

**PUBLIC WORKS PROJECT NUMBER: 84003001-22-058-C1  
CLEAR CREEK WELCOME CENTER  
WEST TERRE HAUTE, INDIANA / INDOT**

**Volume 5 of 6**

**MARCH 2023**

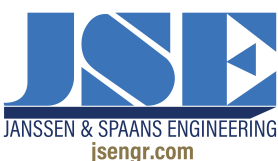
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**PROJECT MANUAL**

**For construction of:**

**Clear Creek Welcome Center  
West Terre Haute, Indiana**

**Public Works Project  
84003001-22-058-C1**

**For**

**Department of Transportation**

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**Date of Issue**

**March 2023**

**CERTIFICATION PAGE**

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## TABLE OF CONTENTS

### PROJECT MANUAL VOLUME 1

#### INTRODUCTORY PAGES

00001 . . . . .	Project Manual	
00002 . . . . .	Certification Page	
00003 . . . . .	Table of Contents	

#### PREBID DOCUMENTATION

DAPW 28 . . . .	Notice to Bidders	1 Page
DAPW 30 . . . .	Instructions to Bidders	6 Pages

#### BID DOCUMENTATION

DAPW 12 . . . .	Contractor's Affidavit of Subcontractor's Employed	1 Page
DAPW 13 . . . .	Contractor's Bid Form	3 Pages
DAPW 14 . . . .	Signature Affidavit	1 Page
DAPW 15A . . .	Bid Bond	1 Page
DAPW 26S2 . .	M/WBE Participation Plan	1 Page
DAPW 26S2 . .	Good Faith Effort Work Sheet	1 Page
DAPW 41 . . . .	Certificate of Corporate Resolution	1 Page
DAPW 121 . . .	Contractor's Non Collusion Affidavit	1 Page

#### PRECONTRACT DOCUMENTATION

DAPW 11 . . . .	Domestic Steel Affidavit	1 Page
DAPW 15 . . . .	Contractor's Bond for Construction	1 Page
DAPW 16 . . . .	Contractor's Certificate of Insurance	1 Page
DAPW 150A . .	Drug Free Workplace Certification	2 Pages

#### CONTRACT DOCUMENTATION

DAPW 26 . . . .	General Conditions of the Contract	19 Pages
DAPW 26S1 . .	Supplement to General Conditions for Minority Business Enterprise Program	6 Pages
DAPW 33 . . . .	Standard Agreement for Construction Projects	19 Pages
Geotechnical Report		
Geotechnical Report Addendum		
Asbestos Reports		
Environmental Commitments		

### **Volume 6 Bid Form Attachment A – Bid Prices**

#### SPECIFICATIONS

<b>Division 1</b>	<b>General Requirements</b>
011000 . . . . .	Summary
012100 . . . . .	Allowances
012200 . . . . .	Unit Prices
012600 . . . . .	Contract Modification Procedures
013100 . . . . .	Project Management and Coordination
013200 . . . . .	Construction Progress Documentation
013300 . . . . .	Submittal Procedures
014000 . . . . .	Quality Requirements
014200 . . . . .	References
015000 . . . . .	Temporary Facilities and Controls
015723 . . . . .	Temporary Storm Water Pollution Control
016000 . . . . .	Product Requirements
017300 . . . . .	Execution

017700.....	Closeout Procedures
017823.....	Operation and Maintenance Data
017839.....	Project Record Documents
017900.....	Demonstration and Training

**PROJECT MANUAL VOLUME 2**

**INTRODUCTORY PAGES**

00001.....	Project Manual
00002.....	Certification Page
00003.....	Table of Contents

<b>Division 3</b>	<b>Concrete</b>
033000.....	Cast In Place Concrete
033543.....	Polished Concrete Finishing

<b>Division 4</b>	<b>Masonry</b>
042000.....	Unit Masonry
044313.....	Anchored Stone Masonry Veneer

<b>Division 5</b>	<b>Metals</b>
051200.....	Structural Steel Framing
053100.....	Stee; Decking
054000.....	Cold-formed Metal Framing
055000.....	Metal Fabrications
055213.....	Pipe and Tube Railings
055819.....	Duct Enclosures
057500.....	Decorative Formed Metal

<b>Division 6</b>	<b>Carpentry</b>
061000.....	Rough Carpentry
061600.....	Sheathing
062023.....	Interior Finish Carpentry
066100.....	Simulated Stone Fabrications

<b>Division 7</b>	<b>Moisture Protection</b>
071113.....	Bituminous Dampproofing
071326.....	Self Adhering Sheet Waterproofing
072100.....	Thermal Insulation
072119.....	Formed-In-Place Insulation
072416.....	Water Drainage EIFS
072726.....	Fluid-Applied Membrane Air Barriers
074213.13.....	Formed Metal Wall Panels
074213.23.....	Metal Comp. Mat. Wall Panels
075419.....	Polyvinyl-Chloride (PVC) Roofing
076200.....	Sheet Metal Flashing and Trim
077100.....	Roof Specialties
077200.....	Roof Accessories
079100.....	Preformed Joint Seals
079200.....	Joint Sealants

<b>Division 8</b>	<b>Doors, Windows and Glass</b>
081113.....	Hollow Metal Doors and Frames
081119.....	Stainless Steel Doors and Frames
081613.....	Fiberglass Doors and Frames
083323.....	Overhead Coiling Doors

084113 .....	Aluminum-Framed Entrances and Storefronts
084426	Dichroic Glass Façade
086337	Edge Clamped Flush-Glazed Curtin Walls and Skylights
087100 .....	Door Hardware
087113	Automatic Door Openers
088000 .....	Glazing
088400	Plastic Glazing
089119	Fixed Louvers

**Division 9**

092216 .....	Non Structural Metal Framing
092900 .....	Gypsum Board
093013 .....	Ceramic Tiling
095113 .....	Acoustical Panel Ceilings
096623 .....	Resinous Matrix Terrazzo Flooring
096813 .....	Tile Carpeting
099113 .....	Exterior Painting
099123 .....	Interior Painting
099300 .....	Staining and Transparent Finishing
099600 .....	High Performance Coatings

**Finishes**

**Division 10**

101416 .....	Plaques
101423 .....	Panel Signage
101423.16	Room-Identified Panel Signage
102420	Decorative Perforated Metal Panel Assembly
102800 .....	Toilet, Bath and Laundry Accessories
104413 .....	Fire Protection Cabinets
104416 .....	Fire Extinguishers
105613	Metal Storage Shelving

**Specialties**

**Division 12**

125700	Industrial Furniture
--------	----------------------

**Furnishings**

**Division 13**

132417 .....	Custom Fireplace
--------------	------------------

**Special Construction**

**Division 31**

312000 .....	Earthmoving
313116 .....	Termite Control

**Earthwork**

**Division 32**

321313 .....	Concrete Paving
--------------	-----------------

**Exterior Improvements**

## **PROJECT MANUAL VOLUME 3**

### **INTRODUCTORY PAGES**

00001 . . . . .	Project Manual
00002 . . . . .	Certification Page
00003 . . . . .	Table of Contents

### **Division 22**

### **Plumbing**

220513 . . . . .	Common Motor Requirements for Plumbing Equipment
220517 . . . . .	Sleeves and Sleeve Seals for Plumbing Pipe
220518 . . . . .	Escutcheons for Plumbing Piping
220519 . . . . .	Meters and Gauges for Plumbing Piping
220523.12 . . . . .	Ball Valves for Plumbing Piping
220523.14 . . . . .	Check Valves for Plumbing Piping
220529 . . . . .	Hangers and Supports for Plumbing Piping and Equipment
220553 . . . . .	Identification for Plumbing Piping and Equipment
220719 . . . . .	Plumbing Insulation
221116 . . . . .	Domestic Water Piping
221119 . . . . .	Domestic Water Piping Specialties
221123 . . . . .	Domestic-Water Booster Pumps
221123.13 . . . . .	Domestic Water Packaged Booster Pumps
221123.21 . . . . .	Inline Domestic-Water Pumps
221316 . . . . .	Sanitary Waste and Vent Piping
221319 . . . . .	Sanitary Waste Piping Specialties
221319.13 . . . . .	Sanitary Drains
221414 . . . . .	Storm drainage Piping
221423 . . . . .	Storm Drainage Piping Specialties
223100 . . . . .	Domestic Water Softeners
223300 . . . . .	Electric, Domestic Water Heaters
224213.13 . . . . .	Commercial Water Closets
224213.16 . . . . .	Commercial Urinals
224216.13 . . . . .	Commercial Lavatories
224216.16 . . . . .	Commercial Sinks
224223 . . . . .	Commercial Showers
224716 . . . . .	Pressure Water Coolers

### **Division 23**

### **HVAC**

230010 . . . . .	Basic Mechanical Requirements
230050 . . . . .	Basic Mechanical Requirements and Methods
230513 . . . . .	Common Motor Requirements for HVAC Equipment
230516 . . . . .	Expansion Fittings and Loops for HVAC Equipment
230517 . . . . .	Sleeves and Sleeve Seals for HVAC Piping
230518 . . . . .	Escutcheons for HVAC Piping
230519 . . . . .	Gauges and Meters
230523 . . . . .	General-Duty Valves for HVAC Piping
230529 . . . . .	Hangers and Supports for HVAC Piping and Equipment
230548 . . . . .	Vibration and Seismic Controls for HVAC Piping and Equipment
230553 . . . . .	Identification for HVAC Piping and Equipment
230593 . . . . .	Testing, Adjusting, and Balancing for HVAC
230713 . . . . .	Duct Insulation
230716 . . . . .	HVAC Equipment Insulation
230719 . . . . .	HVAC Piping Insulation
230800 . . . . .	Commissioning of HVAC
230923 . . . . .	Instrumentation and Controls
230924 . . . . .	HVAC Instrumentation and Controls Installation

231123	Facility Natural-Gas Piping
232113 . . . .	Hydronic Piping
232116	Hydronic Piping Specialties
232513	Chemical Water Treatment
233113. . . .	Metal and Non-Metal Ducts
233119	HVAC Casings
233300. . . .	Air Duct Accessories
233423 . . . .	HVAC Power Ventilators
233713. . . .	Diffusers, Registers and Grilles
234300	Electronic Air Cleaners
238101	Electric Cabinet Unit Heaters
238126	Split-System Air-Conditioners

**DIVISION 26 –**

260500. . . .	Common Work Results for Electrical
260519. . . .	Low Voltage Electrical Power Conductors and Cables
260526. . . .	Grounding and Bonding for Electrical Systems
260529	Hangers and Supports for Electrical Systems
260533. . . .	Raceways and Boxes for Electrical Systems
260544. . . .	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553. . . .	Identification for Electrical Systems
260573.13	Short-Circuit Studies
260573.16	Coordination Studies
260573.19	Arc-Flash Hazard Analysis
260580	Equipment Wiring Systems
260923	Lighting Control Devices
262213	Low-Voltage Distribution Transformers
262416. . . .	Panelboards
262726. . . .	Wiring Devices
262813	Fuses
262816. . . .	Switches and Circuit Breakers
262913.03	Manual and Magnetic Motor Controllers
262923	Variable-Frequency Motor Controllers
263213. . . .	Gaseous Emergency Engine Generators
263600. . . .	Transfer Switches
264313. . . .	Surge Protective Devices for Low-Voltage Electrical Power Circuits
265119. . . .	LED Interior Lighting
265213	Emergency and Exit Lighting

**DIVISION 27**

270500	Communications
270526	Communication Grounding and Bonding
270528	Communications Pathways
270533	Identification for Communications Systems
271106	Cabinets Frames Racks and Enclosures
271119	Termination Blocks and Patch Panels
271513	Copper Horizontal Cabling
271543	Faceplates and Connectors
272133	Wireless Access Points

**DIVISION 28**

284621.11	Addressable Fire-Alarm Systems
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**ELECTRICAL**

**COMMUNICATIONS**

**ELECTRONIC SAFETY AND SECURITY**



## **PROJECT MANUAL VOLUME 4**

### **INTRODUCTORY PAGES**

00001 . . . . .	Project Manual
00002 . . . . .	Certification Page
00003 . . . . .	Table of Contents
033000 . . . . .	Cast-In-Place Concrete
034500 . . . . .	Precast Architectural Concrete
071113 . . . . .	Bituminous Damproofing
079200 . . . . .	Joint Sealants
099600 . . . . .	High Performance Coatings
101419 . . . . .	Dimensional Letter Signage
107516 . . . . .	Ground Set Flagpoles
116800 . . . . .	Play Field Equipment and Structures
129300 . . . . .	Site Furnishings
321373 . . . . .	Concrete Paving Joint Sealants
321400 . . . . .	Unit Paving
321816.13 . . . . .	Playground Protective Surfacing
323116 . . . . .	Welded Wire Fences and Gates
328400 . . . . .	Irrigation System
329113 . . . . .	Soil Preparation
329200 . . . . .	Turf and Grasses
329300 . . . . .	Plants

**PROJECT MANUAL VOLUME 5**

**INTRODUCTORY PAGES**

00001 .	Project Manual
00002.	Certification Page
00003 .	Table of Contents
02000.	Supplemental Civil Specifications

## **PROJECT MANUAL VOLUME 6**

### **INTRODUCTORY PAGES**

00001 . . . . .	Project Manual
00002 . . . . .	Certification Page
00003 . . . . .	Table of Contents
Permits	
012200 . . . . .	Measurement and Payment/Unit Prices
022200 . . . . .	Site Clearing
022400 . . . . .	Dewatering
022600 . . . . .	Excavation Support and Protection
023000 . . . . .	Earthwork
024100 . . . . .	Horizontal Directional Drilling Piping Installation
025100 . . . . .	Water Distribution
025300 . . . . .	Gravity Sanitary Sewage
025450 . . . . .	Sewer Force Mains
027000 . . . . .	Bases and Pavements
029200 . . . . .	Lawns and Grasses
077210 . . . . .	Hatches
113470 . . . . .	Flow Meters
113100 . . . . .	Submersible Lift Station
113250 . . . . .	Order Control

## **DRAWING SET #1 WELCOME CENTER**

### **GENERAL**

G001 COVER SHEET - WELCOME CENTER  
G021 LIFE SAFETY PLAN - WELCOME CENTER

### **STRUCTURAL**

S001 GENERAL NOTES  
S002 DESIGN INFORMATION  
S003 STRUCTURE OVERALL VIEWS

### **STRUCTURAL - WELCOME CENTER**

WC-S101 FOUNDATION AND SLAB ON GRADE PLAN  
WC-S102 MAIN ROOF FRAMING PLAN  
WC-S103 EXHIBIT AREA ROOF FRAMING PLANS  
WC-S200 EXHIBIT SOUTH WALL FRAMING DETAILS  
WC-S201 EXHIBIT NORTH WALL FRAMING DETAILS  
WC-S202 EXHIBIT EAST AND WEST WALL FRAMING DETAILS  
WC-S203 RIBBON SUPPORT FRAMING DETAILS  
WC-S204 RIBBON SUPPORT FRAMING DETAILS  
WC-S300 TYPICAL FOUNDATION DETAILS  
WC-S301 FOUNDATION DETAILS  
WC-S302 TUNNEL DETAILS  
WC-S310 CONCRETE PIER DETAILS  
WC-S320 TYPICAL CONCRETE WALL DETAILS  
WC-S330 TYPICAL SLAB ON GRADE DETAILS  
WC-S400 TYPICAL CMU DETAILS  
WC-S401 CMU WALL ATTACHMENT DETAILS  
WC-S500 BASE PLATE DETAILS  
WC-S501 TYPICAL STEEL DETAILS  
WC-S520 TYPICAL ROOF FRAMING DETAILS  
WC-S540 TYPICAL BRACED FRAME DETAILS  
WC-S550 MAIN ROOF DETAILS  
WC-S551 EXHIBIT ROOF DETAILS  
WC-S552 EXHIBIT ROOF DETAILS  
WC-S553 EXHIBIT ROOF DETAILS

### **ARCHITECTURE - GENERAL**

A010 ARCHITECTURAL INFORMATION

### **ARCHITECTURE - WELCOME CENTER**

WC-A201 OVERALL FLOOR PLAN  
WC-A210 AREA FLOOR PLANS  
WC-A210D AREA FLOOR DIMENSION PLANS  
WC-A211 TUNNEL FLOOR PLANS  
WC-A221 REFLECTED CEILING PLAN  
WC-A231 INTERIOR FINISH PLANS  
WC-A261 ROOF PLAN - EXHIBIT AREA  
WC-A262 ROOF PLAN - RESTROOM AREA  
WC-A301 BUILDING ELEVATIONS

WC-A401	BUILDING SECTIONS
WC-A402	BUILDING SECTIONS
WC-A421	EXHIBIT WALL- EXTERIOR
WC-A422	EXHIBIT WALL SECTIONS
WC-A423	EXHIBIT WALL SECTIONS
WC-A424	EXHIBIT WALL- DETAILS
WC-A425	EXHIBIT WALL- DETAILS
WC-A426	EXHIBIT WALL- GLASS FAÇADE DETAILS
WC-A427	EXHIBIT WALL- GLASS FAÇADE DETAILS
WC-A428	EXHIBIT WALL INTERIOR WALL SECTIONS
WC-A431	CURTAIN WALL- WEST DETAILS
WC-A432	CURTAIN WALL- EAST DETAILS
WC-A433	CURTAIN WALL- TYPICAL DETAILS
WC-A441	WEST VESTIBULE DETAILS
WC-A442	EAST VESTIBULE DETAILS
WC-A443	TYPICAL VESTIBULE DETAILS
WC-A451	RIBBON DETAILS
WC-A461	CURTAIN WALL AND BRACKET ELEVATIONS
WC-A462	CURTAIN WALL SECTIONS
WC-A463	BRACKET AND BASE DETAILS
WC-A464	BRACKET AND ROOF DETAILS
WC-A465	SKYLIGHT DETAILS
WC-A471	CLERESTORY DETAILS
WC-A472	CLERESTORY DETAILS
WC-A501	ENLARGED PLANS
WC-A510	INTERIOR ELEVATIONS
WC-A511	INTERIOR ELEVATIONS
WC-A512	INTERIOR ELEVATIONS
WC-A601	TYPICAL DETAILS
WC-A602	TYPICAL DETAILS
WC-A603	TYPICAL DETAILS
WC-A604	TYPICAL DETAILS
WC-A610	TUNNEL ACCESS DETAILS

### **ARCHITECTURE -TYPICAL**

A701	DOOR SCHEDULE & DETAILS
A702	DOOR DETAILS
A720	TYPICAL LIMESTONE DETAILS
A721	TYPICAL DETAILS

### **PLUMBING**

WC-P001	PLUMBING SYMBOLS AND ABBREVIATIONS
WC-P100	PLUMBING PLAN – UNDERSLAB
WC-P101	PLUMBING PLAN – LEVEL 1
WC-P102	PLUMBING PLAN – ROOF LEVEL
WC-P501	PLUMBING DETAILS
WC-P601	PLUMBING SCHEDULES
WC-P701	PLUMBING DIAGRAMS

## **MECHANICAL**

WC-M001	MECHANICAL SYMBOLS AND ABBREVIATIONS
WC-M101	HVAC PLAN – LEVEL 1
WC-M102	PIPING PLAN – LEVEL 1
WC-M401	MECHANICAL SECTIONS
WC-M402	MECHANICAL VIEWS
WC-M501	MECHANICAL DETAILS
WC-M601	MECHANICAL SCHEDULES
WC-M701	MECHANICAL DIAGRAMS

## **ELECTRICAL**

WC-E001	ELECTRICAL SYMBOLS AND ABBREVIATIONS
WC-E010	ELECTRICAL SITE PLAN
WC-E101	LIGHTING PLANS – LEVEL 1 AND BELOW GROUND
WC-E102	POWER & SYSTEMS PLAN – LEVEL 1
WC-E103	POWER PLAN – ROOF LEVEL
WC-E401	ENLARGED ELEC PLAN AND LIGHTING SECTION
WC-E501	ELECTRICAL DETAILS
WC-E502	ELECTRICAL DETAILS
WC-E503	ELECTRICAL DETAILS
WC-E601	ELECTRICAL SCHEDULES
WC-E602	ELECTRICAL SCHEDULES
WC-E603	ELECTRICAL SCHEDULES
WC-E701	ELECTRICAL DIAGRAMS

## **DRAWING SET #2 TRUCKER RESTROOMS**

### **GENERAL**

G002 COVER SHEET – TRUCKER RESTROOM  
G023 LIFE SAFETY PLAN

### **STRUCTURAL**

TR-S101 TRUCKER RESTROOM STRUCTURAL PLANS  
TR-S300 SECTIONS AND DETAILS

### **ARCHITECTURE**

TR-A201 OVERAL FLOOR PLAN  
TR-A202 AREA FLOOR PLANS  
TR-A301 BUILDING ELEVATIONS  
TR-A411 WALL SECTIONS  
TR-A510 INTERIOR ELEVATIONS  
TR-A601 TYPICAL DETAILS

### **ARCHITECTURE – TYPICAL**

A701-1 DOOR SCHEDULE & DETAILS  
A702-1 DOOR DETAILS  
A720-1 TYPICAL LIMESTONE DETAILS  
A721-1 TYPICAL DETAILS

### **PLUMBING**

TR-P001 PLUMBING SYMBOLS AND ABBREVIATIONS  
TR-P101 PLUMBING PLANS – UNDERSLAB  
TR-P102 PLUMBING PLANS – LEVEL 1  
TR-P501 PLUMBING DETAILS AND SCHEDULES

### **MECHANICAL**

TR-M001 MECHANICAL SYMBOLS AND ABBREVIATIONS  
TR-M101 PLUMBING DETAILS AND SCHEDULES`

### **ELECTRICAL**

TR-E001 ELECTRICAL SYMBOLS AMD ABBREVIATIONS  
TR-E010 ELECTRICAL SITE PLAN  
TR-E101 LIGHTING PLANS – LEVEL 1

### **STRUCTURAL**

TR-E501 ELECTRICAL DETAILS  
TR-E601 ELECTRICAL SCHEDULES  
TR-E701 ELECTRICAL DIAGRAMS

## **DRAWING SET #3 STORAGE BUILDING**

### **GENERAL**

G003 COVER SHEET

### **STRUCTURAL**

SB-S101 STORAGE BUILDING STRUCTURAL PLANS  
SB-S300 SECTIONS AND DETAILS

### **ARCHITECTURE**

SB-A201 OVERALL STORAGE BUILDING PLANS  
SB-A301 BUILDING ELEVATIONS AND SECTIONS  
SB-A411 WALL SECTIONS  
SB-A601 TYPICAL DETAILS  
SB-A602 TYPICAL DETAILS

