardware and work to install.

1.5 Payment

6825480	FURNISH & INSTALL 4' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA
6825482	FURNISH & INSTALL 8' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA
6825484	FURNISH AND INSTALL 10' BREAK-AWAY ALUMINUM PEDESTAL POLE AND BASE	EA

Powder-coating Option:

6888192	POWDERCOATING OPTION FOR 4' ALUMINUM PEDESTAL POLE	EA
6888193	POWDERCOATING OPTION FOR 8' ALUMINUM PEDESTAL POLE	EA
6888194	POWDERCOATING OPTION FOR 10' ALUMINUM PEDESTAL POLE	EA

Foundation Only:

Only for use where pedestrian pole and base is provided by others.

6825486	INSTALL CONCRETE FOUNDATION FOR ALUMINUM PEDESTAL POLE	EA
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Supplemental Technical Specification for

Signal Heads

SCDOT Designation: SC-M-686-1 (01/18)

1.1 Description

This work shall consist of furnishing and installing Signal Heads, LED Modules or Backplates of the types, sizes, and mounting specified, in accordance with these Specifications, the plans and in accordance with the Standard Drawings (675-105-01, 675-105-02).

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Signal Heads.
- The Contractor shall furnish the ENGINEER with any warranties on materials provided by the Manufacturer or Vendor as normal trade practice, including a minimum 5-year warranty for the LED modules.
- In addition, the Contractor shall provide a EIGHTEEN (18) MONTHS workmanship warranty following the FINAL ACCEPTANCE. If any signal head fails by reason of defective material or workmanship, including cracking, falling, peeling or fading, the Contractor shall furnish and install replacement signal heads at no expense to the Department.
- Signal LED modules shall have the incandescent look. Pixelated LED modules shall be supplied as replacement modules only as directed by the ENGINEER.
- The red section in the five section head shall be powder coated.
- Provide fully assembled Signal Heads with LED Modules and the appropriate mounting hardware
- Install Signal Heads where shown on the plans and positioned in accordance with the Standard Drawings.
- Ensure the top section of all vehicle signal heads mounted on the same pole or pedestal is within 6 inches of being the same height unless otherwise specified.
- Install all multi-section/ combination signal heads with their top sections at the same elevation as other signal heads.

1.3.2 Wiring

- Connect electrical cable to the terminals in each signal head to provide the proper display indication.
- Do not externally splice the cable.
- Run electrical cable in accordance with the Standard Drawings.

1.3.3 Mounting

- Provide mounting hardware that is from one manufacturer. The DEPARTMENT will not accept mix-matched mounting assembly parts.
- Tighten mounting assembly to manufacturer standards prior to installing.
- If overhead adjustments are required for aiming, contractor shall field tighten using spanner wrench; Contractor shall ensure that signal heads are securely mounted on span wire or mast arms.
- Mount all traffic signal heads as shown on the plans and in accordance with the Standard Drawings.
- Aim signal faces to ensure good visibility, and to the satisfaction of the ENGINEER.

1.3.4 Signal Backplate

- Fasten Signal Backplates using appropriate hardware recommended by the signal head manufacturer.
- Provide a Signal Backplate that matches signal head without cutting, bending, or breaking. Drilling holes to match screw patterns is acceptable.
- Provide a Signal Backplate in accordance with Standard Drawing.

1.4 Measurement

- The pay items for furnish and install Signal Heads will be measured using the EACH unit and includes furnishing and installing Signal Heads with LED modules as specified on the plans and including ALL mounting hardware, internal electrical connections and ALL required incidental hardware.

1.5 Payment

6865710	FURNISH & INSTALL 12" – 5 SECTION SIGNAL HEAD	EA
6865720	FURNISH & INSTALL 12" – 4 SECTION SIGNAL HEAD	EA
6865723	FURNISH & INSTALL 12" – 3 SECTION SIGNAL HEAD	EA
6865834	FURNISH & INSTALL BACKPLATE W/ RETROREFL.BORDERS FOR TRAFFIC SIGNAL	EA

Supplemental Technical Specification for

Pedestrian Signal Head

SCDOT Designation: SC-M-686-3 (01/18)

1.1 Description

This work shall consist of furnishing and installing Pedestrian Signal Heads, Pedestrian LED Modules of the types, sizes, and mounting specified, in accordance with these Specifications, the plans and in accordance with the Standard Drawings. (675-105-02, 675-105-03, 675-110-00).

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Pedestrian Signal Heads.
- The Contractor shall furnish the ENGINEER with any warranties on materials provided by the Manufacturer or Vendor as normal trade practice, including a minimum 5-year warranty for the LED modules.
- In addition, the Contractor shall provide EIGHTEEN (18) MONTHS workmanship warranty following the FINAL ACCEPTANCE. If any pedestrian signal head fails by reason of defective material or workmanship, including cracking, falling, peeling or fading, the Contractor shall furnish and install replacement pedestrian signal heads at no expense to the Department.
- Pedestrian Signal LED modules shall have the incandescent look. Supply pixelated LED modules as replacement modules only as directed by the ENGINEER.
- The pedestrian head and the mounting hardware are stated as one item.
- Install pedestrian signal heads where shown on the Plans or as needed to accommodate pedestrian movements.
- If multiple Pedestrian Signal Heads are required on the same pole or pedestal, mount within 6 INCHES of being the same height unless otherwise specified on the Plans.
- Mount Pedestrian Signal Heads so that no portion of the assembly is closer than 24 INCHES to the face of the curb.
- Mount Pedestrian Signal Heads to provide a clearance of 9 to 10 feet from the surface grade.

1.3.2 Wiring

- Connect electrical cable to the terminals in each Pedestrian Signal Head to provide the proper display indication when energized by the signal controller.
- Do not externally splice the cable.
- Run electrical cable in accordance with the Standard Drawings.

1.3.3 Mounting

- Use non-corrosive material in all hardware.
- Use FEDERAL YELLOW painted brackets, arms, and other hardware, unless noted otherwise in the plans or special provisions.
- Mount all pedestrian signal heads as shown on the Plans and Standard Drawings.
- See Standard Drawings for mounting information on Clamshell Mount, Side of Pole Mount, Single Post Top Mount, and Dual Post Top Mount.

1.4 Measurement

- The pay items for furnish and install Pedestrian Signal Heads will be measured using the EACH unit and includes furnishing and installing Pedestrian Signal Heads with LED modules as specified on the plans and including ALL mounting hardware, internal electrical connections and ALL required incidental hardware.
- There are separate pay items for furnishing and installing Pedestrian LED modules in existing pedestrian signal heads using the EACH unit.

1.5 Payment

6865782	FURNISH & INSTALL PEDESTRIAN SIGNAL HEAD	EA
6865783	FURNISH & INSTALL COUNTDOWN PEDESTRIAN SIGNAL HEAD	EA

Supplemental Technical Specification for

Pedestrian Push Button Station Assembly with Sign

SCDOT Designation: SC-M-686-4 (01/18)

1.1 Description

This work shall consist of furnishing and installing a PEDESTRIAN PUSH BUTTON STATION ASSEMBLY AND PUSH BUTTON SIGN, of the types, sizes, and mountings specified in accordance with these Specifications, at locations shown on the Plans and in accordance with the Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Pedestrian Push Button Assembly.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice.
- Install Push Button Station Assemblies where shown on the Plans, or as necessary to accommodate pedestrian movements.

1.3.2 Installation

- Install Push Button Station Assemblies on poles in a height of 3-1/2 to 4 feet ABOVE GRADE.
- Orient and wire the Push Button Station Assembly in such a manner to clearly indicate to the pedestrian, the crosswalk with which it is associated.
- Attach Push Button Station Assemblies to poles using 1 inch stainless steel bands or galvanized screwed directly to pole.
- If dual push button station assemblies are required, a single dual mounting bracket shall be used to allow for two push button station assemblies to be mounted with the buttons positioned below the sign.
- Firmly secure the finished assembly to the pole.
- Connect each Push Button Station Assembly with the appropriate electrical cable, and wire to actuate the proper phase of the controller. The necessary cable is specified as a separate item, in accordance with 677.1 ELECTRICAL CABLE.
- Do not splice the cable.
On metal poles, bring the cable for the push buttons through the rear of the assembly directly into the pole or controller cabinet. On wooden poles, use electrical conduit to bring the cable to the assembly.

1.3.3 Push Button Signs

- Install each push button sign on the station assembly to reflect the proper intention of the pedestrian movement.

1.4 Measurement

- The pay items for furnish and install Push Button Station Assembly with Sign will be measured using the EACH unit and includes furnishing and installing the Push Button, Push Button Assembly and Sign as specified on the plans and including ALL mounting hardware, internal electrical connections and ALL required incidental hardware.

1.5 Payment

6865793	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON MICROSWITCH TYPE STATION ASSEMBLY (9"x12") AND SIGN (R-10-3E)	EA
6865794	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON MICROSWITCH TYPE STATION ASSEMBLY (9"x15") AND SIGN (R-10-3E)	EA
6865795	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON MICROSWITCH TYPE	EA
6865796	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE STATION ASSEMBLY (9"x12") AND SIGN (R-10-3E)	EA

6865797	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE STATION ASSEMBLY (9"x15") AND SIGN (R-10-3E)	EA
6865798	FURNISH & INSTALL PEDESTRIAN PUSH BUTTON SOLID STATE WITH LIGHT AND TONE	EA

Supplemental Technical Specification for

LED Blankout Sign

SCDOT Designation: SC-M-686-5 (01/18)

1.1 Description

This work shall consist of furnishing and installing a LED Blankout Sign of Clam-Shell configuration, with Sun Visor and designated mounting hardware. of the types, sizes, and mounting specified, in accordance with these Specifications, the plans and in accordance with the Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to LED Blankout Sign.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice.
- The Blankout Sign and the mounting hardware are stated as one item.
- Install the Blankout Signs where shown on the Plans, positioned according to the Standard Drawings.
- Hang Blankout Sign to ensure good visibility, to the satisfaction of the Engineer.

1.3.2 Wiring

- Connect electrical cable to the terminals in each Blankout sign to provide the proper display indication.
- Do not externally splice the cable.
- Run electrical cable in accordance with the Standard Drawings.
- Electrical cable shall be splice-free lengths of, NO. 14 COPPER WIRE, 4 CONDUCTOR, BLACK, see 677.1 Electric Cable

1.3.3 Mounting

- Use hardware that is non-corrosive material, or chemically compatible with the item being used.
- Use adjustable signal brackets to rigidly mount Blankout Signs.
- Use brackets and suspensions that are painted Federal YELLOW unless directed otherwise by the Engineer (Except mast arm mounts).
- Mount all Blankout Signs as shown on the Standards Drawings.

1.4 Measurement

- The pay items for furnish and install Blankout Signs will be measured using the EACH unit and includes furnishing and installing Blankout Sign housing, with appropriate LED module as specified on the plans and including ALL mounting hardware, internal electrical connections and ALL required incidental hardware.
- There are separate pay items for furnishing and installing Blankout LED modules in existing Blankout sign housing using the EACH unit and includes weather tight neoprene gasket and any other hardware or material necessary to complete installation.

1.5 Payment

6865820	FURNISH & INSTALL NO RIGHT/LEFT TURN SYMBOLIC LED BLANKOUT SIGN W/ SPAN WIRE MOUNTING	EA
6865821	FURNISH & INSTALL NO RIGHT/LEFT TURN SYMBOLIC LED MODULE	EA

Supplemental Technical Specification for

Removal Salvage and Disposal of Equipment and Materials

SCDOT Designation: SC-M-688-1 (01/18)

1.1 Description

This work consists of the removal and salvage or removal and disposal of equipment, materials or refuse that are not designated or permitted to remain. Contractor will dispose of these items in a manner that complies with all state and federal regulations governing disposal.

1.2 Materials

n/a

1.3 Construction

1.3.2 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Removal, Salvage and Disposal of Equipment and Materials.
- Carefully remove the items to be salvaged from the job site and return to the Department. The Contractor shall deliver, and obtain a RECEIPT for, the salvaged equipment, from the SCDOT District Signal Shop or the Local Government Signal Shops to which is delivered. These receipts shall be presented to the Engineer.
- Remove equipment or material to be Disposed and properly dispose at an APPROVED LAND FILL (or material reclamation yard). Any materials designated as HAZARDOUS WASTE shall be disposed in compliance with the SC Department of Health and Environmental Control (DHEC) regulations.
- Any equipment or material to be Disposed shall not be re-sold by contractor as anything other than scrap material.
- Fill every hole caused by removing old equipment on THE SAME DAY. Back-fill, compact, and reseed/sod, in compliance with the Standard Specifications. Cleanly side-trim holes in PAVEMENT then bring to grade and finish with the same paving material as the adjacent pavement. Completely replace sidewalk "squares" (complete square), using forms and expansion material.
- Underground conduit and detector loops not utilized, shall be abandoned in place.
- FINAL ACCEPTANCE and Final Payment will be withheld, until the Contractor has completely demobilized, and until the Contractor presents the proper RECEIPTS indicating the salvaged equipment has been delivered..

1.3.3 *Items that are Removed and Disposed of:*

1.3.2.1 Concrete foundations

- Remove the foundations of ground-mounted cabinets completely. Remove the foundations of signal support poles to a minimum depth of 18 inches below surface grade, unless noted differently on the plans or in the special provisions.

1.3.2.2 Damaged Equipment

- Remove and Dispose of any signal equipment/material that is deemed by the Engineer to be damaged beyond salvaging.

1.3.2.3 Miscellaneous Equipment

- Remove minor equipment from the site and dispose. This includes steel cable, electrical cable, conduit, concrete pads, back guys and pullboxes / handboxes not utilized in the new signalization.

1.3.2.4 Wood Poles

- Remove Wood Poles that are not utilized in the new signalization and are not required by other utilities

1.3.4 Items that are Removed and Salvaged

1.3.3.1 Cabinet Assembly

- Prior to removal, clearly tag each cabinet, controller, conflict monitor, and any other major cabinet equipment item with the intersection name from which it is being removed. (*Fiber interconnect center, video detection cabinet equipment, Ethernet switch, fiber modem, radio cabinet equipment*)
- Record serial numbers for each cabinet, controller, and conflict monitor serial numbers and transmit to the Department

1.3.2.2 Signal Heads

- Prior to removal, clearly tag each signal head with the intersection name from which it is being removed.
- Carefully dismount signal heads keeping as much of the mounting hardware intact as possible.
- During the removal and delivery, take special care to prevent damage to the lenses and visors.

1.3.2.3 Pedestrian Equipment

- Prior to removal, clearly tag each pedestrian head, pedestrian pole and pedestrian button assembly with the intersection name from which it is being removed.
- Carefully dismount pedestrian heads and button assemblies keeping as much of the mounting hardware intact as possible.
- Ensure removal of pedestal pole includes related hardware (nuts, base).
- During the removal and delivery, take special care to prevent damage to the lenses and visors.

1.3.2.4 Metal Poles

- Prior to removal, clearly tag each steel strain pole with the intersection name from which it is being removed.
- Ensure removal of strain poles includes their related hardware (pole caps, bolt covers, hand hole covers, nuts, transformer bases, etc.).
- Bag related hardware and attach to steel strain pole and pedestrian pole to ensure materials remain together.

1.3.2.5 Splice Boxes

- Prior to removal, clearly tag each splice box with the intersection name from which it is being removed.

1.3.2.6 Signs

- Remove and salvage highway signs on existing span wires after the replacement signs have been installed.

1.4 Measurement

The pay item remove, salvage and disposal shall be paid as a lump sum per contract or as per each, which relates to remove, salvage, disposal items per signal. The lump sum pay item includes all signals named in the contract. The each pay item relates to each signal. Costs relating to transportation, disposal, pavement, pole foundation removal 18" below grade and grading repairs are incidental and are to be included in either pay item.

The cost for removing foundations for steel strain poles is provided as each, which is per pole foundation which is all removals needed per steel strain pole foundation removal. The related costs of transportation, disposal, concrete, pavement repair, etc., are incidental and shall be included in the bid price of Removal, Salvage, and Disposal.

1.5 Payment

6885990	REMOVAL, SALVAGE,& DISP.OF EXISTING TRAF. SIGNAL EQUIPMENT	LS
6885991	REMOVAL, SALVAGE,& DISP.OF EXISTING TRAF. SIGNAL EQUIPMENT	EA
	REMOVE FOUNDATION OF STEEL STRAIN POLE COMPLETELY	EA

Supplemental Technical Specification for

Video Detection System

SCDOT Designation: SC-M-688-3 (01/18)

1.1 Description

This work consists of furnishing and installing video detection systems with all necessary hardware and software in accordance with the plans and Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Video Detection System.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice.
- Arrange and conduct site surveys with SCDOT personnel to determine proper camera sensor unit selection and placement.
- Provide SCDOT at least 3 working days notice before conducting site surveys.
- Upon completion of the site surveys, provide SCDOT with revised plans reflecting the findings of the site survey.
- As determined during the site survey, install sensor junction boxes with nominal 6 x 10 x 6 inches dimensions at each sensor location. Provide terminal blocks and tie points for power cable
- Place into operation loop emulator detection systems. Configure loop emulator detection systems to achieve required detection in designated zones. Have a certified manufacturer's representative on site to supervise and assist with installation, set up, and testing of the system.
- Perform modifications to camera sensor unit for gain, sensitivity, and iris limits necessary to complete the installation.
- Do not install camera sensor units on signal poles unless approved by the ENGINEER
- Install a power cable appropriately sized to meet the power requirements of the sensors. At a minimum, provide three conductor 120 VAC field power cable.
- Install the necessary cables from each sensor to the signal controller cabinet along signal cabling routes.
- Install surge protection where coaxial video cables and other cables are required between the camera sensor and other components located in the controller cabinet. Terminate all cable conductors.
- Relocate camera sensor units and reconfigure detection zones as necessary according to the plans for construction phases.