### **ARCHITECTURE – TYPICAL**

A701-2 DOOR SCHEDULE & DETAILS  
A702-2 DOOR DETAILS  
A720-2 TYPICAL ROOF FRAMING DETAILS  
A721-2 TYPICAL DETAILS

### **DUMPSTER ENCLOSURE**

G022 LIFE SAFETY PLAN

### **PLUMBING**

SB-P001 PLUMBING SYMBOLS AND ABBREVIATIONS  
SB-P101 PLUMBING PLAN – UNDERSLAB  
SB-P102 PLUMBING PLAN – LEVEL 1

### **MECHANICAL**

SB-M001 MECHANICAL SYMBOLS AND ABBREVIATIONS  
SB-M101 HVAC PLANS – LEVEL 1

### **ELECTRICAL**

SB-E001 ELECTRICAL SYMBOLS AND ABBREVIATIONS  
SB-E010 ELECTRICAL SITE PLAN  
SB-E101 LIGHTING & POWER & SYSTEMS PLANS – LEVEL 1  
SB-E501 ELECTRICAL DETAILS  
SB-E601 ELECTRICAL SCHEDULES  
SB-E701 ELECTRICAL DIAGRAMS



## **DRAWING SET #4 LANDSCAPE**

G-001	COVER SHEET
G-002	GENERAL INFORMATION
L-201	OVERALL SITE FEATURES PLAN
L-202	SITE FEATURE PLAN
L-501	OVERALL PLANTING PLAN
L-502	PLANTING PLAN
L-503	PLANTING PLAN
L-504	PLANTING PLAN
L-505	PLANTING PLAN
L-506	PLANTING PLAN
L-507	PLANTING PLAN
L-508	PLANTING PLAN SCHEDULE
IR-100	SITE INFRASTRUCTURE & AUTOMATION
IR-101	SITE INFRASTRUCTURE & AUTOMATION
IR-102	SITE INFRASTRUCTURE & AUTOMATION
IR-103	SITE INFRASTRUCTURE & AUTOMATION
IR-104	IRRIGATION DETAILS
L-511	SOILS PLACEMENT PLAN
L-512	SOILS PLACEMENT PLAN
L-513	SOILS PLACEMENT PLAN
L-601	SITE ENLARGEMENT PLAN
L-602	PAVING PLAN
L-603	PAVING PLAN
L-604	PAVING PLAN
L-701	SITE DETAILS
L-702	SITE DETAILS
L-703	SITE DETAILS
L-704	SITE DETAILS
L-705	SITE DETAILS
L-710	SITE DETAILS

## **DRAWING SET #5 SITE**

G-100	TITLE SHEET
G-101	INDEX
G-102	MAINTENANCE OF TRAFFIC
D-100	SITE DEMOLITION PLANS
D-101	SITE DEMOLITION PLANS
C-100	OVERALL SITE PLAN
C-101	SITE PLAN GEOMETRY
C-102	SITE PLAN GEOMETRY
C-103	SITE TYPICAL SECTIONS
C-104	SITE PLANS
C-105	SITE PLANS
C-106	SITE PLANS
C-107	SITE PROFILES
C-108	SITE PROFILES
C-109	SITE PROFILES
C-110	SITE PROFILES
C-111	SITE PLAN DETAILS (WELCOME CENTER BLDG. & AUTO PARKING)
C-112	SITE PLAN DETAILS (ROUNDBOUT)
C-113	SITE PLAN DETAILS (WINNER'S WALK)
C-114	SITE PLAN DETAILS (TRUCK PARKING LOT)
C-115	SITE PLAN DETAILS (TRUCK PARKING LOT)
C-116	SITE PLAN DETAILS (ISLAND LAYOUTS & GRADES)
C-117	SITE PLAN DETAILS (ISLANDS LAYOUT & GRADES)
C-118	SITE PLAN DETAILS (LIFT STATION LAYOUT)
C-119	SITE PLAN DETAILS (TRUCKER RESTROOM LAYOUTS)
C-120	SITE PLAN DETAILS (CURB RAMP 1 & 2 DETAIL)
C-121	SITE PLAN DETAILS (CURB RAMP 3 & 4 DETAIL)
C-122	SITE PLAN DETAILS (CURB RAMP 5 & 6 DETAIL)
C-123	SITE PLAN DETAILS (CURB RAMP 6 & 7 DETAIL)
C-124	SITE PLAN DETAILS (CURB RAMP 9 & 10 DETAIL)
C-125	SITE PLAN DETAILS (CURB RAMP 11 DETAIL)
C-126	SITE PLAN DETAILS (CELL TOWER DETAILS)
C-127	SITE PLAN DETAILS (WALKING PATH, DRIVEWAY, & DITCH)
C-128	SITE PLAN DETAILS (STORAGE BUILDING PAVING PLAN)
C-129	SITE PLAN DETAILS (BARRIER WALL DETAILS)
C-130	SITE PLAN DETAILS (CATCH FENCE DETAILS)
C-131	SITE PLAN DETAILS (DUMPSTER ENCLOSURE PAD)
C-200	SITE GRADING PLANS
C-201	SITE GRADING PLANS
C-202	SITE GRADING PLANS
C-203	SITE GRADING PLANS
C-204	SITE GRADING PLANS
C-205	SITE GRADING PLANS
C-206	TOPSOIL STOCKPILE PLAN
C-300	SITE DRAINAGE LAYOUT
C-301	SITE DRAINAGE LAYOUT
C-302	WELCOME CENTER DRAINAGE DETAILS
C-303	TRUCKER RESTROOM DRAINAGE DETAILS
C-304	TRUCKER RESTROOM DRAINAGE DETAILS
C-305	DRAINAGE STRUCTURE DETAILS
C-306	DRAINAGE STRUCTURE DETAILS
C-307	DRAINAGE STRUCTURE DETAILS
C-308	DRAINAGE STRUCTURE DETAILS
C-309	TRENCH DRAIN DETAILS
C-310	UNDERDRAIN TABLE
C-311	UNDERDRAIN TABLE
C-312	UNDERDRAIN TABLE

C-313	STRUCUTRE DATA TABLE
C-314	STRUCTURE DATA TABLE
C-315	PIPE MATERIALTABLE
C-316	PIPE MATERIAL TABLE
C-400	SITE UTILITY PLAN
C-401	SITE UTILITY PLAN
C-402	SITE UTILITY PLAN
C-500	SMALL SIGNS & PAVEMENT MARKINGS LAYOUT
C-501	SMALL SIGNS & PAVEMENT MARKINGS LAYOUT
C-502	SMALL SIGNS & PAVEMENT MARKINGS LAYOUT
C-503	SHEET SIGNS & POST SUMMARY TABLE
C-504	PANEL SIGNS & POST SUMMARY TABLE
C-600	SITE LIGHTING & its LAYOUT
C-601	SITE LIGHTING & its LAYOUT
C-602	LIGHTING LUMINAIRE SCHEDULE
C-603	LIGHTING FOUNDATION DETAILS
C-604	LIGHTING PHOTOCELL DIAGRAM
C-605	ITS DETAILS & GENERAL NOTES
C-606	ITS FIBER MAP
C-700	SITE STORMWATER MANAGEMENT PLAN
C-701	SITE STORMWATER MANAGEMENT PLAN
C-702	TEMPORARY EROSION CONTROL PLAN
C-800	JOINT LAYOUT PLAN
C-801	JOINT LAYOUT PLAN
C-900	SITE WATER LINE LAYOUT
C-901	SITE WATER LINE LAYOUT
C-902	WATER MAIN DETAILS

CS-100	INDOT STANDARD DRAWING
CS-101	INDOT STANDARD DRAWING
CS-102	INDOT STANDARD DRAWING
CS-103	INDOT STANDARD DRAWING
CS-104	INDOT STANDARD DRAWING
CS-105	INDOT STANDARD DRAWING
CS-106	INDOT STANDARD DRAWING
CS-107	INDOT STANDARD DRAWING
CS-108	INDOT STANDARD DRAWING
CS-109	INDOT STANDARD DRAWING
CS-110	INDOT STANDARD DRAWING
CS-111	INDOT STANDARD DRAWING
CS-112	INDOT STANDARD DRAWING
CS-113	INDOT STANDARD DRAWING
CS-114	INDOT STANDARD DRAWING
CS-115	INDOT STANDARD DRAWING
CS-116	INDOT STANDARD DRAWING
CS-117	INDOT STANDARD DRAWING
CS-118	INDOT STANDARD DRAWING
CS-119	INDOT STANDARD DRAWING
CS-120	INDOT STANDARD DRAWING
CS-121	INDOT STANDARD DRAWING
CS-122	INDOT STANDARD DRAWING
CS-123	INDOT STANDARD DRAWING
CS-124	INDOT STANDARD DRAWING
CS-125	INDOT STANDARD DRAWING

CS-126	INDOT STANDARD DRAWING
CS-127	INDOT STANDARD DRAWING
CS-128	INDOT STANDARD DRAWING
CS-129	INDOT STANDARD DRAWING
CS-130	INDOT STANDARD DRAWING
CS-131	INDOT STANDARD DRAWING
CS-132	INDOT STANDARD DRAWING
CS-133	INDOT STANDARD DRAWING
CS-134	INDOT STANDARD DRAWING
CS-135	INDOT STANDARD DRAWING
CS-136	INDOT STANDARD DRAWING
CS-137	INDOT STANDARD DRAWING
CS-138	INDOT STANDARD DRAWING
CS-139	INDOT STANDARD DRAWING
CS-140	INDOT STANDARD DRAWING
CS-141	INDOT STANDARD DRAWING
CS-142	INDOT STANDARD DRAWING
CS-143	INDOT STANDARD DRAWING
CS-144	INDOT STANDARD DRAWING
CS-145	INDOT STANDARD DRAWING
CS-146	INDOT STANDARD DRAWING
CS-147	INDOT STANDARD DRAWING
CS-148	INDOT STANDARD DRAWING
CS-149	INDOT STANDARD DRAWING
CS-150	INDOT STANDARD DRAWING
CS-151	INDOT STANDARD DRAWING
CS-152	INDOT STANDARD DRAWING
CS-153	INDOT STANDARD DRAWING
CS-154	INDOT STANDARD DRAWING
CS-155	INDOT STANDARD DRAWING
CS-156	INDOT STANDARD DRAWING
CS-157	INDOT STANDARD DRAWING
CS-158	INDOT STANDARD DRAWING
CS-159	INDOT STANDARD DRAWING
CS-160	INDOT STANDARD DRAWING
CS-161	INDOT STANDARD DRAWING
CS-162	INDOT STANDARD DRAWING
CS-163	INDOT STANDARD DRAWING
CS-164	INDOT STANDARD DRAWING
CS-165	INDOT STANDARD DRAWING
CS-166	INDOT STANDARD DRAWING
CS-167	INDOT STANDARD DRAWING
CS-168	INDOT STANDARD DRAWING

**DRAWING SET #6 SANITARY**

G100	TITLE SHEET
G101	INDEX
G102	PROJECT OVERVIEW
C101-C102	GRAVITY SANITARY SEWER PLAN & PROFILES
C103	LIFT STATION SITE PLAN
C104	LIFT STATION DETAILS
C201-C210	LINE "PR-FM » FORCE MAIN PLAN & PROFILES
C400-402	EROSION CONTROL
C500-502	CONSTRUCTION DETAILS



**I-70 EB CLEAR CREEK  
VOLUME 5  
TABLE OF CONTENTS**

**PROJECT MANUAL**

**SPECIFICATIONS**

02000..... Supplemental Civil Specifications

## UTILITY COORDINATION

The Contractor shall be responsible for coordination with all utilities during construction as well as construction of the utilities as shown on plans within the project limits in accordance with INDOT, all other regulating agencies and the individual utility company standards and specifications.

The Town of West Terre Haute will be constructing a new water main in W. 21<sup>st</sup> Street Road (Cook Road) and a new 6" waterline into the welcome Center site. The contractor shall coordinate with the Town's contractor during the construction of this new water line. If questions arise, Ed Stewart of the Town may be contacted at 812-533-1053 (office) or at 812-870-5950 (mobile).

The facilities of Duke Energy exist within the rest areas project limits and are expected to be affected by this project. New 3 Phase service will be installed to replace the existing 3 Phase service. If questions arise, *Tyler Angle* of the utility may be contacted at 812-231-8721 (office) or at 812-249-7163 (Mobile) or at [tyler.angle@duke-energy.com](mailto:tyler.angle@duke-energy.com). Also, work will be occurring within the two Duke Energy transmission easements within the project site and care must be taken to protect the existing transmission poles and facilities. If questions arise, Ryan Daugherty may be contacted at 812-375-2021 or at [Ryan.Daugherty@duke-energy.com](mailto:Ryan.Daugherty@duke-energy.com).

The gas line facilities of CenterPoint Energy do not exist within the rest area project limits at this time, but are planned to be constructed to the project site during the period of this contract. Contractor shall coordinate with the CenterPoint contractor during the construction of the gas line facilities. If questions arise, Jennifer Isbell-Scott may be contacted at 812-231-6303 or at [Jennifer.IsbellScott@centerpointenergy.com](mailto:Jennifer.IsbellScott@centerpointenergy.com).

Fiber Optic Cable will be constructed to the welcome center building either from the proposed cell tower along W. 21<sup>st</sup> Street Road or from offsite across I-70 by Joink, LLC. Contractor shall coordinate with Joink, LLC during the construction of the fiber optic cable. If questions arise, Ray Osland may be contacted at 812-315-6465 or at [ray.osland@joinkllc.com](mailto:ray.osland@joinkllc.com) or Karla Noorlag may be contacted at 812-234-5100 or at [kkarla.noorlag@joinkllc.com](mailto:kkarla.noorlag@joinkllc.com)

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 DEPARTMENT SALVAGEABLE ITEMS
**Description**

Following items will be salvaged by the Department before the Contractor begin any work on site. Contractor shall coordinate with Mr. Carl Rochelle, INDOT Crawfordsville District Facilities at [CRochelle@indot.IN.gov](mailto:CRochelle@indot.IN.gov).

***Main Building and Lot***

- 4 New indoor Furnaces
- 4 new AC condenser units and controls
- 8 Electrical panels
- 1 New electric hanging heater
- 1 Booster pump and controls



13 Benches  
 24 Tables  
 32 Yard Lights  
 2 Sump Pumps  
 1 Meter base  
 Fire Extinguishers

**From the Pole Barn**

1 Pallet Jack  
 1 Metal work Table  
 1 Flammable Cabinet  
 1 Lighting Controls for lot lights

**From the Well House**

2 Electrical Panels  
 1 Phase Inverter(inside and outside components)  
 1 Meter Base  
 1 Well Pump  
 1 Pressure Tank  
 1 Backflow Preventor

**From Waste Water treatment Plant**

1 Window Ac Unit

CCTV ASSEMBLY

**Description**

This work shall consist of furnishing and installing closed circuit television cameras and supporting equipment.

**Materials**

Camera shall, at a minimum, meet the following characteristics:

**Camera Sensors:**

- Sensor 1/2.8" CMOS
- Progressive Scanning
- Resolution 1,920 x 1080
  - 640 x 360 @ 3x digital zoom
- Digital formats:
  - 1080p
  - 1080i
  - 720p
- Frame rate 30 frames per second
- Day/Night format with IR cut filter
- Automatic Day/Night mode
- Color
  - 0.25 lux
- Black and white
  - 0.024 lux
- Signal/Noise ratio >50db
- Motion detection

**Optics:**

- Physical zoom 30x
  - 4.4 to 132 mm
  - Effective 264mm with 2x digital zoom
- Aperture f1.4 -> f4.6
- HAFOV 63.4 ° to 2.1 ° @ 1920x1080
  - 63.4° to 0.7 ° @ 640x360
- Focus auto/manual [Near, far]
- Focus searching:
  - Normal
  - Bright
  - Point Source
- Focus sensitivity:
  - Low
  - Normal
  - High
- Digital zoom 12x on/off
- Auto focus of iris on PTZ

**System Processing:**

- Defog mode
- Image stabilization
- Enhanced intensity
- Whiteout reduction
- Dynamic Range >90dB
- Black light composition
- Shutter auto/manual
- Slow shutter
- White balance adjustments
- Sharpness adjustments
- Noise reduction
- 3 video streams
- Codecs:
  - H.264
  - MJPEG
- Protocols:
  - RTP/RTSP
  - RTSP Interleave
  - HTTP tunneling
  - RTP Multicast
  - 802.3u 100Base-T
  - MIDI-X auto sensing
  - Full duplex
  - TCP
  - UDP
  - IPv4
  - ICMP
  - DNS
  - IGMPv2/3
  - DHCP
  - NTP
  - HTTP
  - SOAP
  - HTTPS
  - FTP
  - SMTP

- SNMP/NTCIP
- ONVIF Profile S
- NTCIP 1205
- 802.3bt (PoE++)
- Video data rate control minimum of 256Kbs
- Video rate control variable or constant
- Video transmittal 99.99% error free
- Support for VLC media player or any media player compliant with the following RFCs:
  - 2236
  - 3984
  - 3550
  - 2435
  - ISO/IEC 13818-1
- Configurations shall be stored on non-volatile memory
- Upload file over web interface or shell
- Security profile support
- Output triggers supporting:
  - FTP
  - Email
  - Tour
  - On-screen display message
- On Screen Display:
  - 7 elements for display
    - Text Preset
    - Date/Time
    - Sector
    - Maintenance
    - Action Event
    - 40 characters per text element
    - Size variant of 20-90 points, incrementing by 10
    - Color of text:
      - Blue
      - Red
      - Green
      - Black
      - White
    - Positioning of:
      - Upper Right/left
      - Lower Right/left
      - Center
      - Custom
    - Banner Display on/off
    - Logo display supporting:
      - BMP
      - PNG
      - GIF
      - X,Y position
      - Transparency
    - Privacy masks:
      - Rectangular shape
      - Colored Red, Green, Blue, Purple, or Gray
      - Opacity 25, 50, or 75%
      - Four levels of brightness adjustment
- Inverted mounting

- 256 Preset locations
- 256 tours containing 10 preset locations each
- Auto Park timer to return to preset or tour after timer expires
  - o Time of off, 1 minute, 999 hours

**Mechanical:**

- IP68 rating
- Powered by PoE++
- Voltage Range NEMA TS 2-2003 section 2.2.7 test C through H
- Transient/Surge Certified to CISPR 24 Levels
- Emissions Certified to CISPR 22 levels
- CE, FCC Part 15B RoHS
- Corrosion MIL-STD-810G, method 509.5 Paragraph 4.5.2, ANSI NCSL Z 540-1
- ISO 172025:2005
- Shock per NEMA TS2 paragraph 2.2.9 10g applied in each of 3 mutually perpendicular planes
- Humidity up to 100%
- Pan Range 360° of continuous rotation
- Tilt range 180°
- Preset Speed Peak of 120° / second
- 180° movement in < 3 seconds
- Manual speed of 0.1° to 45° /second
- Operational temperature -40°F to 167°F Per NEMA TS2 2.2.7
- RJ45 Connection for data and power support
- Inverted mounting
- Set north calibration

Camera shall include required hardware for mounting and connecting device to structure and associated equipment. Camera shall be configured for remote access. Minimum configuration settings shall include:

- IPv4/6 address
- Subnet Mask
- Default IPv4/6 gateway
- NTP server
- DNS server
- DHCP settings
- Hostname
- Domain/workgroup
- Username
- Password

Department ITS Engineer shall provide specific parameters per device for installation upon request.

**Construction Requirements**

All installation services shall comply with all manufacturer's instructions and warranty provisions and warranty contract maintenance services and Department electrical codes. All wiring entry to the camera dome shall use watertight fittings. All materials shall be installed in a neat and professional manner. All wiring entry and exits shall be made at the side or underneath components; no exposed top entry or exits are permitted. This requirement extends to all enclosures, junction boxes, support arms, or any other externally exposed devices.

**~~Method of measurement~~**

~~CCTV Assembly will be measured by the number of units installed.~~

**Basis of payment**

~~CCTV Assembly will be paid for at the contract unit price per EACH.~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay Unit</del>	<del>Symbol</del>
<del>CCTV Assembly</del>	<del>EACH</del>	

~~The cost of all labor, materials, design, vendor support, and items necessary to provide a complete and functioning CCTV assembly shall be included in the cost of CCTV assembly.~~

CONDUIT

**Description**

Work under this item shall include furnishing and installing conduit as shown on the plans and described in these specifications to provide raceways for fiber-optic cable, copper communications cable, and power conductors.

**Materials**

HDPE conduits shall meet or exceed the requirements of section 922.19. Schedule 80, coilable, HDPE conduit shall be color coded orange, green, and blue for communication cable and black for power cable. The HDPE shall meet or exceed the properties listed in ASTM D-3350 for minimum cell classification of Class E Colored with UV Stabilizer. The properties and dimensions shall be in accordance with ASTM F 2160 standard specification for "Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)".

Fiberglass conduit shall be manufactured to NEMA TC-14 2002 standards and listed by Underwriters Laboratories (UL) standard 1684 "Above Ground and Below Ground". Carbon black shall be used as an ultraviolet inhibitor. All fiberglass conduit shall be Iron Pipe Size (IPS), "Standard Wall" with a minimum 0.07-inch wall thickness, and a minimum impact resistance per the following table and in accordance with ASTM D2444.

Table: Fiberglass Conduit Impact Resistance

CONDUIT SIZE	STANDARD WALL IMPACT RESISTANCE
2-inch	40 lbs ft
3-inch	60 lbs ft
4-inch	70 lbs ft
5-inch	100 lbs ft
6-inch	100 lbs ft

PVC and steel conduits shall meet the requirements of section 922.19. Liquid-tight Flexible Metal Conduit (LFMC) shall consist of a single strip of continuous, flexible, interlocked galvanized steel inside and out, forming a smooth internal wiring channel with a liquid tight covering of UV resistant flexible polyvinyl chloride (PVC). LFMC shall be manufactured in accordance with UL 360. All liquid-tight connectors shall be UL/CSA listed for wet locations.