1.4 Measurement

- Furnishing and Install Video Detection System shall be measured as EACH unit and shall include one camera, the cabinet equipment, and all mounting hardware and necessary cable to connect camera to cabinet equipment.
- Furnish and Install Add'l Camera with Hardware & Lead In shall be measured as EACH unit and includes furnishing and installing 1 camera and all mounting hardware and necessary cables to connect to cabinet equipment.

1.5 Payment

6886039	FURNISH & INSTALL VIDEO DETECTION CAMERA MOUNTING HARDWARE	EA
6886040	FURNISH & INSTALL VIDEO DETECTION SYSTEM W/HARDWARE & LEAD-IN	EA
6886041	INSTALL VIDEO DETECTION SYSTEM	EA
6886042	FURNISH & INSTALL VIDEO DETECTION CAMERA W/ HARDWARE & LEAD-IN	EA

Supplemental Technical Specification for

Steel Strain Pole and Foundation

SCDOT Designation: SC-M-688-5 (01/18)

1.1 Description

This work shall consist of furnishing and installing Steel Strain Poles for traffic signal supports at the locations shown on the Plans and in accordance with the Standard Drawings, with anchor bolts and all miscellaneous hardware. This work shall also consist of installing a foundation for the steel strain pole in accordance with the Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Steel Strain Pole.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice.
- Repair galvanized surfaces (poles) which have been scratched or abraded so that bare metal is exposed, by applying 2 coats of 90% (minimum) Zinc-rich, cold-galvanizing compound; to the satisfaction of the ENGINEER.

1.3.2 Location

- Install the pole in the general location shown on the Plans.
- Coordinate with the Engineer to stake the field location of the pole, considering the property lines, underground utilities, and overhead clearances.
- ENGINEER will approve staked locations, however contractor is responsible for locating utilities.
- If utility conflicts are discovered, relocate pole in coordination with the Engineer's approval.
- The pole location may have to be moved based on unmarked utilities.

1.3.3 Foundation

- Drill a hole, as indicated in the Standard Drawings.
- The hole shall be augured (earth-auger), and the concrete poured in UN-disturbed earth.
- Ensure the hole is a uniform diameter, and cleanly augured.
- If foundation cannot be constructed to meet Standard Drawings, provide an alternative foundation design signed and sealed by a SC PE.
- It may be necessary to use a jack-hammer in BED-ROCK; it may be necessary to use a heavy walled CAISSON to line the hole and to pump it dry in high water table areas or areas where springs are encountered. These materials, tools and additional labor are incidental to the project.
- Where shown on the Plans, or as determined by the location of underground utilities, it may be necessary to excavate a hole BY HAND. NO additional payment shall be made UNLESS an item has been established in the BID or Proposal for UNCLASSIFIED EXCAVATION (hand excavation of hole) - CUBIC YARDS.
- Construct the foundation as shown in Standard Drawing 675-115-02 including the rebar cage and conduit.
- Mix, place, pour and test the concrete in accordance with SCDOT Standard Specifications, Sections 701, 702, 703, and 704.
- Provide CLASS 5000 for the foundation. Place the concrete in one continuous pour with vibration.
- Set the Anchor Bolts using pre-formed templates (wood or metal), to provide a "bolt-circle" in accordance with the Standard Drawings or with recommendations of the pole Manufacturer. Leave the templates in place for 2 days (48 hours).
- Capp conduit elbows at both ends, and secure in place in the excavated hole before pouring any concrete.

- Each foundation shall have a minimum of 1-3", 3-2" and 2-1" conduits placed in accordance with the Standard Drawings. Provide additional conduits if shown on the plans. These conduits are incidental to the work.
- Terminate all conduit provided in foundation in a 13"X24"X18"splice box; the splice box shall be installed in accordance with 680.2 Splice Boxes / Junction Boxes. The splice box shall be paid separately.
- Ensure all conduit elbows extend beyond the side of the finished foundation by a minimum of 12 inches, in the direction of, and at a depth matching the incoming conduit. Where a conduit elbow is placed for future use, scribe an "X" in the foundation to indicate the side where such conduit enters. Ensure the conduit protrudes a minimum of 6 inches above the top of the finished concrete foundation.

1.3.4 Grounding

- Furnish and install ground rods and grounding wire with each foundation.
- Configure the ground rod with the foundation, as shown on the Standard Drawings.
- Use grounding clamps of brass or bronze to secure the grounding wire to the ground rod.
- Use a continuous ground wire to bond all metal parts together--pole ground stud; pedestal pole nut; pole-mounted controller cabinet ground; metal conduits; etc.

1.3.5 Installation

- Do not place the steel pole on the foundation for a minimum of 2 days (48 hours after individual pour)
- Do not place strain on the steel pole for a minimum of 7 days (168 hours after individual pour) or as otherwise directed by the ENGINEER.
- Rake each pole away from the line of span wire pull, by adjusting the nuts on the Anchor Bolts.
- When final load is applied, ensure there is a 6 inch (plus or minus one inch) rake at the top of the pole, opposing the direction of the stress.
- Restore the site to prime condition after the pole installation, back filling the area surrounding the pole with topsoil, raking it level and seeding. If the area is sloped, then use landscape turf.

1.3.6 Sidewalk/Island Installation

- When installing the pole in a sidewalk, cleanly cut out the entire "square" of the sidewalk and install the foundation as indicated above.
- Replace the sidewalk using expansion joint material to separate different "pours" and old/new concrete. This work is incidental, unless an item has been established for CONCRETE PATCH or for SIDEWALK.
- In concrete islands, saw-cut out a square opening 4 feet x 4 feet for the pole base and repair as stated above.
- When installed in SIDEWALKS or CONCRETE ISLANDS, contour the entire area and hand-finish to produce a neat visual line. Sharp edges or pedestrian hazards shall not be allowed.

1.3.7 Acceptance

- Acceptance of each pole shall include foundation strength testing plus visual inspection by the ENGINEER.
- The visual inspection shall be made of the pole, overhead cables, and grounding.
- The complete installation shall be structurally sound, and the final pole placement shall be vertical, or raked as specified.
- Contractor shall replace any poles NOT meeting this inspection, without further cost to the project.

1.4 Measurement

- Furnishing and installing 13" Diameter Steel Strain Poles and Foundations, will be measured by EACH, of the size(s) specified, and erected in place as shown on the plans. This shall include foundation, anchor bolts, nut covers, pole cap, reinforcing steel, ground rod, ground wire, and all miscellaneous hardware as required.
- Installing Concrete Foundation for Steel Strain Pole, will be measured by each, shall include reinforcing steel, ground rod, ground wire, and all miscellaneous hardware as required.

1.5 Payment

682505A	FURNISH & INSTALL 26' STEEL STRAIN POLE AND FOUNDATION	EA
6825050	FURNISH & INSTALL 26' STEEL STRAIN POLE (POWDER COATED) AND FOUNDATION	EA
6825056	FURNISH & INSTALL 26' STEEL STRAIN POLE (POWDER COATED OVER GALVANIZED) & FOUNDATION	EA
682505B	FURNISH & INSTALL 28' STEEL STRAIN POLE AND FOUNDATION	EA
6825051	FURNISH & INSTALL 28' STEEL STRAIN POLE (POWDER COATED) AND FOUNDATION	EA
6825057	FURNISH & INSTALL 28' STEEL STRAIN POLE (POWDER COATED OVER GALVANIZED) AND FOUNDATION	EA
682505D	FURNISH & INSTALL 32' STEEL STRAIN POLE AND FOUNDATION	EA

6825052	FURNISH & INSTALL 32' STEEL STRAIN POLE (POWDER COATED) AND FOUNDATION	EA
6825058	FURNISH & INSTALL 32' STEEL STRAIN POLE (POWDER COATED OVER GALVANIZED) AND FOUNDATION	EA

Supplemental Technical Specification for Concrete Strain Pole

SCDOT Designation: SC-M-688-6 (01/18)

1.1 Description

This work shall consist of furnishing and installing pre-stressed Concrete Strain Poles for traffic signal supports at the locations shown on the Plans and in accordance with the Standard Drawings, with all miscellaneous hardware. These poles shall be of the type intended for direct embedding, with the hole back filled with concrete.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Concrete Strain Pole.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice.
- Patch any concrete surfaces which have been chipped, chunked or damaged to the satisfaction of the ENGINEER with a commercial grade vinyl or epoxy based on concrete patching compound, according to manufacturer's instructions.
- CAUTION – Concrete poles are very heavy, quite long and are difficult to handle. Perform transportation, site handling and erection with acceptable equipment and methods and by qualified personnel. The Contractor is cautioned to have cranes, pole trailers and sufficient manpower to perform this work with total safety to the crew and to the motoring public. The Contractor shall review the manufacturer's shop drawings to identify proper pick-up points for lifting.

1.3.2 Location

- Install the pole in the general location shown on the Plans.
- Coordinate with the Engineer to stake the field location of the pole, considering the property lines, underground utilities, and overhead clearances.
- ENGINEER will approve staked locations; however contractor is responsible for locating utilities.
- If utility conflicts are discovered, relocate pole in coordination with the Engineer's approval.
- The pole location may have to be moved based on unmarked utilities.

1.3.3 Hole

- Augur the hole in undisturbed earth of the diameter and to the depth (at least) listed in the standard drawings or as recommended by the manufacturer (whichever is larger). Construct the embedding foundation as shown in Standard Drawing 675-115-02.
- Measure the depth and diameter of the hole with a tape measure to ensure it meets the required dimensions.
- If hole dimensions and backfill foundation cannot be constructed to meet Standard Drawings, provide an alternative foundation design signed and sealed by a SC PE.
- It may be necessary to use a jack-hammer in BED-ROCK; it may be necessary to use a heavy walled CAISSON to line the hole and to pump it dry in high water table areas or areas where springs are encountered. In Wet-lands or loose-sand, it may also be necessary to auger a larger hole. These materials, tools and additional labor are incidental to the project.
- Where shown on the Plans, or as determined by the location of underground utilities, it may be necessary to excavate a hole BY HAND. NO additional payment shall be made UNLESS an item has been established in the BID or Proposal for UNCLASSIFIED EXCAVATION (hand excavation of hole) - CUBIC YARDS.
- In bed-rock, a hole shall be jack-hammered out and be of sufficient depth to hold the design embedded length and a diameter to provide 3 inch clearance all around the concrete pole.

1.3.4 Grounding

- Furnish and install ground rods and grounding wire with each concrete pole.
- Drive the ground rod adjacent to the poured concrete embedding as shown on the Standard Drawing.
- Use grounding clamps of brass or bronze to secure the grounding wire to the ground rod.

- Use a continuous ground wire to bond all metal parts together--pole ground stud; pedestal pole nut; pole-mounted controller cabinet ground; metal conduits; etc.

1.3.5 Installation

- Place the concrete pole in the hole.
- Lift the pole into place, using a sling. A single point lift shall NEVER be used and such misuse could result in the ENGINEER rejecting that pole.
- Next, to lower the pole into the hole, insert a bar into the choker hole (1/3 down the pole)(to prevent the strap from slipping) and use a single strap to raise one end of the pole vertically and jostle the butt end into the hole.
- Lower the pole into the hole and hold vertically by the crane.
- Using a pry bar through the "CANT" hole, rotate the pole so that all holes are at the proper compass orientation angle with the street and incoming conduit runs.
- Rake each pole slightly away (leaned away) from the direction of the span wire pull. For a concrete pole this will typically mean that the back side of the pole is vertically plumb.
- Backfill the hole back with concrete while supporting the concrete pole vertically with a pole or boom truck until the poured embedding concrete begins to set. This will typically be 15 to 20 minutes.
- Mix, place, pour and test the concrete in accordance with SCDOT Standard Specifications, Sections 701, 702, 703, and 704.
- Provide CLASS 3000 for the foundation; Place the concrete in one continuous pour.
- Plug/cover the underground cable entrance hole and any conduit openings to prevent concrete intrusion.
- After installation, the Contractor shall plug or cap all unused openings and couplings on the concrete pole using a threaded plug or a cemented PVC cap.
- Cap at both ends and secure in place any conduit elbows in the excavation before pouring any concrete.
- Each foundation shall have a minimum of 1-3", 3-2" and 2-1" conduits placed in accordance with the Standard Drawings. Provide additional conduits if shown on the plans. These conduits are incidental to the work.
- Terminate all conduit provided in foundation in a 13"X24"X18"splice box; the splice box shall be installed in accordance with 680.2 Splice Boxes / Junction Boxes. The splice box shall be paid separately.
- Ensure all conduit elbows shall extend beyond the side of the finished foundation by a minimum of 12 inches in the direction of and at a depth matching the incoming conduit.
- Do not place stress (steel cables) on the pole until the poured embedding concrete has hardened (typically 72 hours).
- Restore the site to prime condition after the pole installation, back filling the area surrounding the pole with topsoil, raking it level and seeding. If the area is sloped, then use landscape turf.

1.3.6 Sidewalk/Island Installation

- When installing the pole in a sidewalk, cleanly cut out the entire "square" of the sidewalk and install the concrete pole embedded in poured concrete; back fill with tamped dirt to 4 inches below the ground line foundation as indicated above.
- Replace the sidewalk using expansion joint material to separate different "pours" and old/new concrete. This work is incidental, unless an item has been established for CONCRETE PATCH or for SIDEWALK.
- In concrete islands, saw-cut out a square opening 4 feet x 4 feet for the pole base and repair as stated above.
- When installed in SIDEWALKS or CONCRETE ISLANDS, contour the entire area and hand-finish to produce a neat visual line. Sharp edges or pedestrian hazards shall not be allowed.

1.3.7 Acceptance

- Acceptance of each pole shall include foundation strength testing plus visual inspection by the ENGINEER.
- The visual inspection shall be made of the pole, overhead cables, and grounding.
- The complete installation shall be structurally sound, and the final pole placement shall be vertical, or raked as specified.
- Contractor shall replace any poles NOT meeting this inspection, without further cost to the project.

1.4 Measurement

- Furnishing and installing concrete strain poles will be measured by EACH of the length specified. This shall include pole cap and all miscellaneous hardware as required.
- Conduit elbows shall be considered to be incidental to the installation of the concrete pole.

1.5 Payment

6825061	FURNISH & INSTALL 35' CONCRETE STRAIN POLE	EA
6825062	FURNISH & INSTALL 40' CONCRETE STRAIN POLE	EA
6825064	FURNISH & INSTALL 45' CONCRETE STRAIN POLE	EA

Supplemental Technical Specification for

Controller and Cabinet Assembly

SCDOT Designation: SC-M-688-7 (01/18)

1.1 Description

This work shall consist of furnishing and installing Cabinet Assembly, Cabinet Foundation and Controller in accordance with these Specifications, at the locations shown on the Plans, and in accordance with the Standard Drawings. This item shall include all electrical accessories and other items specified.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Controller and Cabinet Assembly.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice or to match warranty on existing state contract items.

1.3.2 Concrete Foundation

- Construct the foundation to the dimensions shown on the Standard Drawing 675-130-02.
- Set bolt pattern in accordance with the recommendations of the Cabinet Manufacturer.
- Set templates for setting anchor bolts and leave in place until the forms are removed.
- Concrete lag bolts drilled into pad are allowed.
- Mix, place and test concrete in accordance with applicable portions of SCDOT STANDARD SPECIFICATIONS Sections 701, 702, 703, and 704. Provide CLASS 3000 concrete.
- Set base mounted cabinets on a bead of silicone caulk.

1.3.3 Ground Rod and Ground Wire

- Furnish and install a ground rod and ground wire with each Cabinet.
- Place the 5/8 INCH by 8 feet (minimum) Copper-clad ground rods near the cabinet's concrete foundation, external to the cabinet pad in a splice box. If additional ground rods are required, place nearby and EXOTHERMICALLY WELD together.
- Place a 1-INCH PVC conduit and elbow in foundation prior to pouring as shown in the Standard Drawing.
- Run ground wires (No. 6 AWG bare, stranded copper wire) continuously from the ground rod to the Controller Cabinet (chassis ground on the AC ground bar) through this conduit; and run ground wires continuously from the ground rod to the foundation anchor bolts, to the conduit bends, etc.
- EXOTHERMICALLY WELD ground wires TO THE GROUND ROD.
- Use grounding bushings on metal conduit.
- For Cabinets mounted on strain poles, connect the grounding stud on the pole.
- The entire ground rod shall be driven below the grade or place in a junction box.

1.3.4 Conduit Elbows

- Do not encase the conduit entering the cabinet in concrete. (See Standard Drawings)
- Set Conduit Elbows in the footing excavation before the concrete is poured.
- The size and number of elbows shall be that necessary to mate with the incoming runs and in accordance with the plans and the Standard Drawings. Run conduit in accordance with Standard Drawing 675-130-02 from pole to splice box and from pole to cabinet where the steel pole is adjacent to a base mounted cabinet.
- Conduit shall extend beyond the side of the finished foundation by a minimum of 12 inches, in the direction of, and at a depth matching the incoming conduit.
- The conduit shall extend beyond the top of the finished foundation into the pole or Cabinet, in accordance with Standard Drawings.
- Cover and protect the open-ends and threads on the conduit bends during construction activities.

1.3.5 **Electrical Wiring**

- Install all required equipment in the Cabinet, and neatly wire with tied or wrapped harnesses. Force-fitted or mutually interfering equipment is not acceptable.
- Label cable harnesses and terminals legibly.
- Terminate all bare wires in a "spade-lug" prior to connection to a terminal strip. 'Crimp-on' the "spade-lug" using a ratchet-type crimping tool.
- Tie wires not facilitating equipment movement to the back or side-panel.
- Install and position equipment for easy access.
- Ensure opening and closing the Cabinet door shall not chaff the wiring.
- Ensure the field (lamp) wiring shall have 3 feet of slack cable in each cabinet.
- Coil the slack and tie neatly in the bottom of the Cabinet.
- Separate signal cables from detector lead-in cables as much as possible, to reduce interference.

1.4 **Measurement**

- Local Controller and Cabinet furnished and/or installed will be measured by EACH TYPE Controller and Cabinet (mounting specified); and erected in place as shown on the Plans including miscellaneous electronics, load switches, wiring, electrical connection, ground rod, ground wire, and all related hardware. This includes a concrete cabinet foundation, anchor bolts and all necessary hardware.
- Furnishing and/or Installing a Concrete Cabinet Foundation will be measured by EACH and will include anchor bolts and all necessary hardware.

1.5 **Payment**

6845510	FURNISH AND INSTALL CONTROLLER AND 336 CABINET ASSEMBLY - POLE MOUNTED	EA
6845511	FURNISH AND INSTALL CONTROLLER AND 332/336 CABINET ASSEMBLY - BASE MOUNTED	EA
6888220	INSTALL CONTROLLER AND 336 CABINET - POLE MOUNTED	EA
6888225	INSTALL CONTROLLER AND 332/336 CABINET - BASE MOUNTED-INCLUDING FOUNDATION	EA
6888226	INSTALL CONTROLLER AND 332/336 CABINET ASSEMBLY-BASE MOUNTED CABINET ON EXISTING FOUNDATION	EA
6845520	FURNISH AND INSTALL 2070 CONTROLLER UNIT IN EXISTING CABINET	EA
6845614	INSTALL 2070 CONTROLLER UNIT &/OR CONFLICT MONITOR IN EXISTING CABINET	EA
6887951	FURNISH AND INSTALL CONCRETE CABINET FOUNDATION	EA

Supplemental Technical Specification for

Flasher Cabinet Assembly

SCDOT Designation: SC-M-688-8 (01/18)

1.1 Description

This work shall consist of furnishing and installing Splice/Flasher Cabinet as indicated on the plans and in accordance with these Specifications and the Standard Drawings.

1.2 Materials

Acceptable materials for Flasher Cabinet Assembly includes an aluminum flasher box, complete with mounting brackets , police lock and key, minimum dimensions of 14" x 14" x 11" . Flasher Cabinet Assembly shall have terminal lugs included. Flasher Cabinet Assembly shall be Pre-wired for Time Switch and include a back panel pre-wired for

- 8 position terminal block
- 10 amp circuit breaker
- SPA-100T lightning surrestor
- Toggle switch for a variety of operation times
- 30 amp isolation relay
- NEMA flasher.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Flasher Cabinet.
- The Contractor shall furnish the ENGINEER with any warranties on materials that are provided by the Manufacturer or Vendor as normal trade practice or to match warranty on existing state contract items.
- Provide all components or hardware made of corrosion-resistant material, or be of the same materials as the item being installed.
- Provide a cabinet designed for pole or pedestal-pole mounting. It shall be furnished with all related corrosion resistant hardware, including top and bottom mounting brackets, or pole-hub. Straps used shall be stainless steel.
- Install a Flasher Cabinet Assembly to operate overhead or shoulder mounted flashers that are powered with electricity.

1.3.2 Mounting/ Foundation

Mount the Cabinet as shown in the Standards Drawings.

1.3.3 Grounding

- GROUNDING AND SURGE/LIGHTNING PROTECTION SHALL BE PROVIDED in every Flasher Cabinet Assembly (unless specifically forbidden by the Manufacturer).
- The Protector shall be Telephone Company grade, and be conformable with the Terminal Block
- Ground the cable shield.
- Run a No. 6 AWG bare stranded copper Ground Wire continuously from the Cabinet to the ground rod at the pole base. Where design requires, drive a new ground rod; and install a ground wire from the Cabinet to the ground rod.

1.3.1 Electrical Wiring

- Connect electrical cables to the terminals in accordance with the signal equipment Manufacturer recommendations.

1.4 Measurement

- Furnishing and/or Installing Flasher Cabinet Assembly, shall be measured by EACH housing, erected and placed as shown on the Plans, including miscellaneous electronics, electrical connections, etc. NOTE: The furnishing, installation, and payment of the conduit, poles, electrical service, and other major items are specified elsewhere.

1.5 Payment

6845655	FURNISH & INSTALL FLASHER CABINET ASSEMBLY	EA
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Supplemental Technical Specification for

Solar Powered Flasher Assembly

SCDOT Designation: SC-M-688-9 (01/18)

1.1 Description

This work shall consist of installing and/or furnishing a Solar Powered Flasher Assembly and performing all related wiring necessary, in accordance with these Specifications and the Standard Drawings.

1.2 Materials

Acceptable materials can be found on the current SCDOT Qualified Products List http://info.scdot.org/Construction_D/sitePages/qualifiedProducts3.aspx.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Solar Powered Flasher Assembly.
- The Contractor shall furnish the ENGINEER with any warranties on materials provided by the Manufacturer or Vendor as normal trade practice, including a minimum 5-year warranty for the LED modules.
- The types of Solar Flasher Assembly is listed below:
 - 24/7 Single Solar 24 Hour Flashing Beacon
 - 24/7 Single Compact Solar 24 Hour Flashing Beacon
 - Dual 24 Hour Solar Powered Flashing Beacon
 - Dual Solar Powered School Flashing Beacon
 - Dual Compact Solar School Zone Flasher

1.3.2 Installation

- Install the entire assembly, including solar engine, signal housing and LED modules with all necessary hardware for mounting to one of the following pole types:
 - Pedestrian Pole
 - Side-of-pole arm
- If the sign is larger than 36 inches, install the assembly using two poles.
- Install Pedestrian Pole in accordance with 682.4 Pedestrian Pole and Base and the Standard Drawings.
- The entire assembly shall mount at one point. Separate mounting for the signal head or any other component shall not be required.

1.4 Measurement

Furnishing and Installing a Solar Powered Flasher Assembly, shall be measured by EACH, erected and placed as shown on the Plans, which shall include all electrical connections and all required incidental hardware and all necessary bases and foundations for poles.

Separate pay items for Pedestrian Poles are in accordance with 682.4 Pedestrian Pole and Base.

1.5 Payment

6865700	FURNISH & INSTALL SOLAR POWERED FLASHER ASSEMBLY - SINGLE BEACON	EA
6865701	FURNISH & INSTALL SOLAR POWERED FLASHER ASSEMBLY - DUAL BEACON	EA
6865702	FURNISH & INSTALL SOLAR POWERED FLASHER ASSEMBLY	EA

Supplemental Technical Specification for

Steel Pole with Mast-Arm

SCDOT Designation: SC-M-690-1 (01/18)

1.1 Description

This work shall consist of designing (foundations, lengths of arms, size of support arms), furnishing and installing Steel Traffic Signal Poles with Mast-Arm(s). Concrete footings with reinforcing steel, anchor bolts, ground rods, conduit elbows, and miscellaneous hardware shall be designed and installed with each pole as required. **Steel mast-arm poles, its components, adapter plates and foundations shall be stamped and sealed by a licensed South Carolina Professional Engineer.**

1.2 Materials

Material Specifications are located at

http://www.scdot.org/doing/technicalPDFs/publicationsManuals/trafficEngineering/TrafficSignal_MaterialSpecs.pdf.

1.3 Construction

1.3.1 General

- The requirements detailed in this specification cover any other pay item not listed in Payment but pertaining to Mast Arms.
- The CONTRACTOR shall furnish the Engineer with all warranties on equipment and material offered by the Manufacturer as normal trade practice.
- Repair poles, which have been scratched or abraded so that bare metal is exposed, to the satisfaction of the Engineer. Repair holes drilled in poles or Mast-Arms
- Use hardware or components made of a non-corrosive material, or be of the same material as the item being installed.
- Install signal head using rigid signal head mount brackets. The bracket shall consist of a top- and bottom-arm, an extruded aluminum vertical tube, a vertical tube clamp, and a mast-arm clamp, with all hardware. The Bracket shall be COMPLETELY RUST PROOF, and shall be fully adjustable in all dimensions and angles.
- *Where required by the Plans, install signs using a rust proof mounting bracket.*
- *Powdercoating Color and type will be specified on the plans or in the Special Provisions.*
- *Decorative options will be specified on the plans or in the Special Provisions.*
- *Luminaires generally require a taller pole, per Standard Drawing or as noted in Special Provisions or Signal Plans.*
- *Luminaire to be furnished and/or installed must be provided by the same manufacturer as the mast arm, unless noted otherwise. Luminaire design and/or color should match mast arm design and/or color unless noted otherwise in Special Provisions or on Plans.*
- Luminaires are metered separately from traffic signal, unless noted otherwise on the plans or in the special provisions.

1.3.2 Location

- Install the pole in the general location shown on the Plans.
- Coordinate with the Engineer to stake the field location of the pole, considering the property lines, underground utilities, and overhead clearances.
- ENGINEER will approve staked locations; however contractor is responsible for locating utilities.
- If utility conflicts are discovered, relocate pole in coordination with the Engineer's approval.
- The pole location may have to be moved based on unmarked utilities.
- The design of the mast arm is based on the location, length and soil type. Contractor shall not order mast arm poles until final pole location is determined free of utilities and is approved by the Engineer.
- Provide soil boring at each signal location to the satisfaction of the Engineer of Record designing the mast arm assembly and foundation. A minimum of one soil boring per signal to a 15' depth is required.

1.3.3 Foundation

- Contractor to provide foundation design (see 1.3.9), including depth and diameter of foundation, reinforcing cage design, strength of concrete;
- Drill a hole, as indicated in the foundation design.
- The hole shall be augured (earth-auger), and the concrete poured in UN-disturbed earth.

- Ensure the hole is a uniform diameter, and cleanly augured.
- The foundation shall be constructed with a circular reinforcing cage (**either tied together, or tack welded**) installed, in accordance with foundation design.
- Steel reinforcement shall conform to the requirements of DOT STANDARD SPECIFICATIONS, Section 703.2.1. The bars shall be of the size and type shown on the foundation design.
- The finished square surface above ground shall be as shown on the Standard Drawings.
- It may be necessary to use a jack-hammer in BED-ROCK; it may be necessary to use a heavy walled CAISSON to line the hole and to pump it dry in high water table areas or areas where springs are encountered. These materials, tools and additional labor are incidental to the project.
- Where shown on the Plans, or as determined by the location of underground utilities, it may be necessary to excavate a hole BY HAND. NO additional payment shall be made UNLESS an item has been established in the BID or Proposal for UNCLASSIFIED EXCAVATION (hand excavation of hole) - CUBIC YARDS.
- Mix, place, pour and test the concrete in accordance with SCDOT Standard Specifications, Sections 701, 702, 703, and 704.
- Use design concrete strength, minimum of CLASS 5000 for the foundation. Place the concrete in one continuous pour with vibration.
- Set the Anchor Bolts using pre-formed templates (wood or metal), to provide a "bolt-circle" in accordance with the Standard Drawings or with recommendations of the pole Manufacturer. Leave the templates in place for 2 days (48 hours).
- Capp conduit elbows at both ends, and secure in place in the excavated hole before pouring any concrete.
- Each foundation shall have a minimum of 1-3", 3-2" and 2-1" conduits placed in accordance with the Standard Drawings. Provide additional conduits if shown on the plans. These conduits are incidental to the work.
- Terminate all conduit provided in foundation in a 13"X24"X18"splice box; the splice box shall be installed in accordance with 680.2 Splice Boxes / Junction Boxes. The splice box shall be paid separately.
- Ensure all conduit elbows extend beyond the side of the finished foundation by a minimum of 12 inches, in the direction of, and at a depth matching the incoming conduit. Where a conduit elbow is placed for future use, scribe an "X" in the foundation to indicate the side where such conduit enters. Ensure the conduit protrudes a minimum of 6 inches above the top of the finished concrete foundation.

1.3.4 **Grounding**

- Furnish and install ground rods and grounding wire with each foundation.
- Configure the ground rod with the foundation, as shown on the Standard Drawings.
- Use grounding clamps of brass or bronze to secure the grounding wire to the ground rod.
- Use a continuous ground wire to bond all metal parts together--pole ground stud; pedestal pole nut; pole-mounted controller cabinet ground; metal conduits; etc.

1.3.5 **Anchor Bolts**

- Provide hooked anchor bolts at least 90 inches long with each steel pole with mast arms.
- Thread and hot dip galvanize the top 12 inches of the anchor bolt.
- Provide two hot dipped galvanized nuts and two washers per anchor bolt.

1.3.6 **Adapter Plate**

- Provide adapter plate with each mast arm that has a different anchor bolt pattern from SCDOT's standard steel pole pattern.
- **Note: Adapter plate(s), bolts, nuts, and washers not required if steel pole with mast arm is designed to be supported by current SCDOT signal foundation (concrete foundation with (4) 2" dia. anchor bolts on a 18-inch dia. bolt circle), and the design meets the design criteria requirements of this specification.**
- With each steel pole with mast arms, provide a 2" thick, hot dipped galvanized steel adapter to allow a pole with a 19" square base plate and 18" dia. bolt circle to be installed. Plate shall be pre-drilled with (4) 2 3/8" dia. bolt holes on the 18" dia. bolt circle. A 10" dia. minimum hole shall be provided in the center of the adapter plate.
- Provide (4) hot dipped galvanized 2" x 10" hex head cap screws, (12) nuts, and (8) washers in a **BURLAP** bag for each adapter plate. Bolts and nuts shall be of sufficient strength to support a 32-foot tall steel pole with steel strain wire supporting signal heads and signs for the intersection in case the steel pole with mast arms is damaged and has to be removed and replaced.
- Adapter plate(s), bolt, and nut selection and design shall be stamped and sealed by a licensed South Carolina Professional Engineer.

- Provide a **BURLAP** bag containing the adapter plate nuts, bolts, and washers inside each steel pole with mast arms.
- *Place the adapter plate, if required, between the leveling nuts and the steel pole with mast arms base.*

1.3.7 Installation

- Do not place the mast arm pole on the foundation for a minimum of 2 days (48 hours after individual pour)
- Do not place a load on the mast arm poles for a minimum of 7 days (168 hours after individual pour) or as otherwise directed by the ENGINEER.
- Each Pole shall be raked away from the line of the Mast-Arm pull, by adjusting the nuts on the anchor bolts.
- When final load is applied, there shall be an essentially vertical appearance as determined by the Engineer.
- Provide 22' minimum vertical clearance between the bottom of the overhead traffic signal mast arm and the pavement and shoulders, unless otherwise shown on the plans.
- Restore the site to prime condition after the pole installation, back filling the area surrounding the pole with topsoil, raking it level and seeding. If the area is sloped, then use landscape turf.

1.3.8 Sidewalk/Island Installation

- When installing the pole in a sidewalk, cleanly cut out the entire "square" of the sidewalk and install the foundation as indicated above.
- Replace the sidewalk using expansion joint material to separate different "pours" and old/new concrete. This work is incidental, unless an item has been established for CONCRETE PATCH or for SIDEWALK.
- In concrete islands, saw-cut out a square opening 4 feet x 4 feet for the pole base and repair as stated above.
- When installed in SIDEWALKS or CONCRETE ISLANDS, contour the entire area and hand-finish to produce a neat visual line. Sharp edges or pedestrian hazards shall not be allowed.

1.3.9 Acceptance

- Acceptance of each pole shall include foundation strength testing plus visual inspection by the ENGINEER.
- The visual inspection shall be made of the pole, overhead cables, and grounding.
- The complete installation shall be structurally sound, and the final pole placement shall be vertical, or raked as specified.
- Contractor shall replace any poles NOT meeting this inspection, without further cost to the project.

1.3.10 Design Criteria

1.3.10.1 AASHTO Standards

- Ensure the Mast-Arm traffic signal Pole is designed to meet the requirements of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals"; American Association of State Highway And Transportation Officials (AASHTO), latest edition.
 - Design all components of the Mast-Arm Pole assemblies to include and to address the following:
 - Mast Arm Length
 - Soil type
 - Design Life – minimum 25-year mean recurrence interval
 - Basic wind speed in accordance with AASHTO Wind Speed map (latest edition)
 - Ice loading
 - Fatigue category II (2)
 - Natural wind gust pressure loads
 - Truck-induced gust pressure loads
 - Mast arm loading as follows in 1.10.2.

1.3.10.2 Minimum Loading Assumptions

- For design, minimum loading assume there is a 4-section polycarbonate, rigidly mounted signal head with backplate centered per lane including auxiliary lanes, an 24" x 8' illuminated street name sign on each arm, and additional 24" x 36" signs adjacent to each signal head. See plans to determine if additional loading is required. Design mast arms for the most stringent loading.

1.3.10.3 Design And Drawings

- The CONTRACTOR SHALL FURNISH pole design details, calculations, and shop-drawings in sufficient detail for complete evaluation and comparison with these Specifications.
- Any exceptions to these Specifications must be stated in writing.