**Construction Requirements**

General:

The Contractor shall comply with Section 807.06, except as noted in this special provision. The Contractor shall install conduits underground

by means of trenching or directional drilling. Except as noted, the plans depict conduit routing and schematic form only. The contractor shall determine final routing based on actual field conditions at each site, including utility locator service markings, to assure no conflicts with existing utilities. In addition to notifying the IUPPS "Call Before You Dig" service, the Contractor shall notify the INDOT ITS Division and the INDOT District to request the ITS locates and highway lighting locates 48 hours in advance of excavation work. The cost of notifying IUPPS, the INDOT ITS division, and the INDOT District office shall be considered incidental to the contract. All conduits shall be placed a minimum of 3 feet below existing grade, except for immediately adjacent to hand holes/vaults or as noted on plans. All conduits shall be stubbed out a minimum of 6 inches into each handhole or vault.

Construction limits shall be restored by grading soil smooth and seeding as necessary to prevent erosion on steep grades. Restoring construction limits will be considered incidental to the conduit installation.

Warning tape shall be furnished and installed in all the trenches containing conduit, as depicted in the plan details.

#### Trenching:

Conduit identified to be installed in a trench may be trenched or plowed at the Contractor's discretion and as permitted by the site conditions. Except as revised herein, conduit trenches shall be in accordance with the INDOT Standard Specifications Section 807.04. Common trenches shall be used for multiple conduits as shown on the plans.

Conduit may be installed by directional drilling at locations called out to be as trenched on the plans with no additional compensation.

Conduit pushes as shown on the plan shall be in accordance with standard specification section 805.11 and 807.06. The Contractor shall verify the existing pavement conditions prior to construction to avoid cracking the pavement.

All flexible roadside delineators disturbed during trenching operations shall be restored or replaced at no additional cost to the contract.

#### Hand Trenching:

Conduit identified as Hand Trench is located in areas where sensitive existing crossing utilities have been identified and will likely require positive identification of the existing utility prior to trenching above or below the existing utility line or where surface features such as riprap would inhibit trenching. The method of positive identification of the existing utility line is at the discretion of the Contractor and shall be accomplished with no additional compensation. Any material that is removed to accomplish Hand Trenching shall be restored or replaced in kind by the Contractor without additional compensation.

Conduit type, number, and size shall be as identified on the plans.

Conduit identified as Hand Trench may be trenched or plowed at the Contractor's discretion and as permitted by site conditions. Except as revised herein, conduit trenches shall be in accordance with 807.04. Common trenches shall be used for multiple conduits, as shown on the plans.

Conduit may be installed by directional drilling at locations called out to be as hand trenched on the plans with no additional compensation.

All flexible roadside delineators disturbed during hand trenching operation shall be restored or replaced at no additional cost to the

contract.

Offset Trenching:

Conduit identified as Offset Trench is in areas where the trench is located behind obstructions. This type of trenching shall utilize a long reach hydraulic driven trenching machine to reach over and beyond the obstruction and complete trench as the same as TRENCH. This trenching machine is typically attached to and powered by an excavator.

Conduit may be installed by directional drilling at locations called out to be offset trench on the plans with no additional compensation.

Bridge Transition Conduit:

Conduit identified as transition is located in areas where the conduit quantity and type changes to accommodate a bridge crossing.

Unless otherwise specified, transition conduit shall be flexible conduit in accordance with 807.02.

Directional Drilling:

The Contractor shall determine all utility locations near the path of the proposed drill, including depth. The Contractor shall use this information to avoid damage to utilities and/or facilities within the work area. The Contractor shall provide this information, including the sources, to the Engineer a minimum of five working days prior to drilling. The Contractor shall not drill until the Engineer approves that submittal.

Prior to drilling, the Contractor shall expose all utilities for which it is customary and safe to do so.

The diameter of the drilled hole shall conform to the outside diameter of the conduit or conduits as closely as practical. The Contractor shall pressure grout as directed by the Engineer, to fill any voids, which develop during the installation operation. The Contractor shall remove and replace any conduit damaged in the directional drilling operations at no expense to the project.

The use of water and other fluids in connection with the drilling operation will be permitted only to the extent necessary to lubricate cuttings. Jetting shall not be permitted, and the use of water alone as a drilling fluid shall not be permitted. The Contractor shall use a drilling fluid/slurry consisting of at least 10% high grade, processed Bentonite to consolidate excavated material, seal the walls of the hole, and furnish lubrication for the subsequent removal of material and immediate installation of the conduit.

The Contractor shall provide a means of collecting and containing drilling fluid/slurry that returns to the surface, such as slurry pit, or a method approved by the Engineer. The Contractor shall include the following procedures: Provide measures to prevent drilling fluids from entering storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto sidewalks, other pedestrian walkways, driveways, or streets. Immediately remove any slurry that is inadvertently deposited on pedestrian walkways. Transport waste drilling slurry from the site and dispose of it. Do not allow slurry to enter wetlands. Protect wetlands from slurry using appropriate soil erosion control measures approved by the Engineer.

The Contractor shall use a digital walkover locating system to track the drill head during the bore. At minimum, the locating system shall be capable of determining the pitch, roll, heading, depth, and horizontal position of the drill head at any point along the bore. During each drilling operation, the Contractor shall locate the drill head every 10 feet along

the bore and prior to crossing any underground utility or structure. Upon completion of the drilling operation and conduit installation, the Contractor shall furnish the Engineer with an as-built profile drawing and plan drawing for the drilled conduit showing the horizontal and vertical locations of the installed conduit.

Conduit identified to be installed between 1,000 feet and 1,500 feet indicates a long continuous bore. Equipment required to directional drill at this distance may be different from other types of directional drilling equipment needed on shorter distance directional drills. These areas of directional drilling are inaccessible to equipment that cannot drill between the handholes and vaults shown on the plans in a single set-up. Alternate means of accomplishing the directional drill may be proposed by the Contractor and shall require approval of the Engineer.

#### Conduit on Structure or Bridge Attached:

Fiberglass conduit shall be provided for all above ground locations where the conduit is to be attached to a bridge, as shown on the plans and in accordance with 807.02 except as revised herein. Fiberglass conduit runs shall be continuous between handholes or points of conduit transition with the exception that expansion joints shall be provided for every 200 feet of exposed conduit, or as recommended by the conduit manufacturer. Fiberglass fittings and expansion joints shall be of the same material from the same manufacturer as the fiberglass conduit. If rebar is struck while drilling lag screw holes into the bridge, drilling shall cease immediately and the hole shall be patched using an epoxy compound approved by the Engineer for patching concrete.

The bridge attachment details shown in the plans represent only one of the methods available for attaching fiberglass conduit to a bridge. The details shown in the plans were chosen because it is assumed to be the most cost-effective method to meet the following goals for this contract. It is not the designer's desire that the plan details should limit the contractor from exploring other options. Regardless of the method used to attach the conduit to the bridge, all materials and workmanship shall be of top quality.

The conduit shall be securely supported at a maximum spacing of 10 feet, or as recommended by the manufacturer, whichever is less.

The conduit shall be allowed to expand and contract without grinding against sharp edges or rough surfaces (such as concrete). Lateral movement shall not be restricted by the conduit attached hardware.

All metallic portions of conduit attachment hardware shall be constructed of non-corrosive aluminum, stainless steel, or galvanized steel.

Nothing may be attached to any bridge that reduces the under-bridge clearance. Drilling or welding of the steel bridge girders will not be permitted. Attaching conduit or hangers to the bridge barrier wall or bridge retaining wall will not be permitted due to the potential for damage from vehicle impacts.

#### Conduit Under Structure:

PVC conduit, Schedule 80 shall be provided for all locations where the conduit is to be attached under a bridge or structure. The under-structure conduit shall be as shown on the plans and according to 807.02 except as revised herein. Conduit runs shall be continuous between junction boxes, handholes, or points of conduit transition with the exception that expansion joints shall be provided for every 200 feet of exposed conduit, or as recommended by the conduit manufacturer. Fittings and expansion joints shall be of the same material and from the same manufacturer as the



conduit. If rebar is struck while drilling lag screw or anchor bolt holes into the bridge deck, drilling shall cease and the hole shall be patched using an epoxy compound approved by the Engineer for patching concrete.

The conduit shall be securely supported at a maximum spacing of 8 feet, or as recommended by the manufacturer, whichever is less.

The conduit shall be allowed to expand and contract without grinding against sharp edges or rough surfaces. Lateral movement shall not be restricted by the conduit attachment hardware except as provided as part of the expansion attachment system such as split stop rings.

All metallic portions of conduit attachment hardware shall be constructed of stainless steel or galvanized steel.

Nothing may be attached to any bridge or structure that reduces the under-bridge clearance for vehicles or vessels passing under the bridge or structure. Areas not permissible for vehicles or vessels passing under may be reduced in clearance for the purpose of extending the conduit from under the structure to the outside of the structure as shown on the plans. These locations are typically under the slope wall and at the beginning and end points of the structure where the conduit transitions from underground to under structure. Drilling or welding of the steel girders will not be permitted. Attaching conduit or hangers to the bridge barrier wall or bridge railing will not be permitted.

#### Install New Conduit Into Existing Handholes:

At locations shown on the plans, the Contractor shall install new conduit into existing handholes or vaults. The Contractor shall use the following procedure:

Remove concrete by cutting, chiseling, or core drilling as required to install new conduit without damaging the existing conduits. It shall be the Contractor's responsibility to protect the cables inside the handhole during this operation.

After removing the concrete, the area shall be washed with pressurized water and then dried with compressed air.

Position new conduits and apply an approved concrete bonding compound on the exposed concrete surfaces as recommended by the concrete manufacturer.

Place grout in all open spaces to prevent dirt and water entry into the handhole.

Perform necessary work to install the new conduit entrance, including but not limited to excavating around edges of the handhole, and replacing crushed stone base removed to install conduit. Take necessary precautions to prevent damage to the existing conduits and cables located in these existing handholes. The Contractor shall be solely responsible for any damage or displacement of the cable, conduit, or handhole arising out of or related to the Contractor's activities. With the exception of concrete pavement removal, breaking into existing handholes will be considered incidental to the installation of conduit and cable and will not be paid for separately.

#### Modifications to Existing Cabinet Conduits:

At locations indicated on the Plans, the Contractor shall furnish and install conduit, cables, and/or equipment into existing cabinets. The Contractor shall take necessary precautions to maintain uninterrupted operation of all existing equipment inside the cabinet throughout the entire installation. The Contractor shall perform all necessary work to install any new conduit. The Contractor shall be solely responsible for any damage

or displacement of existing cables, conduit, or equipment in the cabinet arising out of or related to the Contractor's activities. Installing new conduit, cable, and equipment into existing cabinets will be considered incidental to the cost of providing the conduit, cable, and equipment will not be paid for separately. If existing empty conduits can be located by the Contractor at the existing cabinet, the Contractor may utilize the spare conduit for entry to the cabinet. Utilizing an existing empty conduit is the preferred method for entry to an existing cabinet.

**HDPE Conduit Splicing:**

All HDPE conduit splices shall be fusion splices, unless mechanical splices are approved in writing by the INDOT ITS Technology Deployment Division Director.

**Reattaching Existing Cabling:**

Some locations within this contract require the Contractor to disconnect and pull existing cables free from an old conduit and then reconnect the cables to existing or new equipment. The cost of disconnecting, pulling back, re-pulling, and reconnecting existing cables shall be included in the bid price of the new conduit.

The conduit shall be cleaned by rodding and swabbing to remove all dirt and other foreign materials and capped until conductors are installed.

For all empty HDPE conduit installed under this contract and designated for future use or cable installation by others, the Contractor shall proof the conduit system with a mandrel, as per Table below, to remove any obstruction or debris. The Contractor shall perform the conduit proofing in the presence of the Engineer. The Contractor shall apply a pressure of 100-110 PSI to the conduit, close to the air output valve and stop compressor, and measure air pressure loss. The maximum allowable air pressure loss within 2 minutes of pressurization is 20 psi. The contractor shall record the Conduit Test form attached to this special provision.

Conduit Size (in)	Mandrel Diameter (in)	Minimum Mandrel Length (in)	Maximum Mandrel Length (in)	Proof (%)
1	0.60	1.0	4	80
1 ¼	0.86	1.5	4	80
1 ½	1.12	1.8	4	80
2	1.62	2.4	6	80
3	2.5	3.25	8	80
4	3.5	4.25	8	85
6	5.5	6.25	10	85
8	7.5	8.25	12	85

**Conduit Testing Form**

Date: \_\_\_\_\_ Route: \_\_\_\_\_ Direction: \_\_\_\_\_

Starting Station: \_\_\_\_\_ Ending Station: \_\_\_\_\_

Starting Mile Post: \_\_\_\_\_ Ending Mile Post: \_\_\_\_\_

Conduit #	Conduit Color Marking (Color/Stripe)	Conduit Size (inches)	Cleaned (Rodded and Swabbed) (Check Mark)	Pressure Test Starting Pressure (PSI)	Pressure Test End Pressure (PSI) (2 mins)	Capped (Check Mark)
1						
2						

3						
4						
5						
6						

Contractor: \_\_\_\_\_

Engineer: \_\_\_\_\_

**Method of Measurement**

Conduits of the type, size, and installation method specified shall be measured for payment per linear foot of conduit provided complete and in place.

**Basis of Payment**

Conduit will be paid for at the contract unit price per linear foot. Payment will be made under:

	<b>Pay Item</b>	<b>Pay</b>	<b>Unit</b>
	<b>Symbol</b>		
	Conduit, 3 HDPE, 1 1/4 in., SCH 80, Trench	LFT	
	Conduit, 3 HDPE, 1 1/4 IN., SCH 80, Hand Trench		L
FT	Conduit, 3 HDPE, 1 1/4 IN., SCH 80, Offset Trench		L
FT	Conduit, 3 HDPE, 1 1/4 IN., SCH 80, Bore		L
FT	Conduit, 3 HDPE, 1 1/4 IN., SCH 80, Bore, 1,000 FT. - 1,500 FT		L
FT	Conduit, 3 HDPE, 2 IN., SCH 80, Bore		L
FT	Conduit, 3 HDPE, 2 IN., SCH 80, Trench		L
FT	Conduit, 3 HDPE, 2 IN., SCH 80, Bore		L
FT	Conduit, 2 PVC, 2 IN., Trench		L
FT	Conduit, PVC, 3 IN., Bore		L
FT	Conduit, PVC, 4 IN., Trench		L
FT	Conduit, 1 Steel, Galvanized, 2 IN., Trench		L
FT	Conduit, Steel, Galvanized, 3 IN., Trench		L
FT	Conduit, Fiberglass, 3 IN., Bridge Attach		L
FT	Conduit, Transition, 3		IN
			L

FT	<del>Conduit, 1 Flexible, 2 IN., Overhead Sign Structure</del>							L
FT	<del>Conduit, 4 HDPE, 1 1/4 IN., SCH 80, Trench</del>							L
FT	<del>Conduit, 4 HDPE, 1 1/4 IN., SCH 80, Offset Trench</del>							L
FT	<del>Conduit, 4 HDPE, 1 1/4 IN., SCH 80, Bore</del>							L
FT								

~~The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the conduit.~~

~~The cost of all fittings, caps, bends, sweeps, expansion joints, split stop rings, anchor brackets, installation equipment, trenching, backfilling, epoxy adhesive kits, fusion splices, couplers, connectors, conduit brackets/hangers, anchor bolts, lag screws, lag screw holes, epoxy patch for concrete holes, attachment hardware, warning tape, erosion control, restoring disturbed areas, other supporting equipment, and all other incidentals necessary for installation shall be included in the cost of the conduit.~~

~~The cost to locate, expose, and document the existing utilities shall be included in the cost of the conduit.~~

~~The cost for rodding and swabbing conduits and for mandrel and pressure testing conduits shall be considered incidental to the cost of the conduit. No additional payment will be made for rodding, swabbing, mandrel and pressure testing of the conduit.~~

~~The cost for containing and removing drilling fluid/slurry and protecting wetlands from drilling fluid/slurry shall be included in the cost of the conduit.~~

~~Conduit that is directionally drilled or bored in locations identified as trench shall be paid for under the conduit trench pay items as if the conduit had been trenched.~~

~~Conduit that is directionally drilled or bored in locations identified hand trench shall be paid for under the conduit hand trenching pay item as if the conduit had been trenched.~~

~~Conduit that is installed via an allowed method different from the identified method will not receive any additional payment for additional traffic control, access costs, equipment placement, or any other items beyond what is required for the identified conduit installation method.~~

~~Conduit that is placed as hand trench shall be paid as identified for the number, type and size under the applicable trench or bore pay item.~~

FIBER OPTIC BACKBONE CABLE

**Description**

The Contractor shall provide outdoor-rated, single-mode, armored, fiber optic cable of the number of fibers specified as shown on the plans and as directed by the Engineer. Other ancillary components required to complete the fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, fan-out kits, etc., shall be incidental to the fiber optic cable item and will not be paid for separately.

**Materials**

The single-mode, fiber optic cable shall incorporate a single tube, 12- fiber ribbon design or a loose, buffer tube design. The cable shall

conform to the requirements of Rural Utility Service (RUS) 7 CFR 1755.900 (PE-90) for a single sheathed, armored cable, and shall be new, unused, and of current design and manufacture. The number of fibers in each cable shall be as specified on the plans.

**Minimum Bending Radius:**

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

**Environmental Requirements:**

The cable shall meet all of the specified requirements under the following conditions:

- Shipping/storage temperature: -40°F to +158°F (-50°C to +70°C)
- Installation temperature: -30°F to +158°F (-30°C to +70°C)
- Operating temperature: -40°F to +158°F (-40°C to +70°C)
- Relative humidity from 0% to 95%, non-condensing

All backbone cables shall be suitable for installation in outdoor handholes, manholes, or vaults subject to immersion in water and ice.

**Construction Requirements**

**Experience Requirements:**

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

- Shall have installed two systems where fiber optic cables are outdoors in conduit and where the systems have been in continuous satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses, and telephone numbers of the operating personnel who can be contacted regarding the installed fiber optic systems.
- A minimum of three years of experience in the installation of fiber optic cables, including fusion splicing, terminating, and testing single mode fibers.
- Shall have installed one fiber optic cable system (which may be one of the two in the preceding paragraph), which the Contractor can arrange for demonstration to the Department representatives and the Engineer, if requested.
- Installers shall be familiar with the cable manufacturer's recommended procedures for installing the cable. This shall include knowledge of splicing procedures for the fusion splicer being used on this project and knowledge of all hardware such as breakout (furcation) kits and splice closures. The Contractor shall submit documented procedures to the Engineer for approval and to be used by Construction inspectors.
- Personnel involved in testing shall have been trained by the manufacturer of the fiber optic cable test equipment to be used in fiber optic cable testing procedures. Proof of this training shall be submitted to the Engineer for approval. In addition, the Contractor shall submit documentation of the testing procedures for approval by the Engineer.

**Installation in Conduit:**

The Contractor shall provide a cable-pulling plan, identifying where the cable will enter the underground system and the direction of pull. This

plan shall address locations where the cable is pulled out of a handhole, coiled in a figure eight, and pulled back into the handhole. The plan shall address the physical protection of the cable during installation and during periods of downtime. The cable-pulling plan shall be provided to the Engineer for approval a minimum of 10 working days prior to the start of installation. The Engineer's approval shall be for the installation operation on the freeway and does not include an endorsement of the proposed procedures. The Contractor is responsible for the technical adequacy of the proposed procedures.

During cable pulling operations, the Contractor shall ensure that the minimum bending of the cable is maintained during the unreeling and pulling operations. Entry guide chutes shall be used and the ends of the conduit shall be fitted with bells to protect and guide the cable into the handhole conduit ports. Bells shall be removed after installation of the cable. Lubricating compound shall be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation-bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturers specifically approve the array.

The pulling tension shall be continuously measured and shall not be allowed to exceed the maximum tension specified by the manufacturer of the cable. Fuse links and breaks can be used to ensure that the cable tensile strength is not exceeded. The pulling system shall have an audible alarm that sounds whenever a pre-selected tension level is reached. Tension levels shall be recorded continuously and shall be given to the Engineer upon request.

The number of handholes/manholes/vaults and their locations shall be as shown on the Plans, or as requested by the Engineer.

The cable shall be pulled into the conduit as a single component, absorbing the pulling force in all tension elements.

The steel strength member(s) and Aramid yarn shall be attached directly to the pulling eye during cable pulling. "Basket grip" or "Chinese-finger type" attachments, which only attach to the cable's outer jacket, shall not be permitted. A breakaway swivel, rated at 95% of the cable manufacturer's approved maximum tensile loading, shall be used on all pulls. When simultaneously pulling fiber optic cable with other cables, separate grooved rollers shall be used for each cable.

Three hundred (300) feet of slack fiber shall be installed at all location where splices are being made, one hundred and fifty (150) feet on each side of the splice enclosure and tie-wrapped and coiled as indicated on the plans. Five (5) feet of slack fiber shall be included at all other handholes or vaults not containing splices. Slack cable shall be pulled from the adjacent cabinet or shelter after installation and secured inside of the vault.

#### Construction Documentation Requirements:

Installation Practices for Outdoor Fiber Optic Cable Systems: The Contractor shall examine the proposed cable plant design. At least one month prior to starting installation of the fiber optic cable plant, the Contractor shall prepare and submit to the Engineer for review and approval, ten (10) copies of the Contractor's "Installation Practices for Outdoor Fiber Optic Cable Systems" manual, or as required by the Engineer. This manual shall address the Contractor's proposed practices covering all aspects of the fiber optic cable plant. This submittal shall include all proposed procedures, list of installation equipment, and splicing and test equipment. Test and quality control procedures shall be detailed as well as procedures for corrective action.

Operation and Maintenance Documentation:

After the fiber optic cable plant has been installed, ten (10) complete sets of Operation and Maintenance Documentation shall be provided, or as required by the Engineer. The documentation shall, as a minimum, include the following:

- Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
- Final copies of all approved test procedures.
- Complete performance data of the cable plant showing the losses at each splice location and each terminal connector.
- Complete parts list including names of vendors.

Testing Requirements: The Contractor shall submit detailed test procedures for approval by the Engineer. All fibers shall be tested bi-directionally at both 1310 nm and 1550 nm with both an Optical Time Domain Reflectometer (OTDR) and a power meter and optical source. Any discrepancies between the measured results and these specifications shall be resolved to the satisfaction of the Engineer.