- The design, calculations, and shop drawings shall be stamped and sealed by a licensed South Carolina Professional Engineer.
- The CONTRACTOR SHALL FURNISH a concrete foundation design details and calculations adequate for local soil type and steel pole with mast arm loading.
- Mast arm loading shall be the greater of the Minimum Loading Assumptions or the loading shown on the Plans.
- The design and calculations shall be stamped and sealed by a licensed South Carolina Professional Engineer.
- **Provide CATALOG CUTS ARE REQUIRED FOR REVIEW AND APPROVAL PRIOR TO FABRICATION.**

1.3.10.4 Miscellaneous Items

Steel pole with mast arms design drawing shall include the following:

- 4" x 6" minimum reinforced handhole,
- 1/2" coarse thread grounding stud located on interior of pole handhole,
- strain relief j-hook at top of pole, rain cap,
- holes in steel poles and mast arms for wiring to be routed to traffic signals,
- holes for wiring to be protected with full circumference grommets,
- nut covers to be provided to cover anchor bolt nuts,
- tapered poles and mast arms shall taper uniformly along their length
- additional requirements as shown on the signal plans for the intersections

1.4 Measurement

The following pay items will be measured by Each (EA) erected in place as shown on the plans:

- Design shall include all necessary services to completely design mast arm installation, including necessary geotechnical work, utility research, foundation design, mast arm upright and arm structural design and determining length of mast arms.
- Furnish includes delivery costs and all necessary components necessary to provide and install a fully functional mast arm, including all hardware Adapter Plates (if applicable), Anchor Bolts, Nut Covers, Pole Cap, reinforcing steel, ground rod, ground wire, and all miscellaneous hardware as required.
- Install pay items including foundation include all materials and work necessary to completely install mast arm structure, including rebar, concrete, conduit, and forms.
- Install pay item without foundation includes all work necessary to install mast arm on existing foundation.
- Powdercoating pay items include providing a color option for mast arms, either over the base mast arm material or over the galvanized mast arm material
- Decorative option per mast arm includes providing decorative features such as ornamental pole bases (skirts), fluted options, banner arms or curved options, in accordance with the special provisions or plans.
- Luminaire option for mast arm includes the additional cost for a taller pole (27'), if luminaire is to be mounted above the signal heads.
- Furnish and install mounting assembly pay items include installing the mounting hardware for signs and for signal heads on the mast arm, including all necessary hardware.
- Furnish and install Luminaire includes all necessary materials, equipment and labor for full operational luminaire assembly, including electrical cable, conduit and meter pan if metered separately from traffic signal.
- Pay items for mast arms designating the height and length of the mast arms will only be used when the Engineer has designed full mast arm plans; payment and will be paid for at the contract unit price Each (EA), and include all materials, hardware, manpower and equipment to fully install a functional mast arm assembly.

The following pay item will be measured by cubic yard (CY):

- Install Foundation for Mast Arm includes all materials and work necessary to completely install mast arm foundation, including rebar, concrete, conduit, and forms.

1.5 Payment

6888179	DESIGN, FURNISH & INSTALL STEEL POLE WITH MAST ARM INCLUDING FOUNDATION	EA
6888172	DESIGN, FURNISH & INSTALL STEEL POLE WITH MAST ARM WITHOUT FOUNDATION	EA
6888177	DESIGN, FURNISH & INSTALL STEEL POLE WITH TWIN MAST ARMS INCLUDING FOUNDATION	EA
6888178	DESIGN, FURNISH & INSTALL STEEL POLE WITH TWIN MAST ARMS WITHOUT FOUNDATION	EA

6888166	POWDERCOATING PER MAST ARM OVER BASE	EA
6888167	POWDERCOATING PER MAST ARM OVER GALVANIZED	EA
6888168	DECORATIVE OPTION PER MAST ARM	EA
6888169	LUMINAIRE OPTION FOR MAST ARM - TO ACCOUNT FOR TALLER POLE	EA
6513020	FURNISH & INSTALL MOUNTING ASSEMBLY FOR FLAT SHEET SIGN ERCTD ON MAST ARM	EA
6865831	FURNISH & INSTALL VEHICLE TRAFFIC SIGNAL HEAD MOUNTING ASSEMBLY FOR MAST ARM	EA
6888164	FURNISH & INSTALL DUAL LUMINAIRE INCLUDING LUMINAIRE ARMS AND ALL ASSOCIATED HARDWARE	EA
6888165	FURNISH & INSTALL SINGLE LUMINAIRE INCLUDING LUMINAIRE ARMS AND ALL ASSOCIATED HARDWARE	EA
6888174	INSTALL FOUNDATION FOR MAST ARM INCLUDING CONCRETE AND REBAR	CY
	FURNISH & INSTALL ___' STEEL POLE WITH ___' MAST ARM INCLUDING FOUNDATION	EA
	FURNISH & INSTALL ___' STEEL POLE WITH TWIN MAST ARMS (___'X___')AT ___ DEG. INCLUDING FOUNDATION	EA

Short-Range Radio Device Detector System

SCDOT Designation: SC-M-699-1 (01/18)

1.1 Description

This work shall consist of furnishing and/or installing a Short-Range Radio Device Detector System to detect vehicles on a roadway by using battery-powered magnetometer-type sensors that communicate their detection data by radio to a roadside communications hub before the data is relayed to a local traffic controller and, optionally, a central software system or a data server as may be desired.

The Short-Range Radio Device Detection System shall be capable of monitoring and measuring vehicular and pedestrian movement by identifying and comparing unique Bluetooth (BT) MAC (Media Access Control) addresses associated with Short-Range Radio enabled electronic devices. The system can be used to collect high quality, high-density travel times by sampling a portion of actual travel activity from the traffic stream of a predetermined route. The BT MAC address received by a sequence of two or more Short-Range Radio Device receivers shall be matched and used to develop a sample of travel time for that particular segment of the roadway, based on the relative detection times recorded by the adjacent units. The BT MAC address being detected shall be both discoverable and non-discoverable.

1.2 Materials

The Short-Range Radio enabled device (sensor) shall be an anonymous Short-Range Radio Device BT MAC address, which is a hardware identifier for the manufacturer and specific electronic device type. BT MAC addresses are not associated with any specific user account or any specific vehicle. The BT MAC address shall not be linked to a specific person through any type central database, but is assigned by the Short-Range Radio Device electronic chip manufacturer and shall not be tracked through the sales chain. Privacy concerns typically associated with alternative probe systems shall be eliminated.

A. Requirements (Type A, Type B, and Type C)

The Short-Range Radio Device Detection System shall be connected to, and work in conjunction with the support data processing system, located in a designated server. All The Short-Range Radio Device Detection units shall adhere to the following requirements:

- } Short-Range Radio Device: Class 1 Transceiver with 4 dB to 8 dB Omni Directional Antenna
- } Environmental: 30°C to +65°C, 5 – 90% humidity
- } Connectivity: IP/Ethernet 10/100 Base-T (minimum)
- } I/O ports: minimum one (1) RJ45 Ethernet port

a. Short-Range Radio Device Detection System, Type A

Provide a Short-Range Radio Device Detection System that can be installed in a typical signal or ITS cabinet. The unit shall be enclosed in its own housing and sit on a shelf within the cabinet. Utilize a conduit, as shown on the plans, for routing the antenna cable, and attach the antenna at the location shown on the plans. The power for the Short-Range Radio Device Detection System, Type A unit shall come from typical cabinet power (110 VAC) receptacles or terminal block. Supply all wiring for the Short-Range Radio Device Detection System Type A unit. Should the unit require a POE adapter or transformer to VDC, submit the adapter or transformer to the Department for review. The Contractor shall supply all surge protection devices for the external POE adapter or transformer.

b. Short-Range Radio Device Detection System, Type B

Provide a Short-Range Radio Device Detection System that is self enclosed in a NEMA 4X enclosure that can be mounted to a pole, mast arm or cabinet structure. The voltage input shall be between 6 and 30 VDC, or be able to connect to 110 VAC with appropriate transformers and adapters, as determined by the Department. The Short-Range Radio Device Detection System Type B unit shall be wired to a cabinet or approved communication/power source, as shown on the plans. The unit shall not reside within the cabinet.

Provide all grounding, wiring, adapters, transformers, and surge protection devices needed to support the Short-Range Radio Device Detection System Type B unit, as installed.

c. Short-Range Radio Device Detection System, Type C

Provide a Short-Range Radio Device Detection System that is self enclosed in a NEMA 4X enclosure that can be mounted to a pole, mast arm or cabinet structure. Provide a Solar Power Array, which includes the solar panel, charging unit and batteries necessary for solar power. The Short-Range Radio Device Detection System Type C unit shall also include a GSM cellular modem with antennas, or approved equivalent. This Short-Range Radio Device Detection System type shall be a completely wireless installation. Provide all grounding, wiring, adapters, transformers, and surge protection devices needed to support the Short-Range Radio Device Detection System Type C unit, as installed.

d. Short-Range Radio Device Detection System Support Data System Software and Database

Provide a Support Data System software package, including all necessary database 3rd party software required in order for the software to run as intended in support and conjunction of the Short-Range Radio Device sensor system. The software shall be installed on a server designated by the Department. It is the Contractor's responsibility to populate and configure the database for each field Short-Range Radio Device Detection System, and to test the accuracy of the data. The data shall be in an XML format compatible with the Department's central software. The software shall also display a real time chart or graph showing calculated travel time and speeds of the sampled vehicles and BT MAC address counts. The Short-Range Radio Device Detection System support software is required for all new Short-Range Radio Device Detection System installations, but shall not be required for additional Short-Range Radio Device Detection System sensor installations on an existing network.

B. Functional Requirements for the Short-Range Radio Device Detection System

The sensor shall be capable of delivering data from both an Ethernet connection and a wireless cellular modem. The Short-Range Radio Device Detection sensor working in conjunction with the network's support data processing system must deliver real-time speed and travel time information in XML format to the central software system for routes where the sensors are deployed. The system shall be able to add multiple pairs of Short-Range Radio Device Detection sensors to form a network of manageable travel routes. Each route will display the data for the first and last sensor in addition to the travel-time and speed information for that segment. The Short-Range Radio Device Detection sensor shall be able to detect, at a minimum, within a radius of 300 feet when mounted on a pole or mast arm. The data processing shall be able to filter and 'throw out' BT MAC addresses that do not supply accurate information when compared to other device time stamps of the segment between two Short-Range Radio Detection devices. The data shall be smoothed, and be able to process median and mean average speeds. The following data shall be able to be compared and filtered, as needed, to deliver the most accurate information:

1. Pedestrians
2. Oversize Vehicles
3. Mass Transit (i.e. nearby trains or buses)

The Short-Range Radio Device Detection System equipment shall contain advanced features designed to allow the unit to operate efficiently in a remote environment. Diagnostic and configuration information shall be able to be viewed remotely, such that the health and operating status of the sensor is known. The system shall be designed to be able to automatically or remotely "reboot" if a condition is detected that requires such action.

1.3 Construction

Installation

- A. Installation shall be in accordance with manufacturer's instructions.

Testing

- A. Develop and submit plans for post-installation testing to the Engineer for consideration and approval. Ensure the plans test all functional requirements.
- B. Provide the Engineer with the appropriate XML data interface, as necessary, for testing of the travel time accuracy and integration into the central software.
1. Post-installation test procedures: Utilize the following test procedures after the Short-Range Radio Device Detection System has been installed in its entirety as shown on the Plans.

Commence no post-installation testing until all Short-Range Radio Device Detection sensors systems in the project have been configured, calibrated and programmed to communicate on the SCDOT network to the support data system software. At a minimum, provide the following on the test plan to be submitted and approved by the Engineer:

- a. Inspect all Short-Range Radio Device Detection System field components to ensure proper installation and cable termination.
- b. Inspect the quality and tightness of ground and surge protector connections.
- c. Check power supply voltage and outputs and ensure device connections are as specified in the Plans.
- d. Verify that the installation of cables and connections between all Short-Range Radio Device units, antennas and field cabinets and/or components are as specified in the Plans
- e. Demonstrate that each Short-Range Radio Device unit is fully operational and gathering the required data types at the specified and necessary interval.

1.4 Measurement

Furnishing and/or Installing Components of a Short-Range Radio Device Detector System shall be measured as EACH unit and includes all hardware and cables necessary for installation and operation.

1.5 Payment

6990000	Short-Range Radio Device Detection System Support Data System Software and Database	LS
6990010	Short-Range Radio Device Detector System Type A	EA
6990011	Short-Range Radio Device Detector System Type B	EA
6990012	Short-Range Radio Device Detector System Type C	EA

Signal Heads, Pedestrian Treatments, Illuminated signs, solar flashing assemblies:

Cabinet Items:

Service Items:

4. EQUIPMENT (Only needed if SCDOT is providing equipment to be installed by contractor.)

6.1 SCDOT Provided Equipment (Provide a list of equipment, location of equipment, details concerning equipment & installation)

6.2 Faulty Equipment

- When SCDOT supplied equipment is designated faulty by the Engineer, the Contractor shall return it to the Manufacturer for replacement if it is under warranty, The Manufacturer shall furnish a replacement unit.
- When SCDOT supplied equipment is designated faulty by the Engineer and it is not under warranty, SCDOT shall replace the equipment.

5. SIGNAL INTEGRATION (Only needed if different than the default. The default wording in the Supplemental Specifications (675.0 General Provisions 1.10) indicates SCDOT or local government signal maintenance staff will perform integration. If different than that, list what entity will perform integration.)

- The _____ will perform integration in accordance with the Supplemental Specifications, 675.0 General Provisions.

6. MAINTENANCE DURING CONSTRUCTION – (Only needed if different than the default. The default wording in the Supplemental Specifications (675.0 General Provisions 1.5) indicates that this begins at the contract NTP (notice to proceed) for all signals in the contract. If different than that, list whether maintenance begins at:

- a. When a work order is assigned by construction office
- b. When the contractor begins work at a signal
- c. Other option

7. CONTRACT SCHEDULE – (Only needed if different than the default. The default wording in the Supplemental Specifications indicates that contractor will to provide weekly schedule for all signal work. If SCDOT determines a need to set the schedule, indicate such below:)

Example wording:

This is a "TURN-KEY" project where work is assigned using a work order system. Once work orders have been assigned to the **CONTRACTOR**, he shall furnish the Engineer with a **WEEKLY SCHEDULE** for all active traffic signal construction work orders, each Friday, for the week to come, listing the location and date of each intended activity. This will permit scheduling signal inspection personnel. Deviation from this schedule may cause the Department to delay Inspection and Payments.

SCDOT TRAFFIC SIGNAL SPECIAL PROVISIONS – TRAFFIC CONTROL
FOR TRAFFIC SIGNAL PROJECTS

MAINTENANCE OF TRAFFIC

The Contractor shall execute the item of Traffic Control as required by the Standard Specifications, the plans, the Standard Drawings For Road Construction, these special provisions, all supplemental specifications, the MUTCD, and the Engineer. This is an amendment to the Standard Specifications to require the following:

GENERAL REGULATIONS -

- These special provisions shall have priority to the plans and comply with the requirements of the MUTCD and the standard specifications. Revisions to the traffic control plan through modifications of the special provisions and the plans shall require approval by the department. **Final approval of any revisions to the traffic control plan shall be pending upon review by the Director of Traffic Engineering.**
- **Install and utilize changeable message signs in all lane closures installed on high volume high-speed multilane roadways. Use of changeable message signs in lane closures installed on low volume low speed multilane roadways is optional unless otherwise directed by the plans and the Engineer. Install and use a changeable message sign within a lane closure set-up as directed by the *Standard Drawings For Road Construction*. When a lane closure is not present for any time to exceed 24 hours, remove the changeable message sign from the roadway. Place the sign in a predetermined area on the project site, as approved by the Engineer, where the sign is not visible to passing motorists. The preprogrammed messages utilized shall be in accordance with the *Standard Drawings For Road Construction* when used as part of the traffic control set-up for lane closures. Only those messages pertinent to the requirements of the traffic control situation and the traffic conditions are permitted for display on a changeable message sign at all times. At no time will the messages displayed on a changeable message sign duplicate the legends on the permanent construction signs.**
- **During operation of changeable message signs, place the changeable message sign on the shoulder of the roadway no closer than 6 feet between the sign and the near edge of the adjacent travel lane. When the sign location is within 30' of the near edge of a travel lane open to traffic, supplement the sign location with no less than 5 portable plastic drums placed between the sign and the adjacent travel lane for delineation of the sign location. Install and maintain the drums no closer than 3 feet from the near edge of the adjacent travel lane. This requirement for delineation of the sign location shall apply during all times the sign location is within 30' of the near edge of a travel lane open to traffic, including times of operation and non-operation. Oversized cones are prohibited as a substitute for the portable plastic drums during this application.**
- **All signs mounted on portable sign supports shall have a minimum mounting height of 5' from the bottom of the sign to the ground. All signs mounted on ground mounted u-channel posts or square steel tube posts shall have a minimum mounting height of 7' from the bottom of the sign to the grade elevation of the near edge of the adjacent travel lane or sidewalk when a sidewalk is present.**
- **On multilane primary routes, avoid placement of signs mounted on portable sign supports within paved median areas utilized for two-way left turns unless otherwise directed by the RCE.**
- **When mounting signs on multiple ground mounted sign supports, ensure that each post is of the same type. Combining and installing both ground mounted u-section and square steel tube posts within the same sign assembly is prohibited.**
- **When mounting signs on ground mounted u-section or square steel tube posts, utilize either a sign support / ground support post combination with an approved breakaway assembly or a single direct driven post for each individual sign support of a sign assembly installation. Do not combine a sign support / ground support post combination and a direct driven post on the same sign assembly installation that contains two or more sign supports. Regarding sign support / ground support post combination installations, ensure that post lengths, stub heights and breakaway assemblies comply with the manufacturer's requirements and specifications. Use approved breakaway assemblies found on the *Approved Products List For Traffic Control Devices in Work Zones*.**
- **Temporary "Exit" signs (M1025-00) shall be located within each temporary gore during lane closures on multilane roadways. Mount these signs a minimum of 7' from the pavement surface to the bottom of the sign in accordance with the requirements of the MUTCD.**

- **When covering signs with opaque materials, the Department prohibits attaching a covering material to the face of the sign with tape or a similar product or any method that will leave a residue on the retroreflective sheeting. Residue from tape or similar products, as well as many methods utilized to remove such residue, damages the effective reflectivity of the sign. Therefore, contact of tape or a similar product with the retroreflective sheeting will require replacement of the sign. Cost for replacement of a sign damaged by improper covering methods will be considered incidental to providing and maintaining the sign; no additional payment will be made.**
- **Overlays are prohibited on all rigid construction signs. The legends and borders on all rigid construction signs shall be either reversed screened or direct applied.**
- **Signs not illustrated on the typical traffic control standard drawings designated for permanent construction signs shall be considered temporary and shall be included in the lump sum price bid item for "Traffic Control" unless otherwise specified.**
- **Install "Grooved Pavement" signs (W8-15-48) supplemented with the "Motorcycle" plaque (W8-15P-30) in advance of milled or surface planed pavement surfaces. Install these signs no further than 500 feet in advance of the beginning of this pavement condition on primary routes with speed limits of 60 MPH or less and no less than 500 feet in advance of the beginning of this pavement condition on interstate routes. On multilane roadways, comply with the same guidelines as applied to all other advance warning signs and install two sign assemblies at each sign location, one on each side of the roadway, when roadway conditions warrant. Install these signs immediately upon creation of this pavement condition and maintain these signs until this pavement condition is eliminated.**
- **Install "Steel Plate Ahead" signs (W8-24-48) in advance of an area of roadway where temporary steel plates are present. Install these signs no further than 300 feet in advance of locations where steel plates are present. On multilane roadways, comply with the same guidelines as applied to all other advance warning signs and install two sign assemblies at each sign location, one on each side of the roadway, when roadway conditions warrant. Install these signs immediately upon installation of a temporary steel plate and maintain the signs until the temporary steel plates are removed.**
- **The Contractor shall maintain the travel patterns as directed by the traffic control plans and shall execute construction schedules expeditiously. The Contractor shall provide the Resident Engineer with no less than a two-week prior notification of changes in traffic patterns.**
- **During nighttime flagging operations, flaggers shall wear a safety vest and safety pants that comply with the requirements of ANSI / ISEA 107 standard performance for Class 3 risk exposure, latest revision, and a fluorescent hard hat. The safety vest and the safety pants shall be retroreflectorized and the color of the background material of the safety vest and safety pants shall be fluorescent orange-red or fluorescent yellow-green.**
- **During nighttime flagging operations, the contractor shall illuminate each flagger station with any combination of portable lights, standard electric lights, existing street lights, etc., that will provide a minimum illumination level of 108 Lx or 10 fc.**
- **During nighttime flagging operations, supplement the array of advance warning signs with a changeable message sign for each approach. These changeable message signs are not required during daytime flagging operations. Install the changeable message signs 500' in advance of the advance warning sign arrays. Messages should be "Flagger Ahead" and "Prepare To Stop".**

TRAFFIC CONTROL PROCEDURES –

- Utilize a vehicle train consisting of a primary work vehicle and no less than 1 shadow vehicle. A second shadow vehicle is necessary when simultaneously operating in multiple travel lanes. Install and maintain the vehicle train as directed by these special provisions, the Standard Drawings For Road Construction, and the Engineer.

Two-Lane Two-Way Roadways

- A. Utilize flagging operations to control the traffic flow around the work site where the vehicle train is operating.
- B. Utilize flaggers to control the traffic flow on an intersecting two-lane two-way roadway. Only flaggers and advance warning signs are required on the approaches intersecting the travel lane the vehicle train is operating in. Traffic control devices are not required on the intersecting approaches. The advance warning signs for the flagging operations shall include the following:

W20-7a-48	Flagger symbol
W20-4-48-A	One Lane Road Ahead

W20-1-48-A Road Work Ahead

- C. Maintain two-way radio communications between all flaggers.

Multilane Roadways

- A. During work operations that require the vehicle train to encroach upon or operate within the limits of a travel lane for a time duration of 15 minutes or less, advance warning signs may be omitted.
- B. During work operations that require the vehicle train to encroach upon or operate within the limits of a travel lane for a time duration in excess of 15 minutes but less than 60 minutes, advance warning signs are required. Typical advance warning signs required for a temporary closure of a travel lane shall include the following:

W4-2R(L)-48 Lane Ends symbol
 W20-5R(L)-48-A Right (Left) Lane Closed Ahead
 W20-1-48-A Road Work Ahead

- C. Utilization of flaggers to control the traffic flow in the travel lanes adjacent to the travel lane the vehicle train in operating in is PROHIBITED.
- D. Utilize flaggers to control the traffic flow on an intersecting two-lane two-way roadway. Only flaggers and advance warning signs are required on the approaches intersecting the travel lane the vehicle train is operating in. Traffic control devices are not required on the intersecting approaches. The advance warning signs for the flagging operations shall include the following:

W20-7a-48 Flagger symbol
 W20-4-48-A One Lane Road Ahead
 W20-1-48-A Road Work Ahead

- E. **During work operations that require the vehicle train to encroach upon or operate within the limits of a travel lane for a time duration in excess of 60 minutes, install a standard lane closure as directed by these special provisions, the Standard Drawings For Road Construction, and the Engineer.**

- Conduct all equipment and material preparations prior to entering the roadway.
- Avoid conducting traffic signal work or similar work activities that interfere with or create disruptions to normal traffic operations during morning, mid-day, and afternoon-evening high traffic volume peak periods when possible.
- Conduct all work activities within the boundaries of a travel lane closed to vehicular traffic or a pedestrian thoroughfare closed to pedestrian traffic. Conducting work activities over a travel lane open to traffic is PROHIBITED. Conducting work activities over a pedestrian thoroughfare open to pedestrian traffic is PROHIBITED. Do not conduct any work activities in any manner over a thoroughfare open to vehicular or pedestrian traffic.
- When advance warning signs are required to supplement the vehicle train, install the advance warning signs at spacing intervals based on the regulatory speed limit of the roadway prior to beginning any work. When a work zone traffic control plan or a work zone traffic control standard drawing is not provided to indicate the spacing intervals for a typical 3 advance warning sign array installation, utilize the sign placement intervals below. **These sign intervals do not apply to the sign intervals of the advance sign intervals for standard lane closures.**

ADVANCE WARNING SIGN PLACEMENT INTERVALS	
URBAN / RURAL (LOW SPEED) ≤ 35 MPH	200 / 200 / 200 Feet
URBAN / RURAL (INTERMEDIATE SPEED) 40 - 50 MPH	350 / 350 / 350 Feet
RURAL (HIGH SPEED) ≥ 55 MPH	500 / 500 / 500 Feet
INTERSTATE	1000 / 1500 / 2600 Feet

LANE CLOSURE RESTRICTIONS –

- The lane closure restrictions stated below are project specific, for all other restrictions, see supplemental specification, “Restrictions”, dated September 1, 2015.
- The Department prohibits the Contractor from conducting work within the limits of a paved shoulder or median areas on primary routes during any time of the day that traffic volumes exceed 800 vehicles per hour per direction as determined by the Engineer. The Department reserves the right to suspend a lane closure if any resulting traffic backups are deemed

excessive by the Engineer. Maintain all lane closure restrictions as directed by the plans, these special provisions, and the Engineer.

- Installation and maintenance of a lane closure is PROHIBITED when the Contractor is not actively engaged in work activities specific to the location of the lane closure unless otherwise specified and approved by the Engineer. The length of the lane closure shall not exceed the length of roadway anticipated to be subjected to the proposed work activities within the work shift time frame or the maximum lane closure length specified unless otherwise approved by the Engineer. Also, the maximum lane closure length specified does not warrant installation of the specified lane closure length when the length of the lane closure necessary for conducting the work activity is less. The length and duration of each lane closure, within the specified parameters, shall require approval by the Engineer prior to installation. The length and duration of each lane closure may be reduced by the Engineer if the work zone impacts generated by a lane closure are deemed excessive or unnecessary.
- The presence of temporary signs, portable sign supports, traffic control devices, trailer mounted equipment, truck mounted equipment, vehicles and vehicles with trailers relative to the installation or removal of a closure and personnel are prohibited within the 15 to 30 foot clear zone based upon the roadway speed limit during the prohibitive hours for lane closures specified by these special provisions.

SHOULDER CLOSURE RESTRICTIONS -

- The Department prohibits the Contractor from conducting work within 15' of the near edge of the adjacent travel lane on the outside shoulders or the median areas under a shoulder closure during any time that traffic volumes exceed 800 vehicles per hour per direction. The hourly restrictions for lane closures shall also apply to work activities conducted under a shoulder closure within 15' of the near edge of an adjacent travel lane or a median area. The Department reserves the right to suspend work conducted under a shoulder closure if any traffic backups develop and are deemed excessive by the Engineer. Maintain all shoulder closure restrictions as directed by the plans, these special provisions, and the Engineer.
- On interstate highways, the Department prohibits the Contractor from conducting work within the limits of a paved shoulder or within 10' of the near edge of an adjacent travel lane under a shoulder closure. All work that may require the presence of personnel, tools, equipment, materials, vehicles, etc., within the limits of a paved shoulder or within 10' of the near edge of an adjacent travel lane shall be conducted under a lane closure.
- On primary and secondary roadways, the Department prohibits the Contractor from conducting work within 1' or less of the near edge of an adjacent travel lane under a shoulder closure. All work that may require the presence of personnel, tools, equipment, materials, vehicles, etc., within 1' of the near edge of an adjacent travel lane shall be conducted under a lane closure.
- The Contractor shall install all shoulder closures as directed by the typical traffic control standard drawings designated for shoulder closures, and the Engineer. Substitution of the portable plastic drums with oversized cones during nighttime shoulder closures is PROHIBITED.

TYPICAL TRAFFIC CONTROL STANDARD DRAWINGS -

- The typical traffic control standard drawings of the "Standard Drawings For Road Construction", although compliant with the MUTCD, shall take precedence over the MUTCD. The typical traffic control standard drawings of the "Standard Drawings For Road Construction" shall apply to all projects let to contract.

ADDENDUMS

(Addendums to the "2007 Standard Specifications for Highway Construction")

(A) Construction (Sub-section 601.4) –

Sub-section 601.4.2 Construction Vehicles (paragraph 2) -

- When working within the rights-of-way of access-controlled roadways such as Interstate highways, the Contractor's vehicles may only change direction of travel at interchanges. These vehicles are prohibited from crossing the roadway from right side to the median or vice versa. Use a flagger to control the Contractor's vehicles when these vehicles attempt to enter the roadway from a closed lane or the median area. Ensure the flagger does not stop roadway traffic, cause roadway traffic to change

lanes, or affect roadway traffic in any manner. The Contractor's vehicles may not disrupt the normal flow of roadway traffic or enter the travel lane of the roadway until a sufficient gap is present.

- The Contractor shall have flaggers available to control all construction vehicles entering or crossing the travel lanes of secondary and primary routes. The RCE shall determine the necessity of these flaggers for control of these construction vehicles. The RCE shall consider sight distance, vertical and horizontal curves of the roadway, prevailing speeds of roadway traffic, frequency of construction vehicles entering or crossing the roadway and other site conditions that may impact the safety of the workers and motorists when determining the necessity of these flaggers. Ensure these flaggers do not stop roadway traffic, cause roadway traffic to change lanes or affect roadway traffic in any manner. The Contractor's vehicles may not disrupt the normal flow of roadway traffic or enter the travel lane of the roadway until a sufficient gap is present.
- When working within the rights-of-way of access-controlled roadways with posted regulatory speed limits of 55 MPH or greater and average daily traffic volumes {ADT} of 10,000 vehicles per day or greater, all construction and work vehicles possessing any one or more of the vehicular characteristics listed below are only permitted to enter and exit a right or left shoulder work area during the presence of active lane closures unless otherwise directed by the RCE. These vehicles are not permitted to enter or exit these work areas without the presence of active lane closures unless otherwise directed by the RCE. Shoulder closures are unacceptable and insufficient methods for control of traffic at ingress / egress areas for these vehicles. The restrictive vehicular characteristics include the following:
 - Over six (6) tires
 - Tandem rear axles
 - A base curb weight greater than 8000 lbs.
 - A gross vehicular weight greater than 12000 lbs. unless performing duties as a shadow vehicle while supporting a truck mounted attenuator
 - A trailer in tow except under the following conditions:
 - Trailers transporting traffic control devices (including but not limited to standard and 42" oversized traffic cones, portable plastic drums, signs, portable sign supports, u-channel and square steel tube sign posts) relative to the installation of lane closures, shoulder closures or other traffic control operations approved by the RCE
 - Trailer mounted traffic control devices (including but not limited to advance warning arrow panels, changeable message signs, temporary traffic signals, highway advisory radios, work zone intelligent transportation systems and trailer towed truck mounted attenuators)

(B) Construction (Sub-section 601.4) –

Sub-section 601.4.2 Construction Vehicles -

Auxiliary Warning Lights for Vehicles and Equipment -

- Supplement all construction and/or construction-related vehicles and equipment that operate in a stationary or mobile work zone within or adjacent to a roadway within the highway rights-of-way with AMBER or YELLOW colored high intensity rotating or strobe type flashing auxiliary warning light devices. Utilize, install, operate and maintain a single or multiple lighting devices as necessary to provide visibility to approaching motorists.
- All auxiliary warning light models shall meet *Society of Automotive Engineers (SAE) Class I* standards and SAE Standard J575 relative to *Tests for Motor Vehicle Lighting Devices and Components* and these specifications.
- The amber/yellow color of the dome/lens of an auxiliary warning light device shall meet SAE Standard J578 for amber/yellow color specifications.
- Auxiliary warning lights with parabolic reflectors that rotate shall rotate around a halogen lamp at a rate to produce approximately 175 flashes per minute. The parabolic reflector shall produce a minimum 80,000 candle power and a minimum 54,000 candela through an SAE Standard J846 approved amber dome.
- Equip strobe type flashing auxiliary warning light devices with photosensitive circuit controls to adjust the lighting intensity in response to changes in ambient light conditions such as from day to night. These lights shall have a double-flash capability rated at approximately 80 double flashes per minute and produce a minimum 24 joules of flash energy at the highest power level setting.

- Acceptable auxiliary warning light models shall provide sufficient light output to be clearly recognizable at a minimum distance of 1750 feet.
- Mount all auxiliary warning light devices intended to function as the auxiliary warning light system or as an element thereof on vehicles and equipment at locations no less than 3 feet above the ground and in conspicuous locations to provide visibility to approaching motorists.
- Auxiliary warning light devices and/or models that mount in the locations of the standard vehicle lighting system are unacceptable as the specified auxiliary warning light system due to restrictive simultaneous visibility capabilities from multiple sight angles. However, auxiliary warning light devices that mount in the standard vehicle lighting system locations are acceptable as supplements to the specified lighting devices mounted in locations that do meet the minimum height requirements and provide simultaneous visibility capabilities from multiple sight angles.
- Standard vehicle hazard warning lights are only permitted as supplements to the specified auxiliary warning light devices.

(C) Category I Traffic Control Devices (Section 603) –
***** (Effective on all projects let to contract after May 1, 2010) *****

Sub-section 603.2.2 Oversized Traffic Cones (paragraph 6) -

- Reflectorize each oversized traffic cone with 4 retroreflective bands: 2 orange and 2 white retroreflective bands. Alternate the orange and white retroreflective bands, with the top band always being orange. Make each retroreflective band not less than 6 inches wide. Utilize Type III – Microprismatic retroreflective sheeting for retroreflectorization on all projects let to contract after May 1, 2010 unless otherwise specified. Separate each retroreflective band with not more than a 2-inch non-reflectorized area. Do not splice the retroreflective sheeting to create the 6-inch retroreflective bands. Apply the retroreflective sheeting directly to the cone surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting.

Sub-section 603.2.3 Portable Plastic Drums (paragraph 3) -

- Reflectorize each drum with Type III – Microprismatic retroreflective sheeting: 2 orange and 2 white retroreflective bands, 6 inches wide on all projects let to contract after May 1, 2010 unless otherwise specified. Alternate the orange and white retroreflective bands with the top band always being orange. Ensure that any non-reflectorized area between the orange and white retroreflective bands does not exceed 2 inches. Do not splice the retroreflective sheeting to create the 6-inch retroreflective bands. Apply the retroreflective sheeting directly to the drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting.

(D) Category II Traffic Control Devices (Section 604) –
***** (Effective on all projects let to contract after May 1, 2012) *****

Sub-section 604.2.1 Type I and Type II Barricades (paragraph 3) -

- Reflectorize these barricades with Type VIII or IX Prismatic retroreflective sheeting on all projects let to contract after May 1, 2012 unless otherwise specified. Ensure that the retroreflective sheeting has alternate orange and white stripes sloping downward at a 45-degree angle in the direction of passing traffic. The stripes shall be 6 inches wide.

Sub-section 604.2.2 Type III Barricades (paragraph 3) -

- Reflectorize these barricades with Type VIII or IX Prismatic retroreflective sheeting on all projects let to contract after May 1, 2012 unless otherwise specified. Ensure that the retroreflective sheeting has alternate orange and white stripes sloping downward at a 45-degree angle. Apply the sloping orange and white stripes in accordance with the requirements of the Plans, SCDOT Standard Drawings and the MUTCD. The stripes shall be 6 inches wide.