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter shall conduct the installation test. The Technician is directed to conduct the test using the standard operating procedures defined by the manufacturer of the test equipment. All fibers installed shall be tested in both directions.

The Contractor shall provide the date, time, and location of any tests required by this specification to the Engineer at least 5 days before performing the test. Upon completion of the cable installation, splicing, and termination, the Contractor shall test all fibers for continuity, events above 0.1 dB, and total attenuation of the cable. The test procedure shall be as follows:

Optical Time Domain Reflectometer:

The method of connectivity between the OTDR and the cable shall be a factory patch cord or launch cable of a length equal to the "dead zone" of the OTDR. Optionally, the Technician can use a factory "fiber box" of 328 ft (100 m) minimum with no splices within the box. The tests shall be conducted at 1310 nm and 1550 nm for all fibers.

At the completion of the test, the Contractor shall provide two copies of documentation of the test results along with a Comma Separated File(CSV) to the Project Engineer. The test documentation shall be bound and shall include the following:

- Cable & Fiber Identification:
  - Cable ID
  - Cable Location beginning point
  - Cable Location end point
  - Fiber ID
  - Rube/Ribbon Color
  - Fiber color
- Operator Name
- Date & Time
- Setup Parameters
- Wavelength
- Pulse width (OTDR)
- Refractory index (OTDR)
- Range (OTDR)

- Scale (OTDR)
- Setup Option chosen to pass OTDR "dead zone"
- Test Results:
  - OTDR Test
  - Total Fiber Trace
  - Splice Loss/Gain
  - Events > 0.10 dB
- Physical Length (Cable Marking)
- Fiber Length (OTDR)
- Test results and traces shall also be provided on a CD or flash drive
- Optical Source/Power Meter
- Total Attenuation

These results shall be provided in tabular form. The following shall be the criteria for the acceptance of the cable:

- The test results shall show that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss.
- However, no event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the Contractor shall replace or repair the fiber including that event point.

The total dB loss of the cable, less events, shall not exceed the manufacturer's production specifications as follows:

- 0.5 dB/km at 1310 nm
- 0.4 dB/km at 1550 nm

If the total loss exceeds these specifications, the Contractor shall replace or repair that cable run at the Contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation shall require the replacement of the cable run at the Contractor's expense, including labor and materials.

The aforementioned tests shall be completed on the reel before installation and completed after the complete installation.

**Splicing Requirements:** Splices shall be made at locations shown on the Plans. Any other splices shall be permitted only with the written approval of the Engineer.

All optical fibers shall be spliced as indicated on the Plans. If no information is provided, mainline splices shall concatenate the fibers from the two cable segments, that is, the colors of the buffer tubes and fibers shall be the same across the splice. For splices that breakout the individual fibers, the fibers shall be spliced in accordance with the Plans.

**Slack Storage of Fiber Optic Cables:** As part of this item, slack fiber shall be supplied as necessary to allow splicing of the fiber optic cables to occur in a controlled environment, such as a splicing van or tent. After splicing has been completed, the slack fiber shall be stored underground in vaults.

Where identified on the plans or as directed by the Engineer, additional lengths of fiber shall be stored as maintenance coils. The aggregate lengths of the maintenance coils and the slack fiber shall be used to repair and maintain the fiber optic cable.

Label the destination of each cable in each handhole, vault. Label the destination of each cable at a fiber distribution panel (FDP) located in cabinets, DMSs, and shelters. As a minimum, FDP face plate shall indicate the destination (i.e., dms-465-022-0-nb).



Fiber optic cable shall be tagged inside handholes with a vinyl label containing the text: "CAUTION - FIBER OPTIC CABLE."

Identification of installed Fiber Optic Cables: The backbone fiber optic cable shall be labeled as "Destination (i.e. CDP-S2)" - "Route (i.e. 465)" - "Destination (i.e. CDP-S3" and "Count" - "Fiber Type (SM or MM)" depending on the location of the fiber and type of fiber. Labels shall be permanent wrap-around type, machine printed and shall be installed within 2 feet from each installed splice enclosure, termination shelf, or conduit penetration into a handhole, cabinet or other structure.

**~~Method of measurement~~**

~~Fiber optic cable will be measured per foot of cable provided in conduit, handhole, vault, cabinet, or shelter.~~

**~~Basis of payment~~**

~~Fiber optic cable will be paid at the contract unit price per lineal foot. Payment will be made under:~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Fiber Optic Cable, Armored, ##F Single Mode</del>	<del>LFT</del>	<del>LFT</del>
<del>Fiber Optic Cable, Armored, ##F Single Mode</del>	<del>LFT</del>	<del>LFT</del>

~~The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.~~

~~The bid price shall include all necessary preparation work, pulling equipment and materials, testing, labor, and incidentals necessary to complete the work.~~

FIBER OPTIC CABLE SPLICE

**Description**

The Contractor shall splice optical fibers from different cable sheaths and protect them with a splice enclosure and splice trays at the locations shown on the Plans. Fiber splicing consists of in-line fusion splices for all fibers described in the cable plan at the particular location.

**Materials**

**Splice Enclosures:**

Splice Enclosures shall be designed for use under the most severe conditions such as moisture, vibration, impact, cable stress, and flex temperature extremes as demonstrated by successfully passing the factory test procedures and minimum specifications listed below:

**Physical Requirements:**

The enclosures shall provide ingress for up to four cables in a butt configuration. The closure shall prevent the intrusion of water without the use of encapsulates.

The enclosure shall be capable of accommodating splice organizer trays that accept mechanical or fusion splices. The splice enclosure shall have provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or un-spliced fiber. Splice organizers shall be re-enterable. The splice case shall be UL rated.

Enclosure re-entry and subsequent reassembly shall not require specialized tools or equipment. Further, these operations shall not require the use of additional parts.

The splice enclosure shall have provisions for controlling the bend radius of individual fibers to a minimum of 1.5 in (38 mm).

For splices in armored cables, the splice closure shall provide a method of bonding the armor from all sheaths entering the closure. It shall also provide a means of grounding the armor and closure at the splice location.

**Factory Testing:**

Factory Testing shall conform to the following testing;

**Compression Test:**

The closure shall not deform more than 10% in its largest cross-sectional dimension when subjected to a uniformly distributed load of 1335 N at a temperature of 0° F and 100° F (-18° C and 38° C). The test shall be performed after stabilizing at the required temperature for a minimum of two hours. It shall consist of placing an assembled closure between two flat parallel surfaces, with the longest closure dimension parallel to the surfaces. The weight shall be placed on the upper surface for a minimum of 15 minutes. The measurement shall then be taken with weight in place.

**Impact Test:**

The assembled closure shall be capable of withstanding an impact of 28 N- M at temperatures of 0° F and 100° F (-18° C and 38° C). The test shall be performed after stabilizing the closure at the required temperature for a minimum of 2 hours. The test fixture shall consist of 20 lb (9 kg) cylindrical steel impacting head with a 2 in (5 cm) spherical radius at the point where it contacts the closure. It shall be dropped from a height of 12 in (30 cm). The closure shall not exhibit any cracks or fractures to the housing that would preclude it from passing the water immersion test. There shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5%.

**Cable Gripping and Sealing Testing:**

The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber @ 1550 nm when attached to the cables and the closure assembly. The test shall consist of measurements from six fibers, one from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. The measurements shall be taken from the test fibers before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

**Vibration Test:**

The splice organizers shall securely hold the fiber splices and store the excess fiber. The fiber splice organizers and splice retaining hardware shall be tested per EIA Standard FOTP-II, Test Condition I. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

**Water Immersion Test:**

The closure shall be capable of preventing a 10 ft. water head from intruding into the splice compartment for a period of seven days. Testing of the splice closure will be accomplished by placing the closure into a pressure vessel and filling the vessel with tap water to cover the closure. Continuous pressure shall be applied to the vessel to maintain a hydrostatic head equivalent to 10 ft. on the closure and cable. This process shall be continued for 30 days. Remove the closure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

**Certification:**

It is the responsibility of the Contractor to ensure that either the manufacturer, or an independent testing laboratory has performed all of the above tests, and the appropriate documentation has been submitted to the Department. Manufacturer certification is required for the model of closure supplied. It is not necessary to subject each supplied closure to the actual tests described herein.

**Construction Requirements****Installation:**

Underground splice enclosures shall be installed in ATMS Vaults at locations shown on the plans. After all necessary splices are made and the enclosure is sealed, the Contractor shall install the enclosure in the vault such that it is supported at least one ft. above the aggregate bottom of the vault. The Contractor shall use appropriate hardware for mounting. The Contractor shall seal the splice closure and pressure test it following the manufacturer's instructions. Dry water-blocking compound shall be placed in the closure during this process.

The Contractor shall secure the Splice Closure to the side of the splice facility using cable support brackets or similar methods. All cables shall be properly dressed and secured to rails or racks within the vault. No cables or enclosures will be allowed to lie on the floor of the splice facility. Cables that are spliced inside a building shall be secured to the equipment racks or walls as appropriate and indicated on the Plans.

The enclosure shall be installed according to the manufacturer's recommended guidelines.

The Contractor shall prepare the cables and fibers in accordance with the enclosure and cable manufacturers' installation practices. A copy of these practices shall be provided to the Engineer 21 days prior to splicing operations.

Using a fusion splicer, the Contractor shall optimize the alignment of the fibers and fuse them together. The Contractor shall recoat the fused fibers and install mechanical protection over them.

Upon completing all splicing operations for a cable run, the Contractor shall measure the mean bi-directional loss at each splice using an Optical Time Domain Reflectometer. This loss shall not exceed 0.1 dB.

The Contractor shall measure the end-to-end attenuation of each fiber, from connector to connector, using an optical power meter and source. This loss shall be measured from both directions and shall not exceed 0.5 dB per installed kilometer of single mode cable, measured at 1310 nm.

The test results shall be supplied to the Department in hard copy and electronic versions.

The cable installation shall satisfy the requirements of both the National Electric Code (NFPA-70-2008) and the National Electric Safety Code (IEEE C2- 2007). The standards require that the armor be bonded and grounded any time that the armor is interrupted or exposed by opening the sheath. These documents also provide minimum separations from foreign utilities.

For splices in armored cables, the Contractor shall ground the splice closure using a #6 AWG conductor or equivalent.

As directed by the Engineer, the Contractor at no additional cost to the Department shall replace any cable splice not satisfying the required objectives.

**Method of measurement**

~~Fiber optic fusion splices will be measured for payment per each spliced fiber strand, furnished, installed and tested.~~

~~Splice enclosures will be measured for payment per each enclosure furnished, installed and secured to the wall of the splice facility.~~

~~No additional payment will be made for pulling slack fiber optic cable from nearby vaults, as required to complete a fiber optic splice. The cost of pulling slack cable shall be included in the bid price of the fiber optic splice.~~

~~**Basis of payment**~~

~~Fiber optic fusion splices will be paid for at the contract unit price per each fiber optic strand spliced, complete and in place. Fiber optic splice enclosures will be paid for at the contract unit price per EACH.~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Symbol</del>		
<del>Fiber Optic, Fusion Splice</del>	<del>EACH</del>	
<del>Fiber Optic, Splice Enclosure</del>	<del>EACH</del>	

~~The unit prices include, as a minimum, all testing and performance verification as described herein, and any incidentals necessary to complete the work.~~

FIBER OPTIC LOCATOR POST

**Description**

The Contractor shall furnish Fiber Optic Locator Post for identifying locations of fiber optic cable as shown on the plans or as directed by the Engineer.

**Material**

The Fiber Optic Locator Post shall be made of a non-conductive, high-density polymer, and shall be integrally white in color with an orange cap with black graphic and lettering on two sides. Decals shall be provided on both sides of the markers. Decal shall consist of a standard fiber optic warning message, visible from a distance, such as "Warning Fiber Optic Cable". In addition, the decal shall include the message "Call INDOT Technology Deployment Technicians Supervisor before digging 317-899-8606" along with the Department symbol (digital image is available on the Department's website)." All colors shall be stabilized against ultraviolet light such that they will not fade under continuous exposure to direct sunlight. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F. Each post shall be able to withstand a single vehicle impact at 45 MPH and return to within 10 degrees of vertical within 60 seconds.

**Installation**

A Locator Post shall be installed at fiber optic splice locations. At splice points, posts shall be connected to the fiber splice cases and the armored cable with a #12 ITS, Tracer Wire in innerduct as indicated on the Plans.

Locator Posts shall be installed in accordance with the manufacturer specifications and details.

Locator Posts shall be installed at the same time or immediately

after the installation of underground conduits and vaults for identification of underground infrastructure.

**Method of Measurement**

~~This work will be measured in units of each for the number of markers that are placed and accepted.~~

**Basis of Payment**

~~Payment will be made per each for Fiber Optic, Locator Post at locations as shown on the plans or as approved by the Engineer.~~

~~Payment will be considered full compensation for all work, materials and equipment required to place the markers at the locations shown on the plans, details, or as directed by the Engineer.~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Symbol</del>		
<del>Fiber Optic, Locator Post</del>	<del>EACH</del>	

~~The cost of materials, #12 tracer wire between the vault and post, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.~~

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FIBER OPTIC PATCH CORD

**Description**

The Fiber Optic Patch Cord is used to make fiber optic network device connections between switches and patch panels/terminal blocks with SC and LC connectors as shown on the Plans.

**Materials**

The fiber optic patch cord shall be a Single Mode, 9-Micron, Duplex, Fiber Optic Cable. All conductors shall have the following specifications:

Single Mode Patch Cord 1 Bend Radius - Meets ANSI/TIA/EIA-568B.3 standard 2 Cladding - 125±1µm 3 Core - 9.2±0.4µm 4 Crush Resistance - 750 N/cm 5 Operating Temperature - -4° F to 158° F 6 Return Loss - ≥55 dB typical 7 Tensile Strength - 240 N (54 lb./24.5 kg) 8 Wavelength - 1310 nm, 1550 nm 9 Maximum attenuation - 0.4dB/km at 1310nm, 0.3db/km at 1550nm 10 Protective boot and boot clip to allow up to a 90° bend on the LC end 11 Protective boot shall accommodate a 90° bend within 2.165 inches from the face of the connector

**Construction Requirements**

The Fiber Optic Patch Cords shall be provided in accordance with the manufacturer's instructions and as shown on the plans. All materials shall be installed in a neat and professional manner. All installation services shall comply with all warranty provisions and warranty contract maintenance services in accordance with these specifications. Coordinate layout and installation of fiber patch cables with the Engineer.

All fiber optic ferrules shall be cleaned immediately prior to installation.

**Method of measurement**

~~All Fiber Patch Cables will be measured for payment per the number of units installed and after demonstration of performance.~~

**Basis of payment**

~~Fiber Patch Cables will be paid for at the contract unit price per EACH. Payment will be made under:~~

Pay Item	Pay	Unit
<del>Symbol</del>		
<del>Fiber Optic, Patch Cord, SM, LC-SC, 3 FT</del>	<del>EACH</del>	
<del>Fiber Optic, Patch Cord, SM, LC-SC, 10 FT</del>	<del>EACH</del>	

~~This pay item includes patch panel connections, network card connections, and other equipment.~~

## FIBER OPTIC PATCH PANEL ASSEMBLY

### Description

This work shall consist of furnishing and installing patch panels for terminations inside of the communications shelter or ITS Cabinet.

### Materials

The patch panel shall have brackets and all other hardware required for rack mounting in an EIA standard 19-in. equipment rack, or wall mounted if required as shown on the plans. The enclosure shall take up no more than four rack units for 96 fiber panels and no more than one rack unit for 12 fiber panels. The patch panel shall be made of powder-coated aluminum.

The enclosure shall include routing guides for jumpers, strain relief for pigtails coming from a splice enclosure, and labels for every connector. The panel shall route fiber optic patch cables between any two connectors without reaching the patch cables' minimum bending radius.

#### Twelve Port Panels:

The enclosure shall include a 12 port patch panel cassette module with a male connection MPO, Type A, IP 69k and 68 for connection to the trunk cable and SC connectors on the front panel. The patch panel cassette shall be pre-terminated from the factory between the SC connectors and the MPO connector. Each MPO connector shall not cause in excess of 0.65dB optical signal loss when tested at 1310nm with a typical loss of 0.35dB. Each SC connector shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm. The enclosure shall be designed to hold cassettes totaling at least 36 connectors or as shown on the plans. Provide enough cassettes for every fiber that terminates in the enclosure. Provide blank panels for panel positions that are not equipped with cassettes or patch panels.

#### Ninety-six Port Panels:

The enclosure shall include patch panel modules with SC connectors. Each SC connector on the panel shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm. The enclosure shall be designed to hold modules totaling at least 96 connectors in a vertical array mountable in a 19 inch rack. Provide enough modules for every fiber that terminates in the enclosure. Provide blank panels for panel positions that are not equipped with patch panels.

### Construction Requirements

Contractor shall provide all equipment for fusion splices, pig tails, trays for organizing equipment, break out kits, connectors, labels, and other accessories required to make a complete system. All fibers shall be terminated into the patch panel assembly in either a communications shelter or cabinet location. ~~The cost of terminations shall be included in the patch panel assembly price.~~

### Method of Measurement

~~Fiber optic patch panels shall be measured per each unit furnished and installed, which shall include the patch panel, appropriate mounting hardware, labor, and any other incidental materials necessary to complete~~

~~the work.~~

**~~Basis of Payment~~**

~~Fiber optic patch panels will be paid for at the contract unit price each.~~

~~Payment will be made under:~~

<del>Pay Item Symbol</del>	<del>Pay</del>	<del>Unit</del>
<del>Fiber Optic, Patch Panel Assembly, 96 Port</del>	<del>EACH</del>	
<del>Fiber Optic, Patch Panel Assembly, 12 Port, 1U</del>	<del>EACH</del>	

~~The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.~~

FIBER SMALL FORM-FACTOR PLUGGABLE TRANSCEIVERS

**Description**

The small form-factor pluggable (SFP) transceiver inserts into the ITS switches to interface with the fiber connection.

**Materials**

SFP transceivers shall be compatible with the ITS Field switches and comply with the Multiple Source Agreement (MSA) specifications. The SFP transceivers shall provide performance as follows:

- Operating temperature of -20° F to 130° F
- LC Connector
- Distance Range:
  - Short - 550m for 50 µm multimode fiber
  - Medium - 10km for 9 µm single-mode fiber
  - Long - 70km for 9 µm single-mode fiber
  - Extended - 80km for 9 µm single-mode fiber
- Optical Link Budget:
  - Short 7dB
  - Medium 10dB
  - Long 24dB
  - Extended 24dB
- Transmit/Receive wavelength:
  - Short 850 nm
  - Medium 1310 nm
  - Long 1550 nm
  - Extended 1550 nm
- Data Rate:
  - Short - 1000Mb/s
  - Medium - 1000Mb/s
  - Long - 1000Mb/s
  - Extended - 1000Mb/s
  - SFP+ - 10Gb/s

**Construction Requirements**

SFP transceivers shall be furnished and installed at each site that is to be connected to fiber as shown on the plans.

**Method of measurement**

~~The SFP transceivers will be measured for payment by the unit Each complete and in place. This work shall include test and performance verification, and incidentals necessary to complete the work.~~

**Basis of payment**

~~SFP Transceivers will be paid for at the contract unit price per Each. Payment will be made under:~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Symbol</del>		
<del>Fiber Optic, SFP Transceiver, SM, Medium Range</del>	<del>EACH</del>	
<del>Fiber Optic, SFP Transceiver, SM, Long Range</del>	<del>EACH</del>	
<del>Fiber Optic, SFP Transceiver, SM, SFP+</del>	<del>EACH</del>	

~~The cost of materials, labor, equipment, transportation, placement and all incidentals shall be included in the cost of the pay item.~~

GROUNDING

**Description**

This work includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified herein may be supplemented in other sections of these specifications. All ground wires shall be tinned copper.

The Contractor shall design a ground system for each type of remote site and submit Plans in the form of a design drawing for approval by the Engineer. The design shall be certified by a Professional Engineer in the State of Indiana.

The work shall be completed in accordance with 807 and 922.07. This work shall also comply with Motorola R-56, Motorola Standards and Guidelines for Communications Sites 2000, Chapter 6, External Grounding. Where conflicts exist between Motorola R-56 and specifications, the more stringent requirement shall prevail.

**Materials**

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, or manufacturers with equal products, the following:

- O-Z/Gedney Co.
- Alltec Corporation
- American Electric/Blackburn
- Thomas & Betts Corp.

Grounding and Bonding Products: Products of types indicated and of sizes and ratings to comply with the NEC. Where types, sizes, ratings, and quantities indicated in these Specifications, Plans, Motorola R-56, or 807 are in excess of the NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern. Conductor materials shall be copper.

Wire and Cable Conductors:

- Aluminum wire and cable shall not be used.
- In general, conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- Equipment Grounding Conductor shall be green insulated.
- Grounding Electrode Conductor shall be solid copper wire.
- Bare Copper Conductors shall be solid copper wire: ASTM B-3.
- Assembly of Stranded Conductors in accordance with ASTM B-8.



- Tinned Conductors in accordance with ASTM B-33.

Miscellaneous Conductors:

- Ground Bus shall be bare annealed copper bars of rectangular cross section.

Connector Products:

- In general shall be listed and labeled as grounding connectors for the materials used.
- Pressure Connectors shall be high-conductivity-plated units.
- Bolted Clamps shall be heavy-duty units listed for the application.
- Exothermic Welded Connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

Grounding Electrodes: Ground Rods shall be copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core. Electrolytic ground rods maybe used, if required by soil conditions, with the approval of the Engineer. Ground rods shall be 5/8 in. by 10 ft.

Construction Requirements: Electrical systems and equipment shall be grounded in accordance with Motorola R-56 and NEC requirements except where exceed by the plans or the specifications.

Listing and Labeling:

Products provided shall be listed and labeled. The terms "listed" and "labeled" shall be in accordance with NEC, Article 100.

Electrical Component Standard: Components and installation shall comply with NFPA 70 of the NEC.

UL Standard:

Grounding and bonding equipment shall comply with UL 467, Grounding and Bonding Equipment.