(E) Truck-Mounted Attenuator (Sub-section 605.4.2.2) –

Sub-section 605.2.2.2.3.3 Color (paragraph 1) -

- Use industrial grade enamel paint for cover of the metal aspects of the unit. Provide and attach supplemental striping to the rear face of the unit with a minimum Type III high intensity retroreflective sheeting unless otherwise directed by the Department. Utilize an alternating 4 to 8

inch black and 4 to 8 inch yellow 45-degree striping pattern that forms an inverted "V" at the center of the unit that slopes down and to the sides of the unit in both directions from the center.

(F) Truck-Mounted Attenuator (Sub-section 605.4.2.2) –

Sub-section 605.4.2.2 Truck-Mounted Attenuators (paragraph 6) -

- A direct truck mounted truck mounted attenuator is mounted and attached to brackets or similar devices connected to the frame of a truck with a minimum gross vehicular weight (GVW) of 15,000 pounds (actual weight) unless otherwise directed. A trailer towed truck mounted attenuator is towed from behind and attached via a standard pintle hook / hitch to the frame of a truck with a minimum gross vehicular weight (GVW) of 10,000 pounds (actual weight) unless otherwise directed.
- Each truck utilized with a truck mounted attenuator shall comply with the manufacturer's requirements to ensure proper operation of the attenuator. The minimum gross vehicular weight (GVW) (actual weight) for each truck shall comply with these specifications unless otherwise directed within the "Remarks" column of the *Approved Products List For Traffic Control Devices in Work Zones* in regard to specific requirements for the device in question.
- If the addition of supplemental weight to the vehicle as ballast is necessary, contain the material within a structure constructed of steel. Construct this steel structure to have a minimum of four sides and a bottom to contain the ballast material in its entirety. A top is optional. Bolt this structure to the frame of the truck. Utilize a sufficient number of fasteners for attachment of the steel structure to the frame of the truck to ensure the structure will not part from the frame of the truck during an impact upon the attached truck mounted attenuator. Utilize either dry loose sand or steel reinforced concrete for ballast material within the steel structure to achieve the necessary weight. The ballast material shall remain contained within the confines of the steel structure in its entirety and shall not protrude from the steel structure in any manner.

(G) Trailer-Mounted Changeable Message Signs (Sub-section 606.3.2) -

Sub-section 606.3.2.7 Controller (paragraphs 1-4) -

- The controller shall be an electronic unit housed in a weatherproof, rust resistant box with a keyed lock and a light for night operation. Provide the unit with a jack that allows direct communications between the on-board controller and a compatible personal computer. The unit shall have a LCD display screen that allows the operator to review messages prior to displaying the message on the sign.
- The controller shall have the capability to store 199 factory preprogrammed messages and up to 199 additional messages created by the user in a manner that does not require a battery to recall the messages. Also, the controller shall allow the operator the capability to program the system to display multiple messages in sequence.
- Provide the controller with a selector switch to allow the operator to control the brightness or intensity level of the light source of the sign panel. The selector switch shall include "bright," "dim" and "automatic" modes; inclusion of additional modes is permissible. When the selector switch is in the "automatic" mode, a photosensitive circuit shall control the brightness or intensity level of the light source in response to changes in ambient light such as from day to night and other various sources of ambient light.
- Equip each sign with remote communications capabilities, such as utilization of cellular telephone or internet browser technology, to allow the operator to revise or modify the message selection from the office or other remote location. Also, provide protection to prohibit unauthorized access to the controller, (i.e. password protection).

Sub-section 606.5 Measurement (paragraph 2) -

- Trailer-mounted changeable message signs are included in the lump sum item for Traffic Control in accordance with **Subsections 107.12** and **601.5** of the "2007 Standard Specifications for Highway Construction". No separate measurement will be made for trailer-mounted changeable message signs unless the contract includes a specific pay item for trailer-mounted changeable message signs.
- The Contractor shall provide, install, operate, and maintain the trailer-mounted changeable message sign per traffic control set-up as directed by the Plans, the "Standard Drawings for Road Construction", these Special Provisions, the Specifications, and the Engineer.

Sub-section 606.6 Payment (paragraph 2) -

- In addition to **Subsections 107.12** and **601.6**, the payment for Traffic Control is full compensation for providing, installing, removing, relocating, operating, and maintaining trailer-mounted advance warning arrow panels and trailer-mounted changeable message signs as specified or directed and includes providing the units' primary power source; repairing or replacing damaged or malfunctioning units within the specified time; providing traffic control necessary for installing, operating, and maintaining the units; and all other materials, labor, hardware, equipment, tools, supplies, transportation, incidentals, and any miscellaneous items necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other items of the Contract.

Sub-section 606.6 Payment (paragraph 3) -

- Disregard this paragraph unless the Contract includes a specific pay item for trailer-mounted changeable message signs.

(H) Flagging Operations (Sub-section 610.4.1) –

Sub-section 610.4.1.1 Flagging Operations (paragraph 1) -

- Use a flagging operation to control the flow of traffic when two opposing directions of traffic must share a common travel lane. A flagging operation may be necessary during a lane closure on a two-lane two-way roadway, an intermittent ramp closure or an intermittent encroachment of equipment onto a portion of the roadway. Utilize flagging operations to direct traffic around work activities and maintain continuous traffic flow at reduced speeds when determined to be appropriate by the RCE. As stated above, flagging operations shall direct traffic around the work activities and maintain continuous traffic flow, therefore, stopped traffic shall not be required to stop for time durations greater than those listed below unless otherwise directed by the RCE. Begin measurement of the time interval immediately upon the moment the Flagger rotates the Stop/Slow paddle to display the "Stop" condition to the approaching motorists.

LENGTH OF CLOSURE	MAXIMUM TIME DURATION FOR STOPPED TRAFFIC
1 MILE or LESS	5 Minutes
1 to 2 MILES	7 ½ Minutes

- If the work activities require traffic to be stopped for periods greater than 5 to 7 ½ minutes as stated above, consider alternate work methods, conducting work activities during times of lowest traffic volumes such as during the hours of darkness or complete road closure with detour installation.

(1) SECTION 600: MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES:

"The Contractor is hereby advised that the Department has adopted the MUTCD 2003 - Manual on Uniform Traffic Control Devices for use on all projects. All references to the South Carolina Manual on Uniform Traffic Control Devices (SCMUTCD) are hereby revised to read "MUTCD - 2003 Edition"."

(2) SECTION 600: TRAFFIC CONTROL:

Delete Subsection 601.1.3 of the Standard Specifications in their entirety and replace them with the following:

(1) 601.1.3 Restrictions

¹ **The Department prohibits lane closures on interstate highways during holiday weekends, extended holiday periods or special events as defined below unless otherwise directed by the Engineer.** The Department's holiday lane closure restrictions for holidays that are observed on a Monday will include the weekend and are considered a holiday weekend unless otherwise established by these specifications. The Department defines the typical Monday holiday weekend as from 6:00 am of the Friday before the weekend until 6:00 a.m. of the Tuesday after the holiday. Lane closures, road closures, shoulder closures, pacing operations or any operations that will impact the efficient flow of traffic or hinder normal traffic operations during these Monday holiday weekends as defined above are prohibited unless otherwise directed by the Engineer.

² Easter and Thanksgiving holidays are varied and extended holiday periods of a holiday weekend. Easter holidays are defined as from 12:00 noon of the Thursday before Easter until 6:00 p.m. of the Monday after Easter. Thanksgiving holidays are defined as from 12:00 noon of the Wednesday before Thanksgiving Day until 6:00 a.m. of the Monday after Thanksgiving Day. Lane closures, road closures, shoulder closures, pacing operations or any operations that will impact the efficient flow of traffic or hinder normal traffic operations during the Easter and Thanksgiving holidays as defined above are prohibited unless otherwise directed by the Engineer.

³ The 4th of July holiday is considered an extended holiday period. Considering the progressive nature of the calendar, this extended holiday period will vary from year to year depending upon the day of the week the holiday occurs. See the table below. Lane closures, road closures, shoulder closures, pacing operations or any operations that will impact the efficient flow of traffic or hinder normal traffic operations during the 4th of July holiday as defined below are prohibited unless otherwise directed by the Engineer.

4th of JULY HOLIDAY	
DAY OF WEEK	DURATION
MONDAY	6:00 AM FRIDAY, JULY 1 ST through 10:00 PM SUNDAY JULY 10 TH
TUESDAY	6:00 AM FRIDAY, JUNE 30 TH through 10:00 PM SUNDAY JULY 9 TH
WEDNESDAY	6:00 AM FRIDAY, JUNE 29 TH through 10:00 PM SUNDAY JULY 8 TH
THURSDAY	6:00 AM FRIDAY, JUNE 28 TH through 10:00 PM SUNDAY JULY 7 TH
FRIDAY	6:00 AM FRIDAY, JUNE 27 TH through 10:00 PM SUNDAY JULY 13 TH

SUPPLEMENTAL SPECIFICATIONS

SATURDAY	6:00 AM FRIDAY, JUNE 26 TH through 10:00 PM SUNDAY JULY 12 TH
SUNDAY	6:00 AM FRIDAY, JUNE 25 TH through 10:00 PM SUNDAY JULY 11 TH

SUPPLEMENTAL SPECIFICATIONS

⁴ The Christmas holidays are considered an extended holiday period. Considering the progressive nature of the calendar, this extended holiday period will vary from year to year depending upon the day of the week the holiday occurs. See the table below. Lane closures, road closures, shoulder closures, pacing operations or any operations that will impact the efficient flow of traffic or hinder normal traffic operations during the Christmas holidays as defined below are prohibited unless otherwise directed by the Engineer.

CHRISTMAS HOLIDAYS	
DAY OF WEEK	DURATION
MONDAY	6:00 AM FRIDAY, DECEMBER 22 ND through 10:00 PM WEDNESDAY JANUARY 3 RD
TUESDAY	6:00 AM FRIDAY, DECEMBER 21 ST through 10:00 PM THURSDAY JANUARY 3 RD
WEDNESDAY	6:00 AM FRIDAY, DECEMBER 20 TH through 10:00 PM FRIDAY JANUARY 3 RD
THURSDAY	6:00 AM TUESDAY, DECEMBER 23 RD through 10:00 PM SUNDAY JANUARY 4 TH
FRIDAY	6:00 AM WEDNESDAY, DECEMBER 23 RD through 10:00 PM SUNDAY JANUARY 3 RD
SATURDAY	6:00 AM THURSDAY, DECEMBER 23 RD through 10:00 PM MONDAY JANUARY 3 RD
SUNDAY	6:00 AM FRIDAY, DECEMBER 23 RD through 10:00 PM TUESDAY JANUARY 3 RD

⁵ Special events are events generating excessive traffic as determined by the Department. Lane closures, road closures, shoulder closures, pacing operations or any operation that would impact the efficient flow of traffic or hinder normal traffic operations during special events are prohibited unless otherwise directed by the Engineer.

(2) **LANE CLOSURE RESTRICTIONS –**

The lane closure restrictions stated below are project specific.

Lane Closure Restrictions (Remount Road)	
DAY OF WEEK	DURATION
MONDAY	6:00 AM through 7:00 PM
TUESDAY	6:00 AM through 7:00 PM
WEDNESDAY	6:00 AM through 7:00 PM
THURSDAY	6:00 AM through 7:00 PM
FRIDAY	6:00 AM through 7:00 PM
SATURDAY	6:00 AM through 7:00 PM
SUNDAY	6:00 AM through 7:00 PM

(3) **SECTION 600: TRAILER MOUNTED AUTOMATED FLAGGER ASSISTANCE DEVICE SYSTEM (AFAD):**

1. Description:

This specification details the minimum requirements of all Automated Flagger Assistance Device Systems (AFAD) utilized and placed into operation on the roadways of the state of South Carolina.

An automated flagger assistance device system is a temporary traffic control device system for controlling the flow of traffic through temporary traffic control areas, typically work zones, that generate the requirement for two-way traffic to share a single travel lane. An automated flagger assistance device system shall consist of no less than 2 individual AFAD units linked and remotely controlled by wireless communications. A flagger(s), who has successfully completed a flagger training course sponsored by a South Carolina Department of Transportation approved work zone traffic control training provider, shall operate the system. Install, operate and maintain each AFAD unit as designated by these Supplemental Specifications, the manufacturer’s specifications, the Standard Drawings for Road Construction, the Plans and the Engineer.

An automated flagger assistance device system acceptable for use on the roadways of the state of South Carolina shall be either a Type I “RED / YELLOW” Lens system or a Type II “STOP / SLOW” Sign system.

The automated flagger assistance device system shall comply with all requirements for Automated Flagger Assistance Devices as specified and directed by the MUTCD, latest edition, and this supplemental specification. An automated flagger assistance device system shall operate and comply with all requirements for flagging operations as specified and directed by the latest editions of the MUTCD, the South Carolina Flagger’s Handbook and the Standard Specifications for Highway Construction. Also, an automated flagger assistance device system shall operate and comply with all requirements for flagging operations as specified and directed by the Standard Drawings for Road Construction, the special provisions, the plans and the Engineer.

SUPPLEMENTAL SPECIFICATIONS

2. Operations Requirements:

A. General: Automated flagger assistance device systems are only permitted for use on two-lane two-way roadways where each single travel lane of opposing traffic is required to utilize and share one travel lane. An AFAD system is PROHIBITED for use on multilane roadways with reduced numbers of travel lanes. An AFAD is not a traffic control signal and shall not be used as a temporary traffic control signal or to control traffic at any location with more than 2 opposing single travel lanes seeking to share one travel lane.

B. Documentation: Provide documentation to the SCDOT to verify that each operator of an automated flagger assistance device system has successfully completed instruction in the operation of a system by the manufacturer of that system. Also, provide documentation to verify that each operator has successfully completed a flagger training course sponsored by a South Carolina Department of Transportation approved work zone traffic control training provider.

1. **Work Conducted under Contract to SCDOT** - Provide documentation of proof of successful completion of training in the proper operation of the AFAD system by the manufacturer of the system and successful completion of training as a flagger by a South Carolina Department of Transportation approved work zone traffic control training provider to the Resident Engineer no less than 7 days prior to placing an automated flagger assistance device into operation.

SUPPLEMENTAL SPECIFICATIONS

2. **Work Conducted under Encroachment Permit** - Provide documentation of proof of successful completion of training in the proper operation of the AFAD system by the manufacturer of the system and successful completion of training as a flagger by a South Carolina Department of Transportation approved work zone traffic control training provider along with submittal of the encroachment permit to the SCDOT.

C. Operator: The operator of the an automated flagger assistance device system shall be a recipient of and have successfully completed instruction in the operation of the system by the manufacturer of that system. The operator shall have successfully completed a flagger training course sponsored by a South Carolina Department of Transportation approved work zone traffic control training provider.

The South Carolina Department of Transportation only recognizes the following entities as acceptable providers of work zone traffic control training for organizations outside of the SCDOT who perform work activities within the highway rights-of-way in South Carolina under either contract to SCDOT or encroachment permit:

American Traffic Safety Services Association (ATSSA)
Institute for Transportation Research and Education at North Carolina State University (ITRE)
Carolinas Association of General Contractors (AGC)
National Safety Council South Carolina Chapter

The operator shall control the automated flagger assistance device system from a location with an unobstructed view of the AFAD unit as well as an unobstructed view of the approaching traffic. If a single operator is controlling more than one unit, the operator shall have an unobstructed view of traffic from both directions. At no time is the operator permitted to leave the AFAD unattended when the AFAD is operating.

D. Site Location: When sufficient shoulder space is available, place and position the AFAD unit on the shoulder of the roadway no closer than 1 foot from either the near edge line or the near edge of pavement when an edge line is absent to the near edge of the trailer when the gate arm is in the upright position. When sufficient shoulder space to attain the minimum 1 foot requirement is unavailable, minimal encroachment of the unit upon the adjacent travel lane is permitted.

Place and position the AFAD unit to allow the end of the gate arm, when in the down position, to reach the center of the adjacent travel lane being controlled by the unit. Encroachment by the gate arm when in the down position to a point less than to the center of the adjacent travel lane or into the opposing travel lane beyond the center of the roadway is PROHIBITED.

Install the advance warning signs required for typical flagging operations on each approach. In addition to the typical flagging operations sign array, also include and install a "Be Prepared To Stop" sign (W3-4-48) between the "Flagger" symbol sign (W20-7-48) and the AFAD unit on each approach. Therefore, the required advance warning signs for each approach are, "Be Prepared To Stop" (W3-4-48), "Flagger" symbol (W20-7-48), "One Lane Road Ahead" (W20-4-48-A) and "Road Work Ahead" (W20-1- 48-A).

E. Nighttime AFAD Flagging Operations: During nighttime operations, illuminate each AFAD unit station with any combination of portable lights, standard electric lights, existing street lights, etc., that will provide a minimum illumination level of 108 Lx or 10 fc.

During nighttime operations, operators shall wear a safety vest and safety pants that comply with the requirements of ANSI / ISEA 107 standard performance for Class 3 risk exposure, latest revision, and a fluorescent hard hat. The safety vest and the safety pants shall be retroreflectorized and the color of the background material of the safety vest and safety pants shall be fluorescent orange-red or fluorescent yellow-green.

Supplement the array of advance warning signs with a changeable message sign for each approach during nighttime AFAD flagging operations. These changeable message signs are not required during daytime operations. Install the changeable message signs 500' in advance of the advance warning sign arrays. Messages should be "Flagger Ahead" and "Prepare To Stop".