Equipment Grounding Conductor Application:

Equipment grounding conductors shall comply with NEC Article 250 for size and quantity, except where larger sizes or more conductors are indicated on the plans or by Motorola R-56.

Connections:

In general make connections in such a manner as to minimize galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be compatible and prevent galvanic action. The following requirements shall also apply:

- Use electroplated or hot-tin-coated materials to ensure high conductivity and make contact points closer in order of galvanic series.
- Make connections with clean bare metal at points of contact.
- Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
- Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
- Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to the contact surfaces.

Exothermic Welded Connections:

Use for connections to structural steel, for all underground connections, and for all connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic conduits terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Noncontinuous, metallic conduits shall be bonded, in an electrical manner, at one end with grounding bushings and bare grounding conductors.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

#### Ground Rod Installations:

Ground rods shall be driven into the earth. The top of the ground rod shall be a minimum of 12 inches below finished grade. Conductor terminations to the ground rod shall be made by exothermic welds, rated for underground installation.

#### Compression-Type Connections:

Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

#### Moisture Protection:

Where insulated ground conductors terminated underground insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

#### Field Quality Control:

The procedures for performing resistance testing of the site grounding electrode system shall comply with the following:

The resistance of a grounding electrode system shall be measured after its installation and before it is bonded to the power company neutral wire or any other utility, such as the telephone ground or metallic pipes.

Resistance testing shall be done using the Three-Point/Fall-of-Potential method. The Three-Point/Fall-of-Potential test is the most widely accepted and recommended test method. This procedure is documented in ANSI/IEEE STD 81 and shall be referred to for more details. The testing shall be done in accordance with Motorola R-56. An instrument designed specifically to measure the resistance of a point to each ground shall be used and the instructions provided with the instrument shall be followed for proper measurement method. All measurements shall be recorded along with the location of each ground rod and submitted to the Engineer.

Upon completion of all grounding requirements outlined in these Special Provisions and other applicable documents, the ground resistance for Configuration G sites shall be 4 Ohms or less, all Configuration J shall be 25 Ohms or less, and all other sites shall be 10 Ohms or less.

#### Deficiencies:

Where ground resistances exceed specified values, the Contractor

shall modify the grounding system to reduce resistance values. Additional costs for materials and labor used in these modifications will be considered incidental to the cost of the grounding system.

Reporting:

Prepare test reports of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

Cleaning and Adjusting:

Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work to their original condition. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging, or mulching. Maintain disturbed surfaces, restore vegetation, and restore disturbed paving.

Inspection:

The grounding system will be inspected by the Engineer using the checklist from Motorola R-56 Appendix F pages 601 through 643, as applicable.

~~Method of Measurement~~

~~Grounding will not be measured for payment.~~

~~Basis of Payment~~

~~Grounding will not be paid for separately, and will be considered incidental to the cost of electrical equipment, cabinets, and ATMS equipment. No separate payment will be made for equipment grounding unless otherwise specifically stated herein.~~

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HANDHOLES

SECTION 805.03, BEGIN LINE 30, INSERT AS FOLLOWS:

ATMS Handholes shall be as shown on the plans. The handhole covers shall be bolted into place with stainless steel bolts and washers. The cover frame shall be installed in the handhole with a butyl rubber sealant in tape/coil form for a proper seal between the handhole and frame and to prevent it from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants.

The cover for the ATMS handhole shall be marked with logo imprints of "Traffic Management System," "Traffic Management Fiber," or "Traffic Management Power" horizontally across the cover. Covers labeled "Traffic Management Power" shall be provided whenever the handhole is used for power distribution cables. Covers labeled "Traffic Management Fiber" shall be provided whenever the handhole is used for backbone fiber. Covers labeled "Traffic Management System" shall be provided in all other handholes.

~~SECTION 805.16, BEGIN LINE 664, INSERT AS FOLLOWS:~~

~~Pay Item:~~

~~Handhole, ATMS \_\_\_\_\_ EACH~~

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ITS COMPONENT ACCEPTANCE

ITS Component Acceptance will occur after all components are installed

and integrated with the existing traffic management system. The Contractor shall submit a written request stating that the project ITS components are ready for inspection and acceptance. INDOT ITS will inspect and verify all ITS components installed on this project are acceptable. All deficiencies will be noted and a written inspection punch list form noting all deficiencies shall be presented to the Contractor. Participation of the Department in the testing does not constitute ITS Component Acceptance. Provision of a punch list after initial ITS inspection does not constitute ITS Component Acceptance. After all deficiencies are corrected, the Contractor shall provide a written request for reinspection; noting how all deficiencies were corrected. Upon reinspection and verification that all punch list items have been corrected, INDOT ITS will issue written verification showing the date of ITS Component Acceptance.

## ITS DOCUMENTATION AND SUBMITTALS

### **Description**

The Contractor shall provide four types of documentation and submittals for this contract: wiring diagrams and system schematics, submittal data, as-built documentation, and manuals and maintenance documentation. The Contractor shall submit working drawings in accordance with 105.02 and the following additional requirements.

All documentation shall be provided in electronic format and delivered to INDOT ITS via email as practical. If files exceed the size limits of the contractor's or the department's email service, the contractor shall contact INDOT ITS to discuss appropriate methods of electronic file transfer. All electronic files shall be readable using standard Microsoft Office products or Adobe Acrobat Reader.

All documentation shall also be provided in physical form. Such physical documentation shall be no smaller than 8½ in. by 11 in. or no larger than 24 in. by 36 in. except as approved by the engineer. Standard bound manuals shall be exempted from this requirement. The Department shall maintain the right to reproduce unlimited copies of any documentation for exclusive use on this contract.

All 8½ in. by 11 in. documentation, except standard bound manuals, shall be bound in logical groupings in three ring loose-leaf binders. Binders may also include 11 in. by 17 in. documentation if Z-folded. One copy of each bound grouping of documentation shall be provided labeled in a legible and permanent manner. One copy of all 24 in. by 36 in. documentation and a single reduced set no smaller than 11 in. by 17 in. shall be provided.

All documentation submitted shall be of reproducible quality as determined by the Engineer. All unsatisfactory items will be returned to the Contractor who shall make the submittal again in satisfactory reproducible form as determined by the Engineer.

All literature from manufacturers shall be original documents provided by the manufacturers. Black and white copies of color originals are not acceptable. No facsimile reproductions of any type shall be accepted.

### **Wiring Diagrams**

Wiring diagrams and system schematics shall be prepared and meet the following requirements:

- Include wire designations by color or labels for every piece of field equipment in every cable segment between the equipment.

- Include appropriate designations for every cable and conduit segment. All conduits carrying electrical cables shall be marked or labeled at all maintenance points and points of access. Designations shall include terminology such as, "Power Distribution - 480 VAC", "Video Coax", etc. All designations shall be submitted to the Engineer for approval prior to submittal.
- Show locations of all cable splices.
- Show connections to all communications equipment at the remote sites, CDP sites, and at the Traffic Management Center.
- All radio equipment documentation packages shall include system diagrams, interconnection drawings, parameter lists and optimization procedures.

#### **Submittal Data**

Submittal Data shall be prepared and meet the following requirements:

Prior to the purchase or fabrication of any equipment or material proposed for use on this project, the Contractor shall submit for review by the Engineer catalog cut sheets and specifications for all standard, off-the-shelf items; working drawings shall be submitted for all non-catalog or custom items. An electronic copy of all submittals and working drawings shall be provided in .pdf format. ~~In lieu of electronic copies the Contractor may choose to submit ten paper copies of submittals and working drawings.~~ Every submittal shall be accompanied by transmittal letter providing following information:

- Submittal number
- ~~Pay item number~~
- Manufacturer and model number
- Description

Submittals and working drawings will be approved or rejected in writing, and a memorandum stating the disposition will be returned to the Contractor. Certain items will require verification of performance, which shall be provided with the catalog cut sheets, working drawings, and specifications. See individual equipment specifications for requirements.

The purpose of the submittal and working drawing data is to show specifically and in detail how the Contractor intends to satisfy the requirements of these specification and the plans. If preprinted literature is utilized to satisfy some or all of these requirements, there shall be no statements on the literature which conflict with these specifications or plans. Any such statements will be crossed off and initialed by the Contractor and an appropriate statement be attached indicating how the requirements of these specification or the plans will be fulfilled.

The Contractor shall label each item of submittal and working drawing data with the bid item number or other description of the items to which it applies. Each submittal of catalog cut sheets, specifications, or working drawings, shall contain sufficient information and details to allow the Engineer to evaluate the particular component.

Copies of the catalog cut sheets, specifications, and working drawings shall be submitted by the Contractor to the Engineer and INDOT ITS. All catalog cut sheets and specification submittal data shall be submitted within 30 calendar days following issuance of the Notice to Proceed. All working drawings shall be submitted within 90 calendar days following issuance of the Notice to Proceed. Failure to submit catalog cut sheets, specifications and working drawings within this time frame shall result in **liquidated damages of \$1000 per day** to be withheld from Contractor payment.

All submittals will be returned to the Contractor within 30 days of submission. All submittals returned to the Contractor as rejected shall be

resubmitted for approval within 14 calendar days from the notice of rejection. Failure to resubmit documentation within the 14 calendar days from notice of rejection will result in **liquidated damages of \$1000 per day** to be withheld from Contractor payment.

The Contractor may submit alternatives to the Plans and Special Provisions to the Department for consideration. Any alternative submitted shall be identified with benefits stated and documented.

The Contractor shall submit the following items at a minimum. Any item included in this list that is not a deliverable of the contract may be removed from the requirements with approval by the Engineer. This list does not preclude the submittal of other items as required in the specifications. The submittal requirement items are as follows:

- Fiber optic cable
- Fiber optic drop cable assemblies
- Fiber optic patch panels
- Fiber optic patch cables
- Fiber optic break out kit and connectors
- Fusion splice protection kit
- Fusion splice enclosure
- Small Form-Factor Pluggable Transceivers (SFPs)
- Vaults
- Handholes
- Handhole and vault rings & lids
- Cable duct markers, concrete
- Cable duct markers, flexible (including decal design)
- All conduits
- All electrical and grounding cables
- Cell Modems
- Conduit splicing methods and materials
- Dynamic Message Sign Structure
- Dynamic Message Sign Structure Foundation
- DMS Panels and Signs
- ITS Cabinet
- Wireless Vehicle Detection System
- Monopole
- Monopole Foundation
- Camera Assemblies
- Computers

#### **As-Built Documentation**

Documentation of the work, as-built, shall be provided by the Contractor prior to acceptance of the work. The Contractor shall draw in the final as-built locations for the cabinets, poles, conduits including burial depth, and device locations. These drawings shall be returned in ~~both electronic and paper~~ format.

As part of the final as-built documentation the Contractor shall provide GPS coordinates accurate within 3 ft. of a CCTV, DMS, Cabinet, or Service point location. The coordinates shall be noted on the plans and in a single spreadsheet form provided to the Department.

As part of the final as-built documentation the Contractor shall provide GPS coordinates accurate within 3 ft. of all handhole and vault locations. The coordinates shall be noted on the plans and in a single comma separated value, CSV, file provided to the Department. The CSV file shall be supplied to the Department including the Latitude and Longitude of all

handhole and vault locations in decimal degree format. Each record shall include the type of object, Latitude, Longitude, Road Name, direction of roadway travel, and Nearest Mile Marker to the nearest tenth of a mile. The following is an example of the record format;

Example record: Vault, 39.40247778, -86.44611111, I-69, NB, 136.7

This would be the location record for a vault placed along I-69, on the NB side of the road, at the 136.7 mile marker near the interchange with SR 39.

Component and wiring diagrams shall be provided for all custom manufactured equipment as well as a complete parts listing indicating the manufacturer and model of all electronic components.

In addition to the documentation specified elsewhere, prints of schematic diagrams applicable to the equipment contained in cabinets or the communication shelters shall be provided by the Contractor. An 11 in. by 17 in. laminated wiring diagram, and an 11 in. by 17 in. laminated site drawing shall also be supplied in a weatherproof holder and mounted at each new cabinet and communication shelter.

#### **Manuals and Maintenance Documentation**

Two manuals shall be supplied for each individual component of the system. A reproducible form of the manual shall also be provided. The manuals supplied for the off-the-shelf items shall be those supplied by the equipment manufacturer.

Manuals shall include, at a minimum, the following material:

- Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
- Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
- Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- Servicing instructions and schedules.

The Contractor shall provide a maintenance history for each piece of electronic equipment provided on this contract. This history shall include the equipment type, model and serial numbers, date of manufacture, date and location of installation, date of all associated tests required by these specifications and the performance of the equipment during these tests.

Any maintenance activity performed on the unit because of a failure shall be documented, and shall include: an explanation of all failures, date that the equipment was removed from a cabinet, the repairs that were made, the date and nature of any tests made to check the correct operation of the unit, and the date and the location where the unit was reinstalled in the field.

After each repair conducted, prior to acceptance, the warranty period shall be renewed. No more than one repair shall be allowed prior to acceptance. If a second repair is required, the equipment shall be replaced in kind with a new warranty period.

#### **~~Method of Measurement~~**

~~ATMS Documentation and Submittals will not be measured.~~

#### **~~Basis of Payment~~**

~~System documentation will be considered incidental to the cost of equipment being provided on this contract and will not be paid for separately.~~

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#### ITS EQUIPMENT WARRANTY

Unless otherwise specified in the individual equipment special provisions, equipment warranties shall be provided for a period of time that is customary and normal for the manufacturer but shall not be less than one year from date of final acceptance of the contract. Final acceptance will not be provided without ITS Component Acceptance.

The warranty shall cover, at a minimum, all work and materials for all ITS equipment components and hardware including, but not limited to, all communication equipment including Switches, radios, antennas, SFP's, and all connecting cables; all end devices including microwave detectors, Travel Time Signs, camera assemblies, and camera interfaces; and all ancillary equipment including support structures, step-down transformers, power strips, remote power switches, and UPSs. Documentation shall be provided for all equipment to show compliance with warranty requirements.

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#### ITS POWER SERVICE DROP

##### **Description**

Work under this item shall include furnishing and installing all equipment necessary to provide a complete service point power entry for ATMS equipment. Electrical service, where required, shall be provided by power utility which services the location of the service point. Provide a 100 Amp, 120/240 VAC, 1-phase, 3-wire service or a 100 Amp and 480 VAC 1-phase, 2-wire service or as indicated on the plans.

##### **Materials**

The service drops shall be sized and equipped as shown on the Plans. Meter sockets shall be installed in accordance with the requirements of the utility. Grounding shall be in accordance with Standard Specification 807.12 and shall be part of the service installation.

The service drop or metered panel shall be a Service Entrance rated, NEMA 3R Load Center with integral meter base rated 120/240VAC similar to the GE TSM1610CSCU, Square D RC1624M100S, or Siemens MC2040B1150, or with a separate meter base when rated at 480VAC as indicated in the plans. The panel shall be equipped with a Main Circuit Breaker sized as indicated on the plans or sized for the service provided. Provide a minimum of sixteen, 1 inch, 1-pole circuit breaker spaces in the panel for branch circuits. The enclosure shall be padlockable.

Circuit breakers shall be single or two-pole as required by the branch circuit. Circuit breakers shall have a minimum 10,000 AIC for 240V circuit breakers, and 65,000 AIC for 480V circuit breakers. Panels shall be fully rated; series rated shall not be allowed.

##### **Construction Requirements**

The service point shall be installed at locations as indicated in the Plans and shall also be closely coordinated with the utility's requirements. Work under this item includes overhead and underground service power drops. The Contractor shall pay for all costs required by the utility for service installation.

After coordination with the electric utility's representative, the



Contractor shall contact the ITS Technology Support Director at [jessicakruger@indot.in.gov](mailto:jessicakruger@indot.in.gov) to set up the Service Point Account with the Utility Company in the Department's name so that the Department will be responsible for paying for energy consumption after service is connected for permanent service drops. The Contractor shall pay for any utility construction costs and any associated utility expenses. The Contractor shall pay all utility expenses including energy consumption for temporary service drops. The Service drops shall be in accordance with these Special Provisions and with 807.15.

All electrical work associated with the service power drop installations shall be in accordance with the Plans, Standard Specifications, and the manufacturer's written instructions and applicable requirements of NEC standards. As identified in the plans or per the Engineer request, where the proposed service point is more than 500 ft. from the ATMS remote site, a separate, lockable, subpanel shall be provided at the ATMS site.

All subpanels shall have their own ground rod which is also connected to the site's grounding system. The grounding conductors and ground rod shall be bonded to all non-current carrying metal on the subpanel.

Any location that incurs a new customer set-up charge from the power utility shall be considered as part of the installation. The installation is not complete until power is available at the service point site.

**Method of Measurement**

~~Service points will be measured for payment per unit each complete and in place. Circuit Breakers when identified as the method for power service connection to an existing ITS service point shall be measured for payment per unit each complete and in place.~~

**Basis of Payment**

~~Service Points shall be paid for at the contract unit price per each as follows:~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Symbol</del>		
<del>Service Point, ATMS, Circuit Breaker</del>	<del>EACH</del>	
<del>Service Point, ATMS, 120/240V, Overhead</del>	<del>EACH</del>	
<del>Service Point, ATMS, 120/240V, Underground</del>	<del>EACH</del>	
<del>Service Point, ATMS, Subpanel</del>	<del>EACH</del>	
<del>Service Point, ATMS, Metered Panel</del>	<del>EACH</del>	

~~Terminations, connections, service conductors, circuit breakers when not identified as the power source to an existing ITS Service Point, ground rods, ground wires, fittings, switches, service cabinets, utility current transformer cabinets, PT cabinets, CT cabinets, weatherheads, meter sockets, cables, conduits down to first below grade bend, poles, aluminum channels, braces, and mounting surfaces, and other miscellaneous items shall be incidental to this work and no separate payment will be made. Utility charges that are a standard fee for new service installations are incidental to this work, except as provided below.~~

~~The cost of the ground rod for a subpanel location shall be considered incidental to the cost of the subpanel.~~

~~Padlocks are to be in accordance with the padlock specification and are paid for separately.~~

ITS TRACER WIRE

**Description**

Work under this item shall include furnishing and installing tracer wire in conduits as shown on the plans and as described in these specifications to assist with conduit locates.

**Materials**

Tracer wires shall be a single conductor, high strength copper clad steel, orange color jacket, high molecular weight and high density polyethylene (HMWPE) insulation, #12 AWG wire. The HMWPE jacket shall be a minimum of 30 millimeters in thickness. The wire shall have a minimum break load of 425 pounds and made of fully annealed, high carbon 1055 grade steel. Tracer wires shall be rated for use at 30 volts. Wire connectors shall be waterproof.

**Construction Requirements**

As determined by the Department, new continuous tracer wire shall be placed into each run of fiber optic cable, fiber optic trunk cable, fiber optic lateral cable and fiber optic extension cable from handhole to handhole or vault. A minimum of 3 ft. of tracer wire shall be securely tied off inside of a terminating handhole.

As determined by the Department, a new continuous tracer wire shall be provided in the same raceway with all fiber optic cables. Tracer wire is not required to be installed in above-ground conduits and empty conduits that are part of a duct bank that contains a non-dielectric (conductive) cable. When multiple cables are to be installed in a conduit, all cables shall be pulled simultaneously to prevent friction damage to the cable insulation. Spare and empty conduits shall not be utilized to install the tracer wire.

The tracer wire shall be securely fastened inside of the handhole or vault. A waterproof wire nut or direct burial connector shall be connected to each end of the tracer wire to prevent corrosion. At vaults with splice enclosures the tracer wire shall be connected to the enclosure and also connect to the wire lead for the Fiber Optic, Locator Post.

**Method of Measurement**

~~ITS, Tracer Wire will be measured for payment per linear ft. of materials provided complete and in place.~~

**Basis of Payment**

~~ITS, Tracer Wire will be paid at the contract unit price per linear ft., complete and in place.~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>ITS, Tracer Wire</del>	<del></del>	<del>LFT</del>

~~The cost of materials, labor, equipment, and necessary incidentals are included in the cost of this work. ITS, Tracer Wire shall include fasteners, waterproof wire nuts, waterproof direct burial rated connectors and all other incidentals necessary for installation.~~

~~Waterproof wire nuts or connectors shall be considered incidental to the cost of the tracer wire.~~

ITS, CELLULAR MODEM ASSEMBLY

**Description**

The modem shall provide communication between the ITS Controller and the TMC.

**Materials**

The ITS, Cellular Modem shall consist of the following components:

- One cellular modem gateway
  - o CRADLEPOINT COR SERIES ROUTER MODEL # IBR900-1200
  - o Direct wire GPIO cable
- One, Five-in-one antenna
  - o AG60 SERIES W/CABLE (2 X CELLULAR 3G/4G/LTE/GPS/ 2 X WiFi 2.4GHZ FOR CRADLEPOINT IBR900)

The ITS, Cellular Modem shall provide all the needed features and components to provide data communications between the ITS field cabinet and the Department Traffic Management Centers.

**Construction Requirements**

The ITS, Cellular Modem shall be installed in accordance with the manufacturer's instructions. All materials shall be installed in a neat and professional manner. All installation services will comply with all warranty provisions and warranty contract maintenance services in accordance with these specifications. All installation services shall comply with all local and state electrical codes, and Motorola R-56 requirements. All wiring entry and exits shall be made at the side or underneath components; no exposed top entry or exits are permitted. This requirement extends to all enclosures, junction boxes, support arms, or any other externally exposed devices. Cable termination shall be in accordance with the manufacturer's recommendations. Connectors outside of cabinets shall be sealed in accordance with the manufacturer's recommendations. The contractor shall de-burr all holes made in metal poles or cabinets and install grommets for cable protection.

**Method of Measurement**

~~The ITS, Cellular Modem will be measured for payment per the number of units furnished and installed complete and in place and after passing component and subsystem testing.~~

**Basis of Payment**

~~ITS, Cellular Modem will be paid for at the contract unit price per each.~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Symbol</del>		
<del>ITS, Cellular Modem Assembly</del>		<del>EACH</del>

~~The unit price includes the cellular gateway modem, cellular gateway modem power supply, antenna, cables, environmental enclosure, housing, mount, all mounting hardware, support arms, connections, Ethernet cables, and incidentals necessary to complete the work.~~

PADLOCKS

**Description**

This work shall consist of furnishing and installing padlocks for all cabinets, fence gates, and enclosures specified in these Special Provisions.

**Materials**

The padlock shall be classified as a high security padlock with hardened shackle, laminated body, 4 pin cylinder (minimum) and come complete with a weather cover to protect the lock body and cylinder from sand, dirt, water and ice. A wafer cylinder shall not be used.

NO keys shall be provided to the Department with each padlock supplied. All padlocks shall be keyed alike and be identical to the keys currently in use by the Department. The main body width of the padlock shall not exceed 3" and have a shackle length of 2.25" to 3.75" and a shackle diameter of 5/16".

For padlock information, contact, Brian Stoner, ITS Technology Deployment Division Maintenance Supervisor Indiana Department of Transportation (317) 690-5534 bstoner1@indot.in.gov

~~Method of measurement~~

~~The Padlocks will be measured per item provided by the unit of EACH.~~

~~Basis of payment~~

~~The Padlocks will be paid for at the contract unit price of EACH.  
Payment will be made under:~~

<del>Pay Item</del>	<del>Pay Unit</del>	<del>Symbol</del>
<del>ITS, Padlock</del>	<del>EACH</del>	

VAULT, ATMS

**Description**

This work consists of furnishing and installing ATMS vaults for communications cable access as shown on the plans.

**Materials**

Materials for the ATMS vault shall be as shown in the plans and in accordance with 807.03. All vault covers are required to be bolted into place to prevent accidental removal by mowing crews or other unintentional means. The cover frame shall be installed in the vault with a butyl rubber sealant in tape/coil form for a proper seal and to prevent the frame from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants.

The vault rings and covers shall be as shown on the plans and in accordance with 807.09 except the message displayed on the lid shall read "TRAFFIC MANAGEMENT FIBER". Fabrication of these vault covers shall not commence until working drawings that the Contractor shall have submitted have been approved by the Engineer.

Construction Requirements ATMS vaults shall be installed at all planned and potential future fiber optic cable splicing locations and at additional locations as shown on the plans.

Material surrounding the buried conduit splices and ATMS vaults shall be tamped and added in such a manner so that there are no voids or depressions formed. Conduit entrance and exit points in the new ATMS vaults shall be sealed watertight.

ATMS vaults shall be precast. The top of the vault shall be flat and level with the surrounding ground. The vault shall be placed such that final grading will provide a minimum of 4 inches of soil over the concrete box. Clean applicable surfaces before installing butyl sealant on the cover frame prior to installation in the vault. Adhesive primer shall be used

when moisture is present on surfaces. Follow manufacturer's instructions for proper installation. When the installation is completed, all disturbed portions of the construction area shall be cleaned and any excess excavation or other materials shall be properly disposed of as soon as possible.

**Method of Measurement**

~~The completed work as described for ATMS vault will be measured by the unit of each and shall include furnishing and installation of a new vault, a bolt down cover, butyl sealant, excavation, and all other accessories, grading, and re-seeding necessary for a complete installation.~~

**Basis of Payment**

~~Payment for the work included in this special provision will be paid for at the Contract unit price per each.~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay Unit Symbol</del>
<del>Vault, ATMS</del>	<del>EACH</del>

~~The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.~~

~~All earthwork preparation and grading necessary for installation of the vault shall be considered incidental to this work. All final clean-up and disposal of excess excavation shall be considered incidental to this work.~~

WIRELESS VEHICLE DETECTION SYSTEM

**Description**

This work shall consist of furnishing and installing wireless vehicle detection systems for vehicle detection.

**Materials**

The wireless vehicle detection system, WVDS, is comprised of wireless magnetometer detectors, contact closure cards, receiver processors, and wireless repeaters installed for a signalized intersection. The system shall be capable of monitoring vehicles on a roadway via detection of changes in inductance caused by the presence or passage of a vehicle and shall provide detector outputs to a traffic signal controller.

The WVDS shall include magnetometer detectors, a minimum of two receiver processors, the required mounting equipment, cables, rack mounted cards, set-up and operating software, all connectors, and miscellaneous equipment necessary for the installation and operation of the system. If required, the WVDS shall also include wireless repeaters.

Only models from the Department's approved materials list for traffic signal and ITS devices shall be used.

Ethernet cable for wireless vehicle detectors shall be outdoor rated and UV shielded.

**Construction Requirements**

Prior to the installation, the Contractor shall test all wireless magnetometer detectors and demonstrate proper operation and communication between the wireless magnetometer detectors and the receiver processor and wireless repeater, if required.

Prior to the installation, the Contractor shall demonstrate that each wireless magnetometer detector is within range of its corresponding receiver processor, using wireless repeaters as necessary. All wireless magnetometer

detectors assigned to either a receiver processor or wireless repeater shall be located within a 120° arc measured from the receiver processor or wireless repeater.

The Contractor shall install each wireless magnetometer detector in the roadway according to the manufacturer's recommendations with one wireless magnetometer detector programmed to count vehicles for each through travel lane. Holes cored in the pavement shall be cleaned and dried before installing wireless magnetometer detectors. The cored pavement shall be backfilled according to the manufacturer's recommendations.

Receiver processors and wireless repeaters shall be mounted on traffic signal steel strain, pedestal, cantilever poles, or square steel sign posts. If a square steel sign post is used, it shall have a length of no more than 24 ft and a Type 3 object marker shall be installed on the post, with a mounting height of 4 ft, measured from the edge of the traveled way to the bottom of the object marker. The mounting height of receiver processors above the pavement surface shall be per the manufacturer's specifications. The mounting height of wireless repeaters above the pavement surface shall be per the manufacturer's specifications.

The minimum distance between a receiver processor and wireless repeater mounted on the same structure shall be 2 ft. This distance may be increased to enable better communication between the devices.

After installation, the Contractor shall demonstrate successful communication between each wireless magnetometer detector, receiver processor, and wireless repeater to the Engineer.

**Method of Measurement**

~~Wireless magnetometer detectors, contact closure cards, receiver processors and wireless repeaters will be measured by the number of units installed.~~

**Basis of Payment**

~~Wireless magnetometer detectors, contact closure cards, receiver processors and wireless repeaters will be paid for at the contract unit price per each.~~

<del>Pay Item</del>	<del>Pay</del>	<del>Unit</del>
<del>Symbol</del>		
<del>Contact Closure Card</del>	<del>EACH</del>	
<del>Receiver Processor</del>	<del>EACH</del>	
<del>Wireless Magnetometer Detector</del>	<del>EACH</del>	
<del>Wireless Repeater</del>	<del>EACH</del>	

~~The cost of coring the pavement, sealant, and all work necessary for proper installation and operation of the wireless magnetometer detectors shall be included in the cost of the wireless magnetometer detector.~~

~~The cost of cables, connectors, set-up and operating software, access boxes, rack mounted expansion cards, and all hardware necessary to complete the installation shall be included in the cost of the contact closure cards.~~

~~The cost of required mounting equipment, cables, connectors, and miscellaneous equipment necessary for proper installation and operation of the receiver processors shall be included in the cost of the receiver processors.~~

~~The cost of required mounting equipment, connectors, and miscellaneous equipment necessary for proper installation and operation of the wireless repeaters shall be included in the cost of the wireless~~

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200-R-401 RECYCLED FOUNDRY SAND

(Revised 04-25-21)

**Description**

Recycled foundry sand, RFS, consists of a mixture of residual materials used from ferrous or non-ferrous metal castings and natural sands. The Contractor shall have the option of incorporating RFS into applicable operations in accordance with 105.03.

**Materials**

RFS sources are to be selected from the qualified products list, QPL, of Recycled Foundry Sand. RFS may be substituted for B borrow or Borrow upon the approval by the Department's Geotechnical Services Division.

The Contractor shall provide a copy of the Indiana Department of Environmental Management's, IDEM, waste classification certification for Type III or IV residual sands prior to use. The IDEM certification shall clearly identify the stockpiles with regard to their extent and geographical location.

A type A certification in accordance with 916 shall be provided for recycled foundry sand. The results of the gradation test shall be shown on the certification for recycled foundry sand. Consultants on the Department's list of Qualified Geotechnical Consultants shall perform the testing of RFS materials.

RFS use is restricted to the following additional requirements:

1. RFS derived from Type III residual sand shall not be allowed within 100 ft, horizontally, of a stream, river, lake, reservoir, wetland, or any other protected environmental resource area.
2. RFS derived from Type III or Type IV residual sand shall not be placed within 150 ft, horizontally, of a well, spring, or other ground source of potable water.
3. RFS shall not be allowed adjacent to metallic pipes or other metallic structures.
4. RFS shall not be used as encasement material.
5. RFS shall not be used in MSE wall applications.
6. RFS placement shall be at least 2 ft above ground water elevation.

If RFS is used in embankment, excavation and replacement operations as a replacement for B borrow or borrow, the following additional restrictions will be required.

1. Borrow: RFS shall be in accordance with 203.
2. B borrow: RFS shall be in accordance with 211.

**Construction Requirements**

RFS shall be transported in a manner that prevents the release of fugitive dust and loss of material. Adequate measures shall be taken during construction operations to control fugitive dust from RFS. RFS shall not be applied when wind conditions result in problems in adjacent areas or result in a hazard to traffic on any adjacent roadway. The spreading of RFS shall be limited to an amount that shall be encased within the same workday. If weather causes stoppage of work or exposes the RFS to washing or blowing, additional RFS may be spread when the work resumes. Spraying with water, limewater, or other sealing type sprays will be considered to be acceptable methods for dust control.

When RFS is used as borrow or B borrow, the lift thickness and compaction of the materials shall be in accordance with 203.23. The dynamic cone penetrometer, DCP, criteria will be determined by a test section in accordance with ITM 514. The DCP testing will be performed in accordance with ITM 509. The moisture content shall be controlled in accordance with 203.23. The test section shall be constructed in the presence of a representative of the Department's Geotechnical Services Division. When RFS is used as B borrow, the DCP criteria for the granular soils shall be used in accordance with 203.23. Nuclear density testing of RFS will not be allowed.

When RFS is used in embankment construction, the sideslopes of the RFS shall be encased with 1 1/2 ft of non-RFS borrow materials. All RFS shall be encased with a minimum of 1 ft of non-RFS borrow materials prior to the completion of construction operations in a calendar year. The encasement materials shall be placed and compacted concurrently with the RFS lifts. Encasement materials not meeting the AASHTO M 145 Classifications of A-6 and A-7 shall be submitted to the Department's Geotechnical Services Division for approvals.

**Method of Measurement**

RFS applications will be measured in accordance with the respective uses for borrow or B borrow.

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**Basis of Payment**

RFS will be paid for at the contract unit price in accordance with the respective uses for borrow or B borrow.

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No payment will be made for the transportation, handling, or any special construction requirements such as alternative compaction means or encasement activities, when using RFS materials.

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The cost of the use of water, limewater, sprays, or other activities necessary for dust control, shall be included in the cost of the respective pay item.

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The cost of geotechnical testing for the use of RFS materials shall be included in the cost of the respective pay item.

**RECYCLED FOUNDRY SAND SOURCE QUALIFICATION CRITERIA**

The following procedures covers the requirements for Recycled Foundry Sand sources or otherwise prescribed subject matter to qualify, be added, maintained, and removed from a Department's QPL.

The procedures for qualification may involve hazardous materials, operations, and equipment. These procedures do not purport to address all



of the safety problems associated with the use of the product. The source's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

#### **General Requirements**

1. A source, requesting addition to the QPL, shall provide to the Division of Materials and Tests the following:
  - (a) Name and location of source or manufacturer
  - (b) List of material and specification reference for the material being requested for consideration,
  - (c) Average monthly production of the material by size, type or grade
  - (d) Name, address, and phone number of responsible contact person
  - (e) Facility layout or production process of the material
  - (f) Quality parameters of the material
  - (g) Raw material sampling and testing frequency
  - (h) Procedures for conforming materials which provides a positive linkage between the furnished materials and the quality control test data
  - (i) Procedures for non-conforming materials
  - (j) Procedures for marking and tracking materials
  - (k) Procedures for documentation maintenance
  - (l) Finished material sampling and testing frequency
  - (m) Procedures for reviewing and updating the source operations
  - (n) Testing laboratory quality system
  - (o) Names, titles and qualifications of sampling and testing personnel
  - (p) Location and phone number of the laboratory testing office
  - (q) Sample management describing procedures for samples identification, maintenance of the samples prior to testing, sample retention and disposal of samples
  - (r) Testing report procedures
  - (s) Methods used to identify improper test results and procedures followed when testing deficiencies occur

- (t) Statistical analysis of test results, and
- (u) Maintenance of test records.

The application shall be signed and dated by the source's or manufacturer's representative at the time the application is submitted for acceptance. The application shall be maintained to reflect the current status and revisions shall be provided to the Department in writing.

- 2. Testing may be required which will be performed outside the Department's laboratories. A recognized laboratory shall be the following:
  - (a) a State transportation agency testing laboratory,
  - (b) a testing laboratory regularly inspected by the AMRL,  
or
  - (c) a testing facility approved by the Department.

**Qualification Requirements**

In addition to the general requirements, the source shall also submit the following to the Division of Materials and Tests.

- (a) Name of Testing Facility
- (b) Dates samples were obtained
- (c) Dates samples were tested
- (d) Test method used for IDEM classification
- (e) Letter from IDEM indicating the waste classification of the materials
- (f) Test results for TCLP and neutral leachate
- (g) Stockpile sampling locations, including depths and available historical testing results
- (h) Gradation test results
- (i) Recycled Foundry Sand (RFS) Source Certification.

The Recycled Foundry Sand (RFS) source certification is included as Attachment A. A new approval submission shall be required when re-sampling is required in accordance with 329 IAC 10-9-4(e)(2). (In accordance with 329 IAC 10-9-4 (e)(2) for foundry waste, re-sampling is conducted: at two-year intervals whenever the process changes or according to a schedule for re-sampling by the IDEM Commissioner based on variability noted in previous sampling and other factors affecting the predictability of waste characteristics.)

When metal concentration of the Type III residual sand exceeds 80% of the allowable limits within IDEM classification, an indemnification clause is required. The "Recycled Foundry Sand (RFS) Indemnification Clause" is included as Attachment B.

**Maintaining Qualification**

Test reports shall be generated in accordance with specification requirements for the material and submitted monthly to the Division of Materials and Tests. If the material is not produced by the source in a given month, the monthly submittal shall state:

"No \_\_\_\_\_ was manufactured during \_\_\_\_\_."

Material \_\_\_\_\_ month/year

Samples of material may be obtained randomly for verification at the source or at the point of incorporation into the work in accordance with 106.02.

The source shall provide written notification of any changes, revisions or updates of their operations, source name or address, contact person or product name to the Division of Materials and Tests.

To maintain approval, a summary of new stockpile test results for the acceptance analysis shall be submitted monthly indicating testing every 2,000 t. Tested and approved RFS stockpiles shall be properly signed for easy identification. If no new stockpiles are created in a given month, a letter indicating, "no new RFS stockpiles for month/year were created" shall be submitted to the Division of Materials and Tests.

**Removal from QPL**

A source will be removed from the QPL for the following, but not limited to, reasons:

- (a) test failures determined by Department verification sampling,
- (b) monthly test reports not provided for three consecutive months,
- (c) test reports generated by the source which indicate non-compliance with specification requirements, or
- (d) performance of the product no longer meets the intended purpose.

**Attachment A**

**RECYCLED FOUNDRY SAND (RFS) SOURCE CERTIFICATION**

This is to certify recycled foundry sand (RFS) stockpiles geographically located as follows:

RFS \_\_\_\_\_  
\_\_\_\_\_

RFS was produced by the \_\_\_\_\_  
Company located in \_\_\_\_\_ (City), and \_\_\_\_\_

(State) and was shipped for use on Indiana Department of Transportation projects is Type \_\_\_\_\_ (III or IV) material according to the

IDEM's restricted waste criteria. If any metal concentration exceeds 80% of the allowable limits for a Type III material the foundry shall provide



at regular intervals by properly identified representatives of the Department or a duly assigned representative.

\_\_\_\_\_ (Date of Signing) \_\_\_\_\_ (RFS Producer)

\_\_\_\_\_ (Title)

\_\_\_\_\_ (Signature)

State of \_\_\_\_\_ SS: County of \_\_\_\_\_

Subscribed and sworn to before me by \_\_\_\_\_

of the firm of \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_

\_\_\_\_\_ Notary Public

My Commission Expires: \_\_\_\_\_

This certification has been reviewed and approved by:

\_\_\_\_\_ (INDOT Representative)

\_\_\_\_\_ Date

**Attachment B**

**RECYCLED FOUNDRY SAND (RFS) INDEMNIFICATION CLAUSE**

\_\_\_\_\_ RFS producer shall indemnify, defend, exculpate, and hold harmless the State of Indiana, its officials, and employees from any liability of the State of Indiana for loss, damage, injury, or other casualty of whatever kind or to whomever caused, arising out of or resulting from a violation of the federal or Indiana Occupational Safety and Health Acts (OSHA), the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or any other environmental law, regulation, ordinance, order or decree (collectively referred to hereinafter as "Environmental Laws"), as a result of the supply, testing, and application of residual sand or other materials supplied under this Contract by \_\_\_\_\_ source, whether due in whole or in part of the negligent acts or omissions of: (1) \_\_\_\_\_ Foundry, its agents, officers, or employees, or other persons engaged in the performance of the contract; or (2) the joint negligence of them and the State Of Indiana, its officials, agents, or employees.

This contract shall include, but not be limited to, indemnification from: (1) any environmental contamination liability due to the supply, testing, and application of residual sand in road base, embankments, or other projects designated by the Department as agreed to by the parties, and (2) any liability for the clean up or removal of residual sand, or materials incorporating such sand, pursuant to any Environmental Law.

The RFS producer also agrees to defend any such action on behalf of the State of Indiana, to pay all reasonable expenses and attorneys fees

for such defense, and shall have the right to settle all such claims. Provided, however, that no liability shall arise for any such fees or expenses incurred prior to the time that \_\_\_\_\_ Foundry shall

have first received actual and timely written notice of any claim against the State which is covered by this Indemnification Agreement. If timely written notice of any claim hereunder is not received by Foundry, and \_\_\_\_\_ Foundry is thereby prejudiced in its ability to defend or indemnify, then to the extent of such prejudice, this Indemnification Agreement shall be void.

This Indemnification Agreement does not create any rights in any third party, and is solely for the benefit of the State of Indiana and its agents, officials, and employees.

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202-R-728 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

*(Adopted 05-20-21)*

The Standard Specifications are revised as follows:

SECTION 202, BEGIN LINE 401, DELETE AND INSERT AS FOLLOWS:

**(p) backfill excavations in an approved manner. Backfill shall be B borrow in accordance with ~~211~~904.06 with the exception that B borrow consisting of ACBF or GBF shall not be used within 2 ft of the free water level;**

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## 203-R-726 EXCAVATION AND EMBANKMENT

(Revised 10-21-21)

The Standard Specifications are revised as follows:

SECTION 203, BEGIN LINE 385, DELETE AND INSERT AS FOLLOWS:

When free water is encountered, backfilling shall be accomplished using B borrow, in accordance with ~~211.02,904.06~~ *with the exception that ACBF or GBF shall not be used. Backfilling using B borrow shall occur* to an elevation at least 2 ft above the free water level. Compaction of the B borrow placed above the free water level shall be accomplished using heavy vibratory equipment.

The use of hydraulic methods to construct embankments will be allowed only when authorized in writing. Only B borrow *without ACBF or GBF* shall be placed below the free water level. Backfill at structures shall be in accordance with 211.04.

SECTION 203, BEGIN LINE 479, DELETE AND INSERT AS FOLLOWS:

**203.13 Slides**

*When slides are encountered during construction, or when water is observed seeping out of the slope or slope sloughing occurs the Engineer shall be notified. The Engineer will contact the Department's Geotechnical Engineering Division. The Department will provide the remedial measures to address the slope issues. Soil disturbed due to a slide shall be removed and treated as directed. and their removal* Excavation of material resulting from a slide or sloughing event will be paid for as the class or classes of excavation encountered.

If the contract involves paving, the omission or delay of paving operations may be required at the location of a slide. If proper treatment of a slide has been ~~obtained~~ *completed* prior to ~~completion of~~ *constructing* the remaining pavement, the ~~gap~~ *slide section* may be ~~required to be paved~~, and payment will be at the contract unit price for pavement.

If ~~proper~~ *the* treatment of a slide has not been ~~obtained~~ *addressed* prior to completion of the remaining pavement, the ~~gap left at the slide location~~ *slide section* shall become an exception to the contract item for pavement.

SECTION 203, BEGIN LINE 690, INSERT AS FOLLOWS:

If water is present, the backfill shall be with material in accordance with 211.02, *with the exception that ACBF or GBF shall not be used.* Placement of this material shall follow as closely behind the removal of the peat as possible. It shall be carried across the area from one end to the other by end-dumping and finally left at the established grade. This grade shall be such that keeps end-dumping to a minimum, which nominally shall be approximately 2 ft above free water level. That portion between free water level and this established grade shall be thoroughly water soaked to secure maximum compaction.

SECTION 203, BEGIN LINE 758, DELETE AND INSERT AS FOLLOWS:

**203.18 Embankment Construction**

Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or outside the right-of-way; the placing and compacting of approved material

within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits, and other depressions within the roadway area. Only approved materials shall be used in the construction of embankment backfill. *Recycled concrete pavement shall be from past documented Department projects. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement.* Rocks, broken concrete, RAP, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

~~Recycled concrete pavement may be used in embankment construction. The recycled material shall meet the gradation requirements of B borrow in accordance with 211.02 or rock embankment in accordance with 203.20904.06. Construction requirements shall be in accordance with 203.20(a) or 211.03.~~

*Only RAP particles measuring 2 in. or less in all directions shall be incorporated into the top 5 ft of the embankment. RAP particles incorporated anywhere in the embankment shall be 5 in. or less.*

*When two sizes are used for one embankment, materials shall be separated with a layer of geotextile in accordance with 918.02(c), Type 2A. Geotextile used between recycled material lifts shall be included in the cost of the embankment pay item.*

*Recycled concrete pavement and RAP shall not be mixed together or with other materials. When two or more approved materials are allowed for one embankment, materials shall be separated with a layer of geotextile in accordance with 918.02(c), Type 2A. Geotextile used between recycled material lifts shall be included in the cost of the embankment pay item.*

~~The Recycled concrete pavement or RAP may shall only be placed used below the elevation of the pavement underdrains and shall be constructed in accordance with 203.23. Compacted lift thickness for RAP shall not be greater than 6 in. within the top 5 ft of the embankment. Where the depth of the embankment exceeds 5 ft, the compacted lift thickness for RAP shall not be greater than 12 in. The Recycled concrete pavement and RAP shall not be used within 2 ft of the water table. Proofrolling in accordance with 203.26 shall be performed to cover the whole grade for every 5 ft of fill. Any rut greater than 1/2 in. shall be corrected as directed.~~

*Recycled concrete pavement shall be constructed in accordance with 203.20. RAP shall be constructed in accordance with 203.23 or 203.24. Proofrolling in accordance with 203.26 shall be performed to cover the entire grade for every 5 ft of fill.*

*A geotextile in accordance with 918.02(c), Type 1B shall be placed in accordance with 214 prior to the placement of other material when the material is finer than recycled material subgrade treatment Type IC, Type II, or Type IV in accordance with 207 when recycled concrete pavement or RAP is used for embankment construction. Recycled concrete pavement or RAP shall not be used for embankment construction when subgrade Type I, Type IBC, or Type IBL is specified. Geotextile shall be placed completely covering the top of the embankment. A minimum 24 in. soil encasement shall be constructed concurrently with the recycled concrete pavement or RAP lifts. A minimum 18 in.*

encasement suitable for vegetation growth shall be constructed in accordance with 203.09.

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## 205-R-740 PUMP AROUND

*(Adopted 09-16-21)*

**Description**

This work shall consist of furnishing, installing, and maintaining a pump around in accordance with 105.03.

The pump around shall be part of the temporary stormwater control plan and shall be constructed with the other temporary stormwater control measures in accordance with 205.

**Materials**

Materials shall be in accordance with 205.02.

The pump around dikes shall be constructed of non-erodible materials. Sandbag dikes shall be covered with impervious plastic sheeting, placed on the open channel side of the dikes. Sheet piling shall be watertight. Pump around and dewatering hoses shall be made of impervious material.

**Construction Requirements**

The Contractor may use an alternate method for the channel work as shown on the plans, pending the approval of the Engineer. If an alternate method is proposed, the Contractor shall make the appropriate permit application or amendment.

Traversing the channel reach with equipment within the work area where no work is proposed shall be avoided. If equipment is required to traverse such a reach for access to another area, timber mats or similar measures shall be used to minimize disturbance to the channel. A temporary channel crossing shall be used only when necessary and as approved.

The stormwater control measures adjacent to the channel area shall be installed before construction on the pump around can begin. All work shall stay within the construction limits. Disturbance within that area shall be minimized.

Work shall not be conducted during rain events.

**Pump Around**

The pump around shall be in accordance with the following:

Dewatering of the channel shall be performed by using a mechanical pump. The intake suction hose shall be floated as long as possible to prevent the pump from pulling sediment from the bottom of the pooled area.

Sandbag dikes shall be installed at the upstream and downstream ends of the work area as shown in the details, and the channel flow shall be pumped around the work area. The pump shall discharge onto a stable velocity dissipater consisting of riprap or sandbags or other approved medium.

Water trapped within the work area shall be pumped to a sediment filtering measure such as a dewatering basin, filter bag, or other approved device. The sediment filtering measure shall be located such that the water drains back into a stabilized area and into the channel below the downstream dike.

**Dewatering Filter Bag**

A dewatering filter bag shall be securely connected to the end of the discharge hose.

The dewatering filter bag shall be a single-use or reusable type of bag and shall be constructed of non-woven, polypropylene geotextile material. The bag shall have the following minimum specifications:

- Permittivity - 1.4 sec<sup>-1</sup>
- Grab Tensile - 205 lbs
- Weight - 8 oz/sq yd
- Apparent Opening Size - 80 US Sieve.

The dewatering filter bag shall be placed on a flat surface and on riprap or sandbags to help increase the flow through the dewatering bag and help dissipate the velocity.

Water shall be pumped from the channeled area at a rate not to exceed the maximum manufacturer's recommended flow rate of the dewatering filter bag.

Dewatering filter bags shall be placed in a location in which runoff from the bag will pass through additional sediment control measures prior to leaving the site.

Following the completion of the dewatering, the sediment accumulated within the dewatering filter bag shall be removed from the bag and placed in an upland area.

**Maintenance and Inspection**

The diversion measures shall be inspected within 24 hours of each rainfall event and at least once every seven calendar days. The sediment and debris from the channel or upstream clean water dike shall be removed. The dikes shall be repaired as needed. All outlets shall be checked and repaired as needed to prevent washouts. The dewatering filter bag shall be checked and cleaned.

**Removal**

Pump around shall be removed after construction in the main channel is complete and permanent stormwater control features have been established. Any areas disturbed by the pump around measures shall be returned to their original condition and re-vegetated as needed.

~~**Method of Measurement**~~

~~Pump around will be measured by the number of units installed, complete in place.~~

~~**Basis of Payment**~~

~~The acceptable quantities of pump around will be paid for at the contract unit price per each.~~

~~Payment will be made under:~~

<del><u>Pay Item</u></del>	<del><u>Pay Unit Symbol</u></del>
<del><u>Pump Around.....</u></del>	<del><u>EACH</u></del>

~~The cost of furnishing all materials, equipment, labor, installation, maintenance, and removal required for dewatering and~~

operation of the temporary pump around shall be included in the cost at  
pump around

The cost at temporary channel crossings if required shall be  
included in the cost of the pump around

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## 206-R-719 DEWATERING

(Revised 04-25-21)

**Description**

The Contractor shall design, furnish, install, test, operate, monitor, and maintain a dewatering system of sufficient scope, size, and capacity to prevent groundwater flow into excavations and allow water and construction operations to proceed on dry, stable subgrades.

**Materials**

Materials shall be in accordance with the following requirements.

Sediment filter bags shall consist of nonwoven, needle punched polypropylene geotextile consisting of strong, rot resistant, chemically stable long-chain synthetic polymer materials which are dimensionally stable relative to each other including the selvages. The plastic yarn or fibers used in the geotextile shall consist of at least 85% by weight of polyolefins, polyesters, or polyamides. The plastic yarn or fibers shall have stabilizers and inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure.

The geotextile shall be in accordance with the physical requirements as follows:

PROPERTY	TEST METHOD	REQUIREMENTS*
Tensile Strength	Grab Tensile Strength, ASTM D4632	200 lb
Elongation	Grab Tensile Strength, ASTM D4632	15%
Bursting Strength	ASTM D3786	350 psi
Seam Strength	Grab Tensile Strength, ASTM D4632	180 lb
Puncture Resistance	ASTM D4833	110 lb
Trapezoid Tearing Strength	ASTM C4533	80 lb
Deterioration in Tensile Strength due to Ultraviolet Degradation at 150 h	ASTM D4355	70% strength retained
Apparent Opening Size, AOS	ASTM D4751	No. 80 standard sieve or filter
Flow Rate	ASTM D4491	80 gal./min/sq ft
* The value in the weaker principal direction shall be used. All numerical values represent minimum average roll value and test results from any sampled roll in a lot shall meet or exceed the minimum values in the table. Lots shall be sampled according to ASTM D4354.		

The size of the filter bag shall be appropriate for the site conditions.

**Construction Requirements**

Dewatering operations shall be maintained to ensure stability of excavations and constructed slopes and that the excavation does not flood. Surface water shall be prevented from entering excavations by grading, dikes, or other means. Water from work area dewatering pumps shall be discharged through a sediment filter bag, or other approved device. The filter bag shall be located such that discharge water flows back into a stabilized area downstream of the work area. Dewatering shall be accomplished without damaging existing buildings or structures adjacent

to excavation. The dewatering system shall be removed when no longer needed.

The Contractor shall comply with water disposal requirements of authorities having jurisdiction.

The operation of the dewatering pumps and the condition and efficiency of the sediment filter bags shall be closely monitored. Sediment filter bags which do not perform properly or reach their capacity shall be replaced immediately.

The Contractor shall dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Disposal of water shall not inconvenience others. Sumps, sedimentation tanks, flow-control devices, and temporary sediment and erosion control shall be provided in accordance with 205 and as required by authorities having jurisdiction. Sediment in filter bags shall be removed once it has accumulated to the design volume and be disposed of in accordance with 202.

~~**Method of Measurement**~~

- Dewatering will not be measured, regardless of how many times the system is moved, replaced or relocated. Sediment filter bags will not be measured regardless of the number of times a day a filter bag may become filled and replaced.

-

~~**Basis of Payment**~~

- Dewatering shall be considered incidental to the work being performed and shall be included in the cost of other items.

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- The cost of the pump, materials, installation, inspection, maintenance, sediment filter bags, filter stone, secondary containment, removal and proper disposal, and all necessary incidentals shall be included in the cost of other items.

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207-R-735 SUBGRADE

(Adopted 07-15-21)

The Standard Specifications are revised as follows:

SECTION 207, BEGIN LINE 9, DELETE AND INSERT AS FOLLOWS:

**207.02 Materials**

Materials shall be in accordance with the following:

~~Chemical Modifiers~~..... ~~215.02~~  
 Coarse Aggregate, Class D or Higher,  
     Size No. 5, 8, 43, 53, or 73..... 904.03  
*Fly Ash, Class C*..... 901.02  
 Geogrid, Type IB ..... 918.05  
 Geocell Confinement System ..... ~~214~~918.04  
*Geotextile*..... 918.02  
 Geotextile *Properties* for Pavement  
     and/or Subgrade Stabilizations..... 918.02(c)  
*Lime* ..... 913.04(b)  
*Portland Cement, Type 1*..... 901.01(b)  
 Water ..... 913.01

Air-cooled blast furnace slag shall not be used for subgrade treatment Types ID, IV, and IVA.

Soil Property	Test Method	Requirements
Dry Weight Organic Material	AASHTO T 267	≤ 3%
Max Dry Density	AASHTO T 99	≥ 100 pcf
Liquid Limit	AASHTO T 89	≤ 50
Soluble Sulfate	ITM 510	≤ 1000 ppm
Note: Only soils meeting these requirements will be allowed within the specified thickness of the subgrade treatment in cut sections. Only soils meeting these requirements will be allowed within 24 in. of the finished subgrade elevation in fill sections.		

**CONSTRUCTION REQUIREMENTS**

**207.03 Construction Requirements**

**(a) Subgrade Construction Methods**

The subgrade shall be constructed uniformly transversely across the width of the pavement including shoulders or curbs unless shown otherwise on the plans, by one of the following methods:

1. chemical modification in accordance with 215;
2. aggregate No. 53 in accordance with 301;
3. ~~geogrid~~ *geosynthetic* in accordance with 214 placed under

~~coarse aggregate No. 53~~ in accordance with 301, or

- 4. soil compaction to 100% of maximum dry density;
- 5. ~~geotextile in accordance with 214 placed under aggregate No. 5, 8, and 53 in accordance with 301.~~

Longitudinally, the treatment may vary depending on the method of construction.

SECTION 207, BEGIN LINE 109, DELETE AND INSERT AS FOLLOWS: -

**207.05 Method of Measurement**

~~Subgrade treatment will be measured in both cut and fill areas by the square yard per type. Chemicals for soil modification using cement or lime, excavation, aggregates, geotextile, and geogrid materials will not be measured.~~

~~Geosynthetic specified for use in addition to that required for the specified subgrade treatment will be measured in accordance with 214.05.~~

~~The undercutting of rock, where encountered, will be measured in accordance with 203.27(b).~~

~~Testing, sampling, coarse aggregates, chemicals for modification, water, excavation, geogrid, geotextile, and geocell confining system for specified subgrade treatment types will not be measured.~~

**207.06 Basis of Payment**

~~The accepted quantities of subgrade treatment will be paid for at the contract unit price per square yard per type, complete in place. In areas where shallow utilities are encountered or the Contractor elects to use Type IC for Type IBC or Type IBL, payment will be made at the price of Type IBC or Type IBL.~~

~~The undercutting of rock, where encountered, will be paid for in accordance with 203.28.~~

~~Payment will be made under:~~

<b>- Pay Item</b>	<b>- Pay Unit Symbol</b>
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<del>- Subgrade Treatment, Type _____</del>	<del>.....SYS</del>
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~~The cost of subgrade treatments including testing, sampling, coarse aggregates, chemicals for soil modification with cement or lime, water, excavation, geogrid, geotextile and geocell confinement system, coarse aggregate for Type IC, Type ID, Type II, Type IV, Type IVA, Type V, water, and the excavation required, specified subgrade treatment types shall be included in the cost of the pay item.~~

~~The cost of excavation and grading of existing railroad ballast and railroad bed material shall be included in the cost of subgrade treatment, Type V.~~

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211-R-730 B BORROW AND STRUCTURE BACKFILL

(Adopted 05-20-21)

The Standard Specifications are revised as follows:

SECTION 211, BEGIN LINE 11, DELETE AND INSERT AS FOLLOWS:

**211.02 Materials**

Materials shall be in accordance with the following:

B Borrow .....	As Defined*904.06
Flowable Backfill .....	213
Geotextile.....	918.02
Structure Backfill .....	904.05

~~\*The material used for special filling shall be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter and shall be known as B borrow. It shall consist of suitable sand, gravel, crushed stone, ACBF, GBF, or other approved material. The material shall contain no more than 10% passing the No. 200 (75 µm) sieve and shall be otherwise suitably graded. The use of an essentially one-size material will not be allowed unless approved.~~

Aggregate for end bent backfill shall be No. 8 or No. 9 crushed stone or ACBF, class D or higher.

SECTION 211, BEGIN LINE 81, INSERT AS FOLLOWS:

Where B borrow or structure backfill is required as backfill at culverts, retaining walls, sewers, manholes, catch basins, and other miscellaneous structures, it shall be compacted in accordance with 211.04. *B borrow consisting of ACBF or GBF shall not be used within 2 ft of the free water level.*

214-R-733 GEOSYNTHETICS

(Revised 09-16-21)

The Standard Specifications are revised as follows:

SECTION 214, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

**SECTION 214 – GEOSYNTHETICS**

**214.01 Description**

This work shall consist of furnishing and installing geosynthetics as shown on the plans or as directed by the Engineer and in accordance with 105.03.

**MATERIALS**

**214.02 Materials**

Materials shall be in accordance with the following:

Coarse Aggregate .....	904.03 *
Geocell Confinement System.....	918.04
Geogrid.....	918.05
Geotextile for Pavement and Subgrade.....	918.02
Notes: <del>Coarse Aggregate</del> *Only No. 2, 5, 43, 53, 73, shall be used only. ACBF Slag shall not be allowed used.	

**CONSTRUCTION REQUIREMENTS**

**214.03 Foundation Preparation**

The embankment foundation shall be cleared and grubbed in accordance with 201 and excavated using lightweight equipment to minimize disturbance of the embankment foundation surface soils. Construction activities using equipment which cause pumping and rutting of the embankment foundation soils shall be prevented where possible and shall otherwise be minimized. Fine grading may be waived where impractical. When very soft soil is encountered, the embankment foundation shall be cleared of all trash and rubbish materials without disturbing the vegetation cover or root mat. The embankment foundation shall be subject to approval prior to placement of geosynthetics. Proofrolling of the embankment foundation will not be required in accordance with 203.09 when geosynthetics are used in construction of embankment foundation treatment.

**(a) Geotextile as a Drainage Blanket**

Geotextile shall be stored in such a manner as to prevent exposure to direct sunlight and damage by other construction activities. Geotextile shall be placed taut and transversely after backfilling all wheel tracks. Geotextile shall be overlapped by 3 ft and sewn in accordance with the manufacturer’s guidelines.

Coarse aggregate No. 2 or No. 5 shall be placed as directed and encapsulated with geotextile. Coarse aggregate shall be placed by spreading dumped material over previously placed material with light equipment in such a manner as to prevent damage to the geotextile. Dumping of coarse aggregate will be allowed on *the* initial working platform. The overlap shall be staggered throughout the roadway profile. Coarse aggregate shall be

placed to the full required thickness and compacted before any loaded trucks are allowed on the blanket. The drainage blanket shall have positive drainage.

No vehicles or construction equipment ~~shall~~ *will* be allowed on the geotextile prior to placement of the coarse aggregate. Damaged geotextile shall be repaired or replaced as directed. Damaged geotextile may be patched by placing a piece of the same geotextile over the damaged area. The overlap shall be at least 3 ft wide. The remaining lifts of the embankment shall be in accordance with 203.23.

**(b) Geotextile Placement for Pavement, Subgrade, or Embankment**

The subgrade or embankment shall be proofrolled in accordance with 203.26 and any defect or rut shall be repaired as directed prior to the geotextile placement. Geotextile shall be placed taut, without wrinkles and stretched in tension. Coarse aggregate shall be placed with a minimum disturbance to grade. Any damage to geotextile shall be repaired in accordance with 214.03(a). The remaining grade shall be constructed in accordance with 207. *Geotextile for pavement, subgrade, or embankment shall be in accordance with 918.02(c).*

*When geotextile for moisture management is specified, the grade shall be prepared in such a way as to provide positive drainage. The surface shall be prepared in accordance with 201.03 and compacted in accordance with 203.23. All rocks shall be broken and compacted in accordance with 203.24. Geotextiles shall be placed taut, without wrinkles, in accordance with the manufacturer's guidelines, as shown on the plans, or as specified. Damaged geotextile shall be replaced. Geotextile for moisture management shall be in accordance with 918.02(d).*

Geotextile shall be covered within three calendar days of placement.

**(c) Geogrid Placement in Embankment and Subgrade**

The geogrid shall be installed in accordance with the Engineer's designs or the manufacturer's recommendations. The geogrid shall be kept taut during placement of the initial lift of backfill. Installation shall require the use of stakes, staples, sandbags, pile of granular fill, or other approved means to hold the geogrid in place during fill placement operations. ~~Type IA~~ *Geogrid shall be used for embankment foundation treatment. Type IB geogrid shall be used for subgrade treatment, type IV.* When placing ~~type IA~~ *geogrid in the embankment foundation, any rutting in the granular material shall not exceed 3 in. in the embankment foundation.* The Engineer may increase the lift thickness to obtain stability of the granular material.

~~If required by the Engineer, the geogrid material supplier shall provide a qualified manufacturer's representative on the contract site at the start of the work to assist the Contractor. The representative shall also be available during the construction when required by the Engineer or the Contractor.~~

~~When type IB geogrid is used~~ *specified for subgrade, proofrolling shall be performed in accordance with 203.26 prior to placing the type IB geogrid. Deflection or rutting shall not exceed 1 in. Any defect shall be repaired as directed. The first 6 in. of coarse aggregate No. 53 shall be spread and compacted with a 10 t roller in static mode. The spreading and compaction of the aggregate shall be performed so that adequate*

~~interlocking~~ of the aggregate and geogrid is ~~obtained~~ *interlock*. The second 6 in. of coarse aggregate No. 53 shall be constructed in accordance with 301.

*When geogrid is specified for subbase or base applications, geogrid shall be placed as shown on the plans and in accordance with the manufacturer's guidelines.*

*When specified, the geogrid material supplier shall provide a qualified manufacturer's representative on site at the start of the work to assist the Contractor. The representative shall also be available during the construction when requested by the Engineer or the Contractor.*

The geogrid shall be overlapped a minimum of 2 ft side to side and end to end for *subgrade, subbase, and base applications* ~~type IB~~. ~~The type IA g~~ Geogrids shall be overlapped 3 ft in areas where foundation conditions cannot support foot traffic or where 2 ft is found to be inadequate during fill placement. Overlaps shall be oriented in the direction of fill placement, or shingled, to prevent advancing fill from lifting any geogrid roll edges. Overlaps shall be further secured to prevent separation during fill placement. Damaged geogrid shall be patched. Patching shall include placement of a minimum of 3 ft of overlapped geogrid beyond the damaged area. If the damaged portion extends for more than 50% of the roll in the width direction, the entire width shall be replaced.

Geogrid shall be covered with fill within three calendar days after placement. Only that amount of geogrid required for pending work shall be placed to minimize exposure of the geogrid.

#### **(d) Geocell Confinement System**

The Contractor shall construct the grade in accordance with 203. A layer of geotextile shall be placed in accordance with 214.03(b) and shall be anchored at the roadway edge when widening or when intersecting an existing roadway. The geocell confinement system, GCS, shall be placed and anchored as shown on the plans, or as directed. The Contractor shall ensure that the GCS is anchored vertically and the geocell shall be filled with a minimum of ~~34~~ in. of coarse aggregate No. 5, No. 8, or No. 43. If the Contractor chooses No. 5 or No. 8, geotextile in accordance with 918.02(a), Type 1B shall be placed on the GCS before placing No. 53 or No. 73. The GCS shall be oriented with the smaller cell dimension perpendicular to the roadway. The remaining GCS shall be filled with ~~No. 53 or No. 73~~ and at least 98 in. of No. 53 or No. 73. ~~shall be placed on the GCS.~~ The aggregate shall be back dumped and compacted with a light roller in accordance with 301. No trucks or construction vehicles ~~shall~~ *will* be allowed on the GCS. A light tracked bulldozer or other equipment may be used as directed. ~~A~~ *The* 6 in. lift above GCS shall be compacted with low frequency and amplitude, with a minimum of six passes. The remaining aggregate shall be placed and compacted lightly at first, then with high amplitude. Efforts shall be made to ensure that the geotextile and GCS are in tension. ~~The Contractor may propose an alternate means of providing a typical section for the GCS, and shall submit the proposal to the Engineer for review and approval. The proposal shall be certified by a professional engineer licensed in the State of Indiana.~~

*The Contractor may propose an alternate means of providing a typical section for the GCS, and shall submit the proposal to the Engineer for review and approval. The proposal shall be certified by a professional engineer registered in the State of Indiana.*

GCS shall be constructed in accordance with 207 and 214.

**214.04 Fill Placement**

Construction vehicles shall will not be allowed on the geogrid geosynthetic. The placement of the fill shall proceed forward along the roadway centerline and outward to the embankment edges and compacted in accordance with 203.23. The Engineer may waive density requirements for the first lift of embankment foundation treatment if the fill is determined to be too weak to support compaction equipment.