3. System Requirements:

A. General: An automated flagger assistance device system shall consist of a Main AFAD unit and a Remote AFAD unit, linked and remotely controlled by wireless communications. The individual trailer-mounted units shall have nesting capabilities to permit towing of both units in a single trailer configuration. When nested, all lights including stop, tail and turn signal lights of both units shall operate uniformly.

B. Power Source: The electrical power for operation of the sign shall be supplied by a 12 VDC power source or a 110 VAC or a 120 VAC power source. Provide and mount a D/C power source for the unit on the trailer. An adaptable 110 VAC or 120 VAC power source may be used when available and selected for use.

- 1. D/C Powered:** Power the unit by means of a battery bank charged by photovoltaic solar panels and/or a built-in 110 VAC 10 amp battery charger. House the battery bank in a lockable heavy duty weatherproof box or cabinet. The battery bank shall have the capability to provide sufficient operating power to the unit for no less than 7 continuous days.
- 2. A/C Powered:** Power the unit by means of a 110 VAC or 120 VAC power source. Equip the unit with ground fault circuit interrupter circuit breakers. Conduct all A/C power adaptations with UL approved equipment and methods.

C. Remote Control: Equip each AFAD unit with a controller capable of receiving and implementing instructions through wireless communications from a handheld transceiver. Also, equip each AFAD unit with a handheld transceiver that provides wireless communication with the unit controller to permit operation of the individual unit or the system by an operator or operators from remote locations. The system shall provide the capability for total system operation and control of both units by one operator from a primary handheld transceiver as well as allow independent unit operation by one operator per unit from unit specific handheld transceivers.

Monitor and verify data transmissions utilized to control the AFAD units. Digitally encode signal transmissions to minimize interference. Comply with all applicable requirements of the Federal Communications Commission. In the event communications are disrupted or lost, the system shall go into a "fail safe" mode and display the "Circular Red" / "STOP" indications and lower the gate arms.

D. Gate Arm: Equip each AFAD unit with an automated gate arm that descends to a down position across the travel lane that approaching traffic is operating in when the AFAD unit displays the condition for approaching traffic to stop. The automated gate arm shall ascend to an upright position when the AFAD unit displays the condition to allow stopped traffic to proceed past the location of the AFAD unit.

Acceptable operation of the gate arm shall require the gate arm to begin descent to the down position no less than 2 seconds or more than 4 seconds after the AFAD unit displays the condition for approaching traffic to stop. The gate arm shall begin ascent to the upright position not less than 1 second or more than 2 seconds prior to display of the condition to allow stopped traffic to proceed.

The gate arm shall measure no less than 8 feet in length and shall have a minimum vertical height of 4 inches when placed in the down position. Reflecterize both sides of the gate arm with a Type III Microprismatic retroreflective sheeting with vertical alternating red and white stripes at 16 inch intervals.

The gate arm shall deflect in the event an errant vehicle drives through and strikes the gate arm and then return to a functional position after the errant vehicle clears the gate arm.

E. Trailer: Fabricate and equip each trailer with a single axle, springs, support assembly and four (4) leveling or stabilizer jacks. Properly equip the trailer to comply with South Carolina Law governing motor vehicles. The minimum requirement for lights and reflectors shall include turn signals, dual tail lights, and brake lights. Equip each trailer with Safety chains meeting SAE J-697 standards and paint each trailer with Federal Standard No. 595, Orange No. 12246.

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Each trailer mounted AFAD unit shall have the capability to withstand winds up to 80 MPH without overturning when in the operating configuration or position.

4. Type I “RED / YELLOW” Lens System:

A Type I “RED / YELLOW” Lens AFAD system shall alternately display a steadily illuminated Circular RED lens and a flashing Circular YELLOW lens to control traffic without the need for a “human flagger” in the immediate vicinity of the AFAD unit. The steadily illuminated Circular RED lens shall illuminate when approaching traffic is required to stop and the flashing Circular YELLOW lens shall illuminate when stopped or approaching traffic is permitted to proceed pass the location of the AFAD unit.

A RED / YELLOW Lens AFAD unit shall have no less than one set of Circular RED and Circular YELLOW lenses in a vertical configuration that have diameters of no less than 12 inches. Arrange the lenses to place the Circular RED above the Circular YELLOW and provide a minimum height of no less than 7 feet from the bottom of the apparatus housing the Circular YELLOW lens to the grade elevation of the travel lane under control of the AFAD unit. However, if the lenses are located over any portion of a travel lane in which traffic is operating and may pass underneath the lenses, the minimum mounting height shall be no less than 15 feet from the bottom of the apparatus housing the YELLOW lens to the grade elevation of the travel lane under control of the AFAD unit in which traffic is operating.

The gate arm shall begin its descent to the down position not less than 2 seconds or more than 4 seconds after the Circular RED lens is illuminated. The automated gate arm shall begin its ascent to the upright position not less than 1 second or more than 2 seconds prior to illumination of the flashing Circular YELLOW lens.

Install a “Stop Here On Red” sign (R10-6-36) or (R10-6a-30) on the right side of the approach at the point at which motorists are expected to stop when the Circular RED lens is illuminated.

(4) Transition Between RED and YELLOW Conditions -

Transition to Circular RED condition - The flashing Circular YELLOW lens shall enter into a minimum 5 second steady illumination phase prior to transitioning to the steadily illuminated Circular RED condition. The gate arm shall begin its descent not less than 2 seconds or more than 4 seconds after the Circular RED lens is illuminated.

Transition to Circular YELLOW condition - The gate arm shall complete its ascent to the upright position not less than 1 second or more than 2 seconds prior to illumination of the flashing Circular YELLOW lens. The steadily illuminated Circular RED lens shall transition to the flashing Circular YELLOW lens.

The Type I “RED / YELLOW” Lens AFAD system shall include a fail-safe system with a conflict monitor or similar device to prevent display of conflicting indications between units. Also, the system shall provide indicators to notify the operators of power loss that may impede proper operation of the system.

5. Type II “STOP / SLOW” Sign System:

A Type II “STOP / SLOW” Sign AFAD system shall have a STOP / SLOW sign that alternately displays the STOP (R1-1-36) face and the SLOW (W20-8-36) face of a STOP / SLOW paddle to control traffic without the need for a “human flagger” in the immediate vicinity of the AFAD unit. The STOP sign face shall display when approaching traffic is required to stop and the SLOW sign face shall display when stopped or approaching traffic is permitted to proceed pass the location of the AFAD unit.

The STOP / SLOW sign, fabricated from a rigid material, shall have an octagonal shape with a minimum face size of 36 inches by 36 inches. Reflectorize each face of the sign with a Type VII, Type VIII or Type IX Prismatic Retroreflective sheeting included on the latest edition of the *SCDOT Qualified Products List 20*. The STOP sign face shall have a red background with white letters and border and the SLOW sign face shall have a diamond shaped orange background with black letters and border. The letters shall have a minimum height of 8 inches. The sign faces shall have a minimum mounting height of

SUPPLEMENTAL SPECIFICATIONS

7 feet from the bottom of the sign to the grade elevation of the travel lane under control of the AFAD unit.

SUPPLEMENTAL SPECIFICATIONS

Supplement the Type II "STOP / SLOW" Sign AFAD unit with active conspicuity devices. Include a steadily illuminated RED lens beacon to illuminate when the STOP sign face is displayed and a flashing YELLOW lens beacon to illuminate when the SLOW sign face is displayed. Each beacon shall have a 12 inch signal lens. Mount the RED lens beacon no more than 24 inches above the top of the STOP sign face and YELLOW lens beacon no more than 24 inches above the top or to the side of the SLOW sign face.

Type B warning lights are PROHIBITED as alternatives to the 12 inch signal lens beacons.

The gate arm shall begin its descent to the down position 2 seconds or more than 4 seconds after the transition to a complete display of the STOP sign face is accomplished and the illumination of the steadily illuminated RED lens beacon. The automated gate arm shall begin its ascent to the upright position not less than 1 second or more than 2 seconds prior to the initiation of the transition from the STOP sign face to the SLOW sign face.

Install a "Wait On Stop" sign (R1-7-30) and a "Go On Slow" sign (R1-8-30) either on the same support structure as the AFAD unit or immediately adjacent to the AFAD unit.

(5) Transition Between STOP and SLOW Conditions -

Transition to STOP condition - The RED lens beacon shall enter into a "flashing mode" no less than 5 seconds prior to transitioning from the SLOW sign face to the STOP sign face. Immediately upon completion of the transition to complete display of the STOP sign face, the "flashing mode" of the RED lens beacon shall transition to a steadily illuminated condition. The gate arm shall begin its descent in not less than 2 seconds or more than 4 seconds after completion of the transition to a complete display of the STOP sign face and illumination of the steadily illuminated RED lens beacon.

Transition to SLOW condition - The STOP sign face shall begin the transition to the SLOW sign face. The gate arm shall begin its ascent to the upright position not less than 1 second prior to the initiation of the transition from the STOP sign face to the SLOW sign face. The RED lens beacon shall cease to illuminate and the flashing YELLOW lens beacon shall begin to illuminate immediately upon completion of the transition of the STOP sign face to the SLOW sign face and the ascent of the gate arm to its completed upright position.

The Type II "STOP / SLOW" Sign AFAD system shall include a fail-safe system with a conflict monitor or similar device to prevent display of conflicting indications between units. Also, the system shall provide indicators to notify the operators of power loss that may impede proper operation of the system.

3. Method of Measurement: Unless otherwise specified, Automated Flagger Assistance Device Systems (AFAD's) are not measured for separate payment but are included in the contract lump sum bid price item Traffic Control as specified in Subsections 107.12 and 601.5 of the *2007 Standard Specifications for Highway Construction*.

4. Basis of Payment: Unless otherwise specified, payment for an Automated Flagger Assistance Device System (AFAD) is included in the contract lump sum bid price item Traffic Control as specified in Subsections 107.12 and 601.5 of the *2007 Standard Specifications for Highway Construction*. The payment shall be full compensation for providing, installing, removing, and relocating as necessary, operating, and maintaining an Automated Flagger Assistance Device System (AFAD). Payment shall include furnishing all labor, hardware, equipment, tools, incidentals, and any miscellaneous items necessary for installing, operating, and maintaining the system.

(6) SECTION 600: WORK ZONE TRAFFIC CONTROL TRAINING REQUIREMENTS FOR CONTRACTORS / SUBCONTRACTORS:

1. Description:

S-18-22 at S-18-58 Intersection Improvements

00900-50

SUPPLEMENTAL SPECIFICATIONS

This specification details the work zone traffic control training requirements for employees and representatives of a contractor or subcontractor under contract to the South Carolina Department of Transportation (SCDOT) whose job duties include responsibilities relative to implementation and maintenance of the Transportation Management Plan (TMP). "Employees and representatives of a contractor or subcontractor" will henceforth be referred to as "employee" or "employees" and "contractor or subcontractor" will henceforth be referred to as "contractor".

The SCDOT requires the contractor to provide documentation to substantiate successful completion and attainment of a passing score of a prescribed training course conducted by an SCDOT approved provider by those employees whose job duties categorize them as "designated trainees" as defined hereinafter.

2. Implementation:

These requirements for work zone traffic control training for employees of those entities under contract to the SCDOT whose job duties include responsibilities relative to implementation and maintenance of a TMP shall become effective on all projects let to contract after September 1, 2013.

3. Designated Trainees:

An employee whose job duty responsibilities, as designated hereto, impact or involve any of or all of the components of a TMP must successfully complete an advanced work zone traffic control training program. These components include the primary component, the "Temporary Traffic Control" plan, and the secondary components, the "Transportation Operations" plan and the "Public Information" plan.

An employee whose job duties include any of the following responsibilities regarding the TMP shall successfully complete an advanced work zone traffic control training program conducted by an SCDOT approved work zone traffic control training provider:

- Supervision of the field installation of any or all components of the TMP
- Supervision of the maintenance of any or all components of the TMP
- Supervision of the removal of any or all components of the TMP
- Design and development of revisions to an existing TMP
- Design and development of a new or alternate TMP
- Any decision-making responsibilities regarding the TMP

Those employees whose job duties do not include responsibilities relative to the TMP as stated above are not required to attend an advanced work zone traffic control training program. However, it is recommended that all employees whose job duties place them on the job site within the highway rights-of-way within 30 feet or less of a travel lane open to traffic should attend a basic work zone traffic control training course.

Also, an employee whose job duties include "flagger" shall successfully complete a "Flagger Training" course. However, regarding an employee whose job duties include "flagger" but does not involve any of the responsibilities listed above, successful completion of a "Flagger Training" course is the only mandatory work zone traffic control training course required for this employee; other work zone traffic control training courses are elective.

4. Approved Work Zone Traffic Control Training Providers:

The SCDOT recognizes the following organizations as acceptable providers of an advanced work zone traffic control training program, a “Flagger Training” course or the optional basic work zone traffic control training course:

American Traffic Safety Services Association (ATSSA)
Institute for Transportation Research and Education at North Carolina State University (ITRE)
Carolinas Association of General Contractors (AGC)
National Safety Council South Carolina Chapter

These organizations provide work zone traffic control training in compliance with the MUTCD and reference requirements specific to SCDOT. Therefore, work zone traffic control training provided by entities other than those listed above are not considered comparable and shall be unacceptable.

Specific course material for work zone traffic control training courses designated as “Basic”, “Advanced”, “Supervisor” or “Flagger” and any additional training courses not specified here is determined by the work zone traffic control training course provider and has undergone review and received acceptance by SCDOT. Also, the passing score for each training course is determined by the work zone traffic control provider.

5. Training Requirements / Qualifications:

Successful completion of an advanced work zone traffic control training program is defined as achieving a passing score in all courses, including any prerequisite courses, to attain a level considered “advanced”, “supervisor” or any other relative term as designated by the provider to imply the trainee has an understanding of the course material inclusive of design, implementation and maintenance of work zone traffic control scenarios. Upon successful completion of the program, the trainee should also possess an understanding for determining the need for and developing and implementing adjustments as necessary when applying typical work zone traffic control applications to non-typical work site conditions and scenarios.

The employee whose job duty responsibilities mandate successful completion of an advanced work zone traffic control training program shall do so prior to performing any job duties with responsibilities relative to design and development of a TMP or revisions of an existing TMP or any decision-making responsibilities regarding the TMP or supervision of the field installation and maintenance of any and all components of the TMP.

Also, an employee whose job duties mandate successful completion of a “Flagger” training course shall do so prior to performing any job duties relative to flagging traffic.

Each employee who has successfully completed an approved advanced work zone traffic control training program or a “Flagger” training course shall attend and complete a refresher course relative to the employee’s job duties on a 5-year incremental time frame.

6. Documentation:

The contractor shall provide proof of successful completion of an acceptable advanced work zone traffic control training class by those employees whose job duty responsibilities mandate successful completion of approved work zone traffic control training to the Resident Engineer prior to the employee performing the job duties that incorporate responsibilities which necessitate approved work zone traffic control training. For proof of successful completion of an approved work zone traffic control training class, provide a copy of the certificate of training from the organization who conducted the training to the Resident Engineer. Failure to provide the required documentation as specified shall prevent SCDOT acceptance of the employee as properly trained and acceptable for conducting those job duties that necessitate the prescribed work zone traffic control training.

The contractor shall provide proof of successful completion of an acceptable "Flagger Training" course by all employees whose job duties require them to be the "Flagger" within a flagging operation to the Resident Engineer prior to the employee performing any "Flagger" job duties.

The contractor shall provide proof of successful completion of an acceptable advanced work zone traffic control refresher course for those employees no later than 60 days beyond the 5 year anniversary date of the employee's certificate date of completion of a previous advanced work zone traffic control training program.

Documentation of proof of completion of a basic work zone traffic control training course by employees whose job duties require their presence on the job site within the highway rights-of-way but exclude any responsibilities relative to the TMP is not required.

(7) SECTION 605: PERMANENT CONSTRUCTION SIGNS:

Utility locations must be performed prior to the placement of Permanent Construction Signs. State Law requires that the location of each sign be marked with a white line in the roadway or a stake in the shoulder. The locator company will mark 25 feet on either side of the location. The responsibility for marking the sign locations prior to the contractor calling PUPS for utility locate lies with the party responsible for lines and grades on the project. If Construction Lines and Grades is a pay item, then the Prime Contractor is responsible for marking the sign location. If this is not included, it is the Department's responsibility to mark the locations.

Prior to marking the sign location, care must be taken when marking the signs to ensure that there are no obstructions or other mitigating factors that will cause the sign to be moved outside of the 50 foot utility window. Any costs associated with staking out the sign locations are considered incidental to the cost of Permanent Construction Signs.

Requests for utility locates must be specific and isolated to the sign locations if no ground disturbing activities are occurring outside of the sign placement.

**SECTION 329400
LANDSCAPE MAINTENANCE**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Landscape Maintenance.

1.3 QUALITY ASSURANCE

A. Maintenance Logs Bi-Annual Review

- 1. The contractor and/or maintenance provider shall keep a log of all weekly, monthly and yearly maintenance work performed on site. The maintenance log must be kept current and complete, and shall be made available to the Owner, or their representative, upon request. The Owner may schedule bi-annual reviews or audits of the maintenance logs with the maintenance providers.
 - a. The Owner will provide a maintenance log template for the reproduction and use of all maintenance providers associated with the project.

B. Pruning Guidelines

- 1. In most areas, the trees and shrubs should be allowed to reach their full heights and widths. The exception to this is around signage, buildings, and within traffic sight distance triangles. In these areas the trees and shrubs should be pruned to maintain appropriate visibility (to and from). However, no trees or shrubs in any location should be sheared. If pruning is necessary, then hand pruning rather than shearing will be required. At all locations, shrubs should be allowed to grow together in informal masses and both trees and shrubs should be retained in their natural growth habit and form.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

PART 2 PRODUCTS

2.1 SOD

- A. Bermuda Grass

2.2 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 1. Type:
 - a. baled pine straw, medium to long needle length (longleaf or slash).
 2. Color: Natural.