**214.05 Method of Measurement**

~~Geotextile for pavement, and subgrade, embankment, and moisture management will be measured by the square yard, for the type specified. Geotextile for coarse aggregate and drainage blankets will be measured in accordance with 301 and 616, respectively. Geogrid will be measured by the square yard, for the type specified. The quantity will be computed based on the total area of geosynthetics shown on the plans. The aggregate used for the embankment foundation improvement will be measured in accordance with 301.09. The geogrid reinforced subgrade, GCS, and the excavation required to place the GCS will be measured in accordance with 207.05.~~

~~The GCS and the excavation required to place the GCS will not be measured.~~

**214.06 Basis of Payment**

~~The accepted quantity of geotextile will be paid for at the contract unit price per square yard per type of geotextile. Geotextile for subgrade and geotextile for embankment will be paid for as geotextile for pavement, for the type specified, at the contract unit price per square yard. The accepted quantities of geogrid will be paid for at the contract unit price per square yard per type of geogrid. The aggregates will be paid for in accordance with 301.10. The geogrid reinforced subgrade will be paid for in accordance with 207.06.~~

~~Payment will be made under:~~

<del>Pay Item</del>	<del>Pay Unit Symbol</del>
<del>Geotextile for Moisture Management, _____ type</del>	<del>.....SYS</del>
<del>Geotextile for Pavement, _____ type</del>	<del>.....SYS</del>
<del>Geotextile for Subgrade, _____ type</del>	<del>.....SYS</del>
<del>Geogrid, _____ type</del>	<del>.....SYS</del>

~~The cost of furnishing the materials, manufacturer's representative, all labor and equipment required for furnishing and placing the geotextile or geogrid, all work necessary to establish grades, geogrid splices, overlaps, stakes or pins, supplemental product test data, and patching or replacement of damaged geotextile or geogrid shall be included in the cost of this work.~~



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## 306-R-753 16 FT STRAIGHTEDGE

*(Adopted 08-18-22)*

The Standard Specifications are revised as follows:

SECTION 305, BEGIN LINE 19, DELETE AND INSERT AS FOLLOWS:

**305.03 New PCC Base**

Construction of new PCC bases shall be in accordance with 502, except for 502.14, and 502.20. The CMDS shall be in accordance with 502.03 except utilization of the Department provided spreadsheet is not required. The surface shall be finished with wet burlap or by wood floats. Smoothness of the base ~~will~~*shall* be controlled *by the Contractor* with a 16 ft long straightedge longitudinally and *will be controlled by the Department* with a 10 ft long straightedge transversely. *The 16 ft straightedge shall be in accordance with 306.03(d). The 10 ft straightedge will be in accordance with 306.03(d).*

~~SECTION 305, AFTER LINE 198, INSERT AS FOLLOWS:~~

~~- *Furnishing and operating the 16 ft straightedge shall be included in the cost of other pay items within this section.*~~

SECTION 306, BEGIN LINE 59, DELETE AND INSERT AS FOLLOWS:

**(d) Straightedge**

**1. Straightedge – 16 ft**

~~A 16 ft straightedge shall be a rigid beam mounted on two solid wheels on axles 16 ft apart. The straightedge has a mounted push bar to facilitate propelling the device along or across the pavement. Tolerance points are located at the 1/4, 1/2, and 3/4 points and may be composed of threaded bolts capable of being adjusted to the tolerance required~~*The straightedge shall be a walk behind, rigid beam device on two solid wheels on axles 16 ft apart with adjustable rods at the 1/4, 1/2, and 3/4 points. The adjustable rods shall be set to a 1/4 in clearance from the bottom of the rods to the bottom of the wheels when checked with a taut stringline running from wheel to wheel at each end of the straightedge. The straightedge shall be operated in the wheel path approximately 3 ft transversely from the edge line in the direction of traffic and parallel to the pavement centerline. The operator of the straightedge shall walk the equipment over the completed pavement surface while maintaining the alignment of the equipment in the presence of the Engineer.*

~~SECTION 306, AFTER LINE 267, INSERT AS FOLLOWS:~~

~~- *Furnishing and operating the 16 ft straightedge shall be included in the cost of other pay items within this section.*~~

SECTION 409, BEGIN LINE 142, DELETE AND INSERT AS FOLLOWS:

**(f) Smoothness Equipment**

**1. Profilograph**

The ~~profilograph~~*inertial profiler* shall be in accordance with ITM 912917.

**2. Straightedge—16 ft**

~~A 16 ft straightedge shall be a rigid beam mounted on two solid wheels on axles 16 ft apart. The straightedge has a mounted push bar to facilitate propelling the device along~~

or across the pavement. Tolerance points are located at the 1/4, 1/2, and 3/4 points and may be composed of threaded bolts capable of being adjusted to the tolerance required.

### **3. Straightedge—10 ft**

The 10 ft straightedge is the same as a 16 ft straightedge except that the wheels are mounted 10 ft apart. A handheld rigid beam may be substituted.

~~SECTION 410, BEGIN LINE 499, DELETE AND INSERT AS FOLLOWS:~~

~~- Payment for furnishing, calibrating, and operating the profilograph *inertial profiler*, and furnishing IRI profile information will be made in accordance with 401.22401.18.~~

~~-~~

~~- *Furnishing and operating the 16 ft straightedge shall be included in the cost of other pay items within this section.*~~

~~-~~

~~SECTION 410, BEGIN LINE 538, DELETE AND INSERT AS FOLLOWS:~~

~~- The price for profilograph *Inertial Profiler*, HMA will be full compensation regardless of how often the profilograph *inertial profiler* is used or how many profilograms are produced *often the IRI is determined*.~~

SECTION 414, BEGIN LINE 173, DELETE AND INSERT AS FOLLOWS

#### **414.13 Smoothness**

~~A straightedge in accordance with 409.03(f) will be used to determine smoothness. The 16 ft straightedge will be used to accept smoothness along the direction of mainline traffic and the 10 ft straightedge will be used to accept smoothness transverse to the direction of mainline traffic. *Pavement smoothness shall be controlled by the Contractor with a 16 ft long straightedge longitudinally, and will be controlled by the Department with a 10 ft long straightedge transversely. The 16 ft straightedge shall be in accordance with 306.03(d). The 10 ft straightedge will be in accordance with 306.03(d). Smoothness correction shall be in accordance with 401.18(ee).*~~

SECTION 506, BEGIN LINE 463, DELETE AND INSERT AS FOLLOWS:

For patches which are not to be overlaid and have a length greater than 20 ft, pavement smoothness will be in accordance with 501.25 except ~~profilograph *inertial profiler*~~ requirements will not apply.

SECTION 508, BEGIN LINE 282, DELETE AND INSERT AS FOLLOWS:

#### **(c) Profilograph *Inertial Profiler***

The ~~profilograph *inertial profiler*~~ shall be in accordance with ITM 912917.

#### **(d) Straightedge—16 ft**

~~A 16 ft straightedge shall be a rigid beam mounted on two solid wheels on axles 16 ft apart. The straightedge has a mounted push bar to facilitate propelling the device along or across the pavement. Tolerance points are located at the 1/4, 1/2, and 3/4 points and may be composed of threaded bolts capable of being adjusted to the tolerance required.~~

#### **(e) Straightedge—10 ft**

~~A 10 ft straightedge is the same as a 16 ft straightedge except that the wheels are mounted 10 ft apart. A handheld rigid beam may be substituted.~~

501-R-752 INERTIAL PROFILER WITH SMOOTHNESS PAY ADJUSTMENTS FOR PCCP,  
FIXED INTERVAL

(Revised 10-20-22)

The Standard Specifications are revised as follows:

SECTION 501, BEGIN LINE 63, DELETE AND INSERT AS FOLLOWS:

The aggregate blend submitted on the CMDS shall produce an optimized aggregate gradation in accordance with ~~ITM 226 sections 6.2.1 and 6.3~~ *the Department provided spreadsheet*. The aggregate blend shall consist of, at a minimum, one concrete coarse aggregate and one fine aggregate, size No. 23. One additional class A intermediate-sized coarse aggregate may be included if approved by the Engineer.

SECTION 501, DELETE LINES 409 THROUGH 514.

SECTION 501, AFTER LINE 514, INSERT AS FOLLOWS:

**501.25 Pavement Smoothness**

*Pavement smoothness will be accepted by means of an inertial profiler, a 16 ft long straightedge, or a 10 ft long straightedge as described below.*

**(a) Inertial Profiler with Smoothness Pay Adjustments**

*When a pay item for Inertial Profiler, PCCP is included in the contract, the Contractor shall furnish, calibrate, and operate an approved inertial profiler in accordance with ITM 917 for the acceptance of longitudinal smoothness on the mainline traveled way, including adjacent acceleration or deceleration lanes, where both of the following conditions are met:*

- 1. The posted speed is greater than 45 mph.*
- 2. The traveled way width and slope are constant and is at least 0.5 mi in length.*

*The profiles International Roughness Index, IRI, results including areas of localized roughness, and fixed interval IRI results shall become the property of the Department. The inertial profiler shall remain the property of the Contractor.*

*The paving exceptions and areas exempt from inertial profiler operation will be in accordance with ITM 917.*

*If the posted speed limit for an entire smoothness section is less than or equal to 45 mph, the section will be exempt from inertial profiler operation and the smoothness within the section will be accepted in accordance with 501.25(b).*

*If the posted speed limit is greater than 45 mph for a portion of a smoothness section and is less than or equal to 45 mph for the remainder, the section smoothness acceptance will be as follows:*

- 1. By inertial profiler for the portion of the section with a posted speed limit greater than 45 mph.*

2. *In accordance with 501.25(b) for the portion of the section with a posted speed limit less than or equal to 45 mph.*

***(b) 16 ft Straightedge***

*The Contractor shall furnish and operate a 16 ft straightedge in accordance with 306.03(d) and as described below. The 16 ft straightedge shall be used to measure smoothness along the direction of mainline traffic.*

*Locations on the pavement surface scraped by the straightedge shall be marked. The pavement shall be corrected in accordance with 501.25(e) to meet the required tolerance. For existing utility and manhole castings that required no grade adjustment, the tolerance may be adjusted after being reviewed and approved by the Engineer.*

*For contracts which include the Inertial Profiler, PCCP pay item, the 16 ft long straightedge or the Inertial Profiler simulating the 16 ft long straightedge shall be used to measure longitudinal smoothness at the following locations:*

1. *All mainline traveled way lanes shorter than 0.5 mi.*
2. *All mainline traveled way lanes at locations exempted from inertial profiler operation in accordance with ITM 917.*
3. *All mainline traveled way lanes within smoothness sections with posted speed limits less than or equal to 45 mph throughout the entire section length.*
4. *All tapers.*
5. *All ramps.*
6. *All turn lanes, including bi-directional left turn lanes shorter than 0.5 mi.*
7. *All acceleration and deceleration lanes associated with ramps with posted speeds of 45 mph or less.*
8. *All shoulders.*
9. *All intersections with significant change in cross slope.*

*For contracts where the inertial profiler is not used for smoothness acceptance, the 16 ft straightedge shall be used to measure longitudinal smoothness at the above locations, on all mainline traveled way lanes and ramps with posted speeds greater than 45 mph, and on ramp acceleration or deceleration lanes.*

***(c) 10 ft Straightedge***

*The 10 ft straightedge will be in accordance with 306.03(d). The 10 ft straightedge will be used to check transverse slopes across travel lanes and shoulders, approaches, and*

*crossovers. When the 10 ft straightedge is used, the pavement variations shall be corrected to 1/8 in. or less.*

***(d) Areas of Localized Roughness, ALR***

*At locations where the inertial profiler is used, all areas having a localized roughness in excess of 160 in./mi utilizing continuous IRI with a 25 ft window shall be corrected subject to approval by the Engineer. After ALRs have been identified, a grinding simulation shall be performed to estimate whether the ALR can be corrected to an IRI value of less than 160 in./mi with no more than 1/4 in. grind depth at any spot. If such correction is not possible, then an ALR with an IRI value less than 190 in./mi can remain uncorrected if approved by the Engineer and ALR with an IRI value greater than 190 in./mi shall require full depth removal and replacement of sufficient area to meet specifications.*

*In addition, if there is only one ALR in any two-lane mile section, then no smoothness correction will be required if the ALR does not exceed 190 in./mi and the overall smoothness in accordance with 501.25(d) of the two-lane mile section does not require any corrective action. A two-lane mile section will start one mile before the ALR and end one mile after the ALR in order that all two-lane mile sections will have, at most, one ALR each.*

***(e) Smoothness Correction***

*Pavement smoothness variations outside specified tolerances shall be corrected by grinding with a groove type cutter or by replacement. Grinding will not be allowed until the PCCP is 10 days old and flexural strength testing yields a modulus of rupture of 550 psi or greater. The grinding of the pavement to correct the profile shall be accomplished in either the longitudinal or the transverse direction. The PCCP texture after grinding shall be uniform. If the grinding operation reduces the tining grooves to a depth of less than 1/16 in. and the longitudinal length of the removal area exceeds 15 ft, or two or more areas are within 30 ft of each other, the PCCP shall be re-textured in accordance with 504.03.*

*The width of the corrected area may be partial or full lane width, depending on the respective wheel path profiles. After the corrective action is complete, the inertial profiler shall be operated throughout the entire affected smoothness section to verify the adequacy of the corrective action.*

*At locations where the 16 ft straightedge is used, the pavement variations shall be corrected to 1/4 in. or less.*

SECTION 501, DELETE LINES 632 THROUGH 657.

SECTION 501, AFTER LINE 657, INSERT AS FOLLOWS:

***(d) Smoothness***

*Smoothness pay adjustments will only be applied when the smoothness is measured by an inertial profiler in accordance with 501.25(a).*

*When the pavement smoothness is tested with an inertial profiler, payment will be based on the Mean Roughness Index, MRI, for each lane for each 0.1-mile section of paving. The MRI for a 0.1-mile section is the average of the IRI of the two-wheel paths. A Quality Assurance Pay Factor, PF<sub>s</sub>, for smoothness will apply to the planned thickness of*

the PCCP. The quality assurance adjustment for each section will be calculated by the following formula:

$$q_s = (PF_s - 1.00) \times A \times U$$

where:

$q_s$  = quality assurance adjustment for smoothness for one section

$PF_s$  = pay factor for smoothness

$A$  = area of the section, sq yd

$U$  = unit price for the material, \$/sq yd.

The quality assurance adjustment for smoothness,  $Q_s$ , for the contract will be the total of the quality assurance adjustments for smoothness,  $q_s$ , on each section by the following formula:

$$Q_s = \sum q_s$$

When smoothness is measured by an inertial profiler, payment adjustments will be made for any 0.1-mile section based on the initial MRI generated and in accordance with the following table. The MRI pay factors for smoothness will be determined prior to any required smoothness correction in accordance with 510.25(d). Smoothness correction if required shall be in accordance with 501.25(d). For any 0.1-mile sections containing transverse construction joints that are required as per the planned maintenance of traffic, the pay factors for smoothness may be determined after corrective action at the discretion of the Contractor. Regardless of the tabulated value, the maximum pay factor for a smoothness section where corrective action has been performed will be 1.00.

<i>PAY FACTORS FOR SMOOTHNESS</i>	
<i>Posted Speed greater than 45 mph</i>	
<i>MRI, in./mi</i>	<i>Pay Factor, <math>PF_s</math></i>
<i>over 0 to 35</i>	<i>1.08</i>
<i>over 35 to 40</i>	<i>1.07</i>
<i>over 40 to 45</i>	<i>1.05</i>
<i>over 45 to 50</i>	<i>1.03</i>
<i>over 50 to 55</i>	<i>1.02</i>
<i>over 55 to 60</i>	<i>1.01</i>
<i>over 60 to 70</i>	<i>1.00</i>
<i>over 70 to 75</i>	<i>0.99</i>
<i>over 75 to 80</i>	<i>0.98</i>
<i>over 80 to 85</i>	<i>0.96</i>
<i>over 85 to 90</i>	<i>0.95</i>
<i>over 90</i>	<i><math>PF_s</math> will be 0.95 and the section shall be corrected to 90 or less.</i>

~~SECTION 501, BEGIN LINE 719, DELETE AND INSERT AS FOLLOWS:-~~

~~- **501.31 Basis of Payment**~~

~~- The accepted quantities of QC/QA PCCP will be paid for at the contract unit price per square yard for the thickness specified, complete in place.~~

~~Furnishing and operating the 16 ft straightedge shall be included in the cost of other pay items within this section.~~

~~- Payment for furnishing, calibrating, and operating the profilograph inertial profiler, and furnishing IRI profile information will be made at the contract lump sum price for profilograph Inertial Profiler, PCCP.~~

~~SECTION 501, BEGIN LINE 746, DELETE AND INSERT AS FOLLOWS:~~

~~- Profilograph Inertial Profiler, PCCP ..... LS~~

~~SECTION 501, BEGIN LINE 752, DELETE AND INSERT AS FOLLOWS:~~

~~- The price of profilograph Inertial Profiler, PCCP will be full compensation regardless of how often the profilograph inertial profiler is used or how many profilograms are produced often the IRI is determined.~~

SECTION 502, BEGIN LINE 358, DELETE AND INSERT AS FOLLOWS:

**502.20 Pavement Smoothness**

Pavement smoothness will be in accordance with 501.25 except profilograph inertial profiler requirements will not apply.



## 601-R-750 GUARDRAIL

(Adopted 03-17-22)

The Standard Specifications are revised as follows:

SECTION 601, BEGIN LINE 22, DELETE AND INSERT AS FOLLOWS:

All guardrail, ~~post, accessories, fittings,~~ and *connection* hardware shall be supplied from a manufacturer listed on the QPL of Guardrail Manufacturers in accordance with 910.09. Guardrail end treatments shall be selected from the QPL of Guardrail End Treatments in accordance with 601.07 and impact attenuators shall be selected from the QPL of Impact Attenuators in accordance with 601.08.

SECTION 910, BEGIN LINE 591, INSERT AS FOLLOWS:

**910.10 Guardrail Posts**

Guardrail posts shall be either steel or timber as specified and shall be in accordance with the following requirements. *A type C certification in accordance with 916 shall be provided for the guardrail posts.*

SECTION 910, BEGIN LINE 615, DELETE AND INSERT AS FOLLOWS:

**910.11 Guardrail Accessories, Fittings, and Hardware**

These items consist of brackets, splice plates and bars, post anchors, diaphragms, clamps and clamp bars, end caps, connections *hardware*, anchor rod assemblies, deadmen, ~~bolts, screws, nuts, washers~~ and blockouts of the type, dimensions, and design shown on the plans. They shall be in accordance with the requirements set out below. Items of the same type shall be interchangeable regardless of the source. *Connection hardware consisting of bolts, nuts, washers, and splice plates will only be accepted from qualified manufacturers on the QPL of Guardrail Manufacturers. A type C certification in accordance with 916 shall be provided for all other accessories and fittings.*

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603-R-414 POLYVINYL CHLORIDE COATED CHAIN LINK FENCE

(Revised 05-23-13)

**Description**

This work shall consist of the furnishing and placement of polyvinyl chloride, PVC, coated chain link fence and gates in accordance with 105.03.

**MATERIALS**

**Materials**

Materials shall be in accordance with the following:

Chain Link Fabric, PVC, Class 2b.....	ASTM F668
Concrete, Class B.....	702
Concrete, Packaged Dry.....	901.08
Fence Posts.....	910.13
Gates.....	ASTM F1043
Tension Wire.....	ASTM F1664

The fence fabric shall be No. 9 gauge wire with 2 in. mesh. Tension wire shall be No. 9 gauge wire.

The color of all fence materials including the fabric, tension wire, posts, bars, gates, and miscellaneous hardware shall be in accordance with ASTM F668 and in accordance with the plans.

All caps, beveled tension and brace bands, and connectors used in construction of PVC coated chain link fence shall be pressed steel, malleable or cast steel, galvanized and PVC coated in accordance with ASTM F668.

All gate hardware shall meet the requirements for industrial fences. Hardware subject to movement and not vinyl-clad shall be field painted with touchup paint specifically formulated for this purpose.

**CONSTRUCTION REQUIREMENTS**

**General**

Construction operations shall be in accordance with 603.03, 603.04, 603.05, and 603.06.

**~~Method of Measurement~~**

PVC coated chain link fence, and resetting PVC coated chain link fence will be measured by the linear foot. Measurement will be made along the top of the fence from outside to outside of end posts for each continuous run of fence.

PVC coated gates will be measured as complete units of the size and type specified.

**~~Basis of Payment~~**

The accepted quantities of PVC coated chain link fence and resetting PVC coated chain link fence will be paid for at the contract unit price per linear foot, complete in place. PVC coated gates will be paid for at the contract unit price per each of the size specified, complete in place.

Payment will be made under:

<del>Pay Item</del>	<del>Pay Unit</del>	<del>Symbol</del>
<del>Fence, Chain Link, PVC Coated, _____ in.....</del>	<del>height</del>	<del>LFT</del>
<del>Fence Gate, Chain Link, PVC Coated _____ in. x _____ in.....</del>	<del>height length</del>	<del>LFT</del>
<del>Fence, Chain Link, PVC Coated, Reset.....</del>		<del>LFT</del>

The cost of adding grounding in accordance with the National Electric Safety Code including all materials, and labor shall be included in the cost of the fence.

The cost of PVC fence, corner, end, line, and pull posts shall be included in the cost of the fence.

The cost of PVC fence, posts and miscellaneous hardware shall be included in the cost of the gate.

The cost of all miscellaneous hardware related to the type of fence including brace connections, caps, clips, clamps, hinges, rivets, ties, truss rods, diagonal braces and stretcher bars shall be included in the cost of the fence.

The cost of concrete for posts, braces or anchors shall be included in the cost of the fence and gates.

The cost of removal, storage, re-installation, and the replacement of damaged or missing parts shall be included in the cost of the resetting fence.

621-R-398 CAPPING CUT AND FILL SLOPES STEEPER THAN 3:1

(Revised 05-23-13)

**Description**

This work shall consist of:

- (a) covering soil slopes with a cohesive soil to establish vegetation;
- (b) use of soil reinforcement materials and blankets for mulching seed as shown on the plans and in accordance with these requirements;
- (c) use of water absorption chemicals to hold water and keep moisture available for seed germination; and
- (d) soil testing for pH, nutrient supply, and organic matter percentage.

**Materials**

The materials shall be in accordance with the following:

**(a) Mulch