2.4 PESTICIDES AND HERBICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION

3.1 Specific Maintenance Specifications

- A. The Hanahan Downtown Streetscape is designed to reflect the ambiance of small town life and friendly main street retail. As such, it is designated as the area of most intensive maintenance and attention. Attention should be given to maintain a high level of quality and care while allowing for influence of the surrounding areas.
- B. Watering: There will be no irrigation system. Gatorbag – like systems will need to be utilized on trees and hand-watering to water landscaped areas on a regular schedule as necessary to promote healthy plant growth.
- C. Planting Areas
 - 1. The following types of vegetated areas shall be treated as specified. Re-mulching will be by Contractor. For specific schedule of activities refer to Maintenance Schedule.
 - a. Turf Lawn
 - 1. Rotary mow all turf areas.
 - 2. Edge all curb/walk/drive to turf areas.
 - 3. Apply fertilizer appropriate for Bermuda turf grass.
 - 4. Pre-emerge turf areas for weed control.
 - 5. Post-emerge turf areas for weed control.
 - 6. Remove leaf litter and debris from turf areas.
 - 7. Treat for pests and diseases as needed.
 - b. Planting Beds
 - 1. Edge all beds.
 - 2. Pre-emerge bed areas for weed control.
 - 3. Post-emerge bed areas for weed control.
 - 4. Remove large limbs and debris from bedded areas as needed.
 - c. Trees
 - 1. Prune trees to insure proper growth and appearance and as needed to remove dead and diseased branches and maintain safety.
 - 2. Apply fertilize for optimal growth.
 - 3. Treat for pests and diseases as needed.

d. Shrubs

1. Maintain shrubs as informal masses with maximum flowering.
2. Allow foliage to grow to ground as natural shape dictates.
3. Prune shrubs to insure proper growth and appearance and as needed to remove dead and diseased branches. Allow shrubs to reach mature sizes.
4. Apply fertilize for optimal growth.
5. Treat for pests and diseases as needed.

e. Ornamental Grasses

1. Cut back to 4" in spring, before new growth emerges.
2. Ornamental grasses should not be edged.
3. Fertilize only on an as needed basis to correct specific soil deficiencies identified in a soil test report.

f. Ground Cover

1. Prune away from walks, curbs, walls, tree trunks, and shrub trunks on a regular basis or as needed.
2. Once established, prune periodically to thin out and as necessary to remove irregular foliage masses which distract from an overall uniform appearance.
3. Apply fertilize for optimal growth.

g. Hardscape Areas

1. Blow or sweep all surfaces (not including roadways) to a clean professional appearance.
2. Stains on hardscape surfaces to be cleaned.

D. Maintenance Schedule (estimated number of times per month)

Task	Maintenance Requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Turf Management													
Mowing	36 x year	1	2	3	4	4	5	4	5	4	2	1	1
Trimming	As Needed Weekly Throughout Year												
Fungicide- Turf	As Needed Throughout Year												
Pre-emergent Turf	2 x year			1						1			

Task	Maintenance Requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Post-emergent Turf	2 x year			1		1			1				
Fertilize Turf	5 x year			1		1	1		1		1		
Core Aeration – WS	1 x year												
Turf Pest Control	2 x year												
Lime / Sulfur Application	1 x year												
Reestablish Verge Areas post construction of houses	As Needed Throughout Year												
Hardscape Surface Blow	As Needed Per Visit Throughout Year												
Weed Control (non-herbicide)	26 x year	2	2	2	3	3	2	2	2	2	2	2	2
Plant Bed Management													
Bed Edging	18 x year	1	1	1	2	2	2	2	2	2	1	1	1
Curb/Walkway Edging	12 x year		1	1	2	2	2	2	1	1			
Re-mulch/Redefine Planting Beds – Pine Straw Mulch	As Needed Throughout Year												
Pruning - Shrub	As Needed Per Visit Throughout Year												
Pruning- Ornamental Grass	1 x year		1										
Fertilize Shrub	2 x year		1						1				
Pest Control	2 x year		1						1				
Fungicide- Shrubs	As Needed Throughout Year												
Tree Management													
Pruning- Tree	As Needed Per Visit Throughout Year by Qualified Professional												
Pruning – Crape Myrtles			1										

Fungicide- Trees	As Needed Per Visit Throughout Year by Qualified Professional												
Fertilize Tree	As Needed Per Visit Throughout Year by Qualified Professional												
Irrigation													
Refill water bags / hand watering	As Needed Throughout Year												
Hardscape Surface													
Clean surfaces of litter, leaves/stains, etc.	As Needed Throughout Year												
Other													
Leaf and Litter Control	As Needed Per Visit Throughout Year												
Annual Flower Install	2 x year				1					1			
Fertilize Annual Flowers	12 x year	1	1	1	1	1	1	1	1	1	1	1	1

3.2 General Landscape Maintenance Guidelines

A. Refer to Part I Specific Landscape Maintenance Guidelines and Maintenance Schedule for description of landscape areas where practices are to be employed and for frequency of employment.

B. Explanation of Terms and Practices

1. Mowing

- a. Mowing shall be performed uniformly by a rotary mower with sharp blades.
- b. From March through August use a mowing height of 2". Turf height shall not be allowed to exceed 2 ½". From September through the end of the season use a mowing height of 1 ½". Do not exceed a mowing height of 2 inches as this can result in excess thatch that leads to turf health problems. Mowing frequency shall be such so only 1/3 of the plant height is removed at any one time.
- c. During periods of stress or in areas of shade the mowing height may be raised ½".
- d. Prevent thatch accumulation or remove thatch when it exceeds ½-inch in thickness. Do not burn off thatch and debris as this may damage the Tifway 419 Bermuda grass. Use vertical mowers (with blades set 2" apart), aerifiers, power rakes or other dethatching equipment to remove the thatch. Avoid making more than a single pass with equipment over any one area of turf to prevent damage and minimize recovery

2. Trimming
 - a. Whip/string cutting equipment shall not be used around light fixtures, furniture, signage or tree trunks.
3. Bed Edging
 - a. Reinforce bed edge with flat shovel for a clean, uniform edge.
4. Curb Edging
 - a. Reinforce turf/hardscape edge with rotary edger for a clean, uniform edge.
 - b. Whip/string cutting equipment shall not be used around light fixtures or tree trunks.
5. Pruning
 - a. Trees
 1. Pruning is the most crucial factor in the long term maintenance of trees. Trees should not only be pruned to eliminate dead or damaged growth, but also to promote structural integrity, to accommodate changing site conditions, or in accordance with a specifically prescribed design intent.
 - a. All non-emergency pruning activities shall be reviewed and approved by Owner or Landscape Architect prior to commencement of work.
 - b. Follow ANSI A300 Pruning Standards.
 - c. In general, deciduous trees should be pruned only when they are dormant. Evergreen trees should be pruned prior to their primary growing season.
 - d. In general, remove no more than twenty percent (20%) of the total tree foliage during any single pruning effort. Prune trees to select and develop permanent branches that have a smaller diameter than the trunk or branch to which they are attached. Prune: branches that are dead/diseased/broken; branches that have crossing lateral branches; narrow "V" shaped fork branches; sharp angled/vertically growing branches such as water sprouts; branches that obstruct or are growing into walls, roofs, utilities or other constructed features; unusually heavy branches that may break and fall during high winds; to maintain adequate head clearance (7 foot minimum at sidewalks and 14 foot minimum at drives); and to remove unusual branches that detract from the natural appearance of the tree. Shape tree canopies that would naturally interfere with building walls or roofs to achieve an overall balanced, natural form.
 - b. Crape Myrtles
 1. Follow ANSI A300 Pruning Standards.
 2. Prune only when dormant.
 3. In general, remove no more than twenty percent (20%) of the total tree foliage during any single pruning effort. Prune trees to select and develop permanent branches that have a smaller diameter than the trunk or branch to which they are attached. Prune: branches that are dead/diseased/broken; branches that have crossing lateral branches; narrow "V" shaped fork branches; and sharp angled/vertically growing branches such as water sprouts.
 4. Prune to maintain a balanced form within each tree.

5. Trees should never be sheared or pruned in a manner that creates flat faces or edges, or geometric forms.
 6. Trees should never be pollarded (removal of upper branches resulting in stubs along the trunk).
- c. Shrubs
1. Follow ANSI A300 Pruning Standards.
 2. Shrubs should never be sheared.
 3. Pruning times shall be appropriate for the species.
 - a. Shrubs that bloom in the spring or winter shall be pruned after blooming.
 - b. Shrubs that bloom in the summer or fall shall be pruned when dormant or in early spring before new growth emerges.
 - c. Shrubs which have interesting or showy fruit shall be pruned after fruit has fallen or faded till undesirable.
 4. Shrubs should never be pruned in a manner that creates flat faces or edges, geometric forms or any shape that is contrary to their natural branching and leafing structure.
 5. Shrubs adjacent to walks and drives should be pruned back with the tapered removal of select branches and never sheared with a flat face or edge.
- d. Ornamental Grasses- Follow pruning guidelines set forth by Clemson Co-operative Extension
<http://www.clemson.edu/extension/hgic/plants/landscape/flowers/hgic1178.html>
6. Fertilizing, Pest and Disease Control
- a. Soil tests shall be performed a minimum of every three years. Fertilization programs shall be based on soil test results.
 - b. Apply fertilizers when air temperatures are below 80 degrees Fahrenheit and soil temperatures are above 40 degrees Fahrenheit. Apply when foliage is dry.
 - c. Fertilizer shall be lightly watered in (¼" to ½") after application to ensure soil absorption and prevent excess nitrogen runoff in streams. Avoid applying fertilizer immediately before a heavy rain event to avoid nitrogen loss.
 - d. Care shall be taken when applying any kind of fertilizer near the lake edge to avoid distribution of chemicals directly in the lake water.
 - e. Tifway 419 Bermuda Turf Fertilization
 1. Avoid over-fertilization.
 2. Soil pH shall be maintained between 5.0 to 5.5.
 3. No Nitrogen fertilizer shall be applied before turf greens in spring.
 4. Either general (all-purpose) fertilizers or specific applications may be used. The ratios and amounts in both methods should be based on soil tests.
 - a. General (All-Purpose) Fertilizer
 - i. Always apply an amount of potassium that is equal to or higher than the amount of nitrogen.
 - ii. Phosphorus levels shall be kept low to avoid causing iron deficiencies (to keep iron available to turf roots).
 - iii. Recommended all-purpose applications include:
 1. Early Spring - Weed and Feed

2. Late Spring – 7lbs 16-4-8 + Iron
 3. Early Summer – 7lbs 16-4-8 + Iron
 4. Late Summer - 7lbs 16-4-8 + Iron
 5. Fall – 10lbs 5-10-15 + Iron
 6. Or a ratio recommended with soil test results.
- iv. Nitrogen (N) shall be applied at a rate of 4 to 6 lbs N per 1000 square feet annually.
5. Do not add lime unless a soil test specifically recommends lime.
- f. Tree and Shrub Fertilization
1. Avoid over fertilization.
 2. Slow release fertilizers are preferred for plant health and protection of ground water systems.
 3. Major element fertilizer should be applied to the soil for long term results. Foliar sprays should be used only to correct deficiencies of minor elements.
 4. Trees and shrubs individually planted in turfgrass areas shall be fertilized according to the rates required by the surrounding turfgrass. No additional fertilizer beyond what is prescribed for the turfgrass should be required. If these trees and shrubs show distress and indicate a unique deficiency requiring additional fertilization, a fertilizer type and ratio may be used to address the specific deficiency. Space any additional fertilizer applications a minimum of 3 months apart and do not exceed the total nitrogen application permitted for the surrounding turfgrass.
5. Trees and shrubs exhibiting signs of stress shall be evaluated and addressed on a case by case basis.
- i. Plants under stress may exhibit one or more of the following symptoms:
 - i. Light green or yellow leaves
 - ii. Leaves with dead spots
 - iii. Leaves smaller than normal
 - iv. Fewer leaves and/or flowers than normal
 - v. Short annual twig growth
 - vi. Die back of branches
 - vii. Wilting of foliage
 - ii. Symptoms may be caused by nutrient deficiency or other factors such as inadequate/excess moisture, soil aeration, pH imbalance or disease. Care should be taken to diagnose and address the actual problem.
6. Spring fertilization shall occur before start of new growth.

7. Fall fertilization shall occur one approximately one month after the first killing frost, but when soil temperatures are above 40 degrees.
8. Application for Shrubs
 - a. Fertilizer shall be applied evenly to the root zone area of the shrubs.
 - i. For individually planted shrubs, the area of the root zone shall be determined by multiplying 1.5 times the distance from the trunk to the edge of the outermost branches.
 - ii. For massing of shrubs, the area of root zone may be calculated as a mass, multiplying the length and width of the bed or planting area, rather than by individual plants.
 - b. General (All-Purpose) Fertilizer
 - i. Rates of application should be based on a nitrogen level of 10-16 percent. Recommended all-purpose applications include:
 1. 16-4-8
 2. 12-4-8
 3. Or a ratio recommended with soil test result.
 - ii. Ratios of 1-1-1- are acceptable, such as 8-8-8 or 10-10-10.
 - c. Fertilizer shall be applied at a rate of 2-4 lbs of actual nitrogen per 1000 square feet. Do not exceed 4 lbs of actual nitrogen per 1000 square feet.
 - i. If new shoots are greater than 6 inches in length, fertilizer is not required.
 - ii. Newly installed plants or plants under stress should receive only a light application of fertilizer.
 - iii. Additional fertilizer may be required if the area is experiencing excessive rainfall.

H. Pest and Disease Control

1. Provide pest and disease control as required at all times to maintain a healthy, vigorous landscape.
2. Care shall be taken when applying any kind of pest or disease treatment, including fungicides, near lake edges to avoid distribution of chemicals directly in the lake water.
3. Turf Disease Control
 - a. If nematodes are suspected, submit a soil sample to the cooperative extension office or other testing service and follow recommendations provided.
 - b. Brown patch, dollar spot, and other fungi and diseases shall be treated as needed following manufacturer's specifications.
4. Shrub and Tree Disease Control

- a. Fungicides and other disease control products shall be applied per manufacturer's specifications.

I. Weed Control

1. All cracks in sidewalks, asphalt trails and other paved areas within the allotted landscaped areas shall be kept free of weeds.
2. All areas of crushed/chipped limestone within the allotted landscaped areas shall be kept free of weeds.
3. Herbicides shall be applied per manufacturer's specifications. Check labels for safety regarding use around specific plant species. Dicamba herbicide shall not be used near dogwood trees.
4. Care shall be taken when applying any kind of herbicide near lake edges to avoid distribution of chemicals directly in the lake water.
5. Turf Weed Control
 - a. Turf areas shall be kept free of weeds.
 - b. Apply pre-emergent herbicide.
 - i. Apply for control of crabgrass, goosegrass and foxtail.
 - c. Apply post-emergent herbicide.
 - i. Apply as needed for control of annual and perennial broadleaf weeds.
 - ii. Apply post-emergent until 3 weeks after turf greens up.
 - iii. Do not apply post-emergent herbicide unless grass and weeds are actively growing.
 - d. Do not apply herbicides if turf is under stress (drought).
 - e. Carefully read and follow all manufacturer recommendations for application for Tifway 419 Bermuda turfgrass. Following instructions for other types of turfgrass can damage bermuda grass.
 - f. Bermuda grass is sensitive to some herbicides. Check manufacturer's recommendations prior to application. Do not apply the following herbicides:
 - i. MSMA
6. Plant Bed Weed Control
 - a. All planting beds shall be kept free of weeds.
 - b. Apply post-emergent herbicide as needed.

J. General Clean-up

1. Sidewalks shall be swept or air blown of all grass clippings and debris produced during regular maintenance activities.
2. Turf areas shall be cleaned of leaves, twigs and debris as needed to maintain appearance and health.
3. Sidewalks within the allotted areas shall be swept or air blown whenever any debris or soil has washed from adjacent slopes or planted areas. Litter shall be completely removed from all common areas regularly.
4. Hand pick and properly dispose of any and all litter in trash or recycle as appropriate. Empty on-site trash receptacles as needed.

C. Natural Areas

1. Areas that have been disturbed by construction activities but are outside of the Landscaped Area will be returned to natural state.

D. Landscape Drainage Features

1. Weather events can put stress on drainage features when heavy rains fill swales. Silt, sediment and debris can impede water flow in swales if allowed to accumulate, creating the potential for damage to surrounding areas if the water flows downhill in unintended places. Drainage flows blocked by debris can also cause puddling to occur, saturating soil and potentially damaging plant roots. To avoid potential problems, a visual inspection of all drainage features should be performed once each season and after tropical storm and hurricane events. Problems shall be addressed as needed to maintain positive drainage:
 - a. In shrub areas, remove soil, silt, vegetation and debris that preclude efficient flow of water through the constructed swale to the designated outfall area, or fill low spots that impound water and maintain undesirable soil saturation levels.
 - b. In turf grass areas, dethatch flow lines; or remove sod, lower grade and replace sod to recreate the original swale/flow line blocked by turf grass thatch buildup. Refer to Mowing section of this Part for specifications on removing thatch.
 - c. In the case of a severe weather event such as a tropical storm or hurricane, significant damage shall be assessed by the contractor and reviewed with the Owner prior to commencement of repair work and may be billed hourly if deemed in excess of routine maintenance practice.

EEND OF SECTION 329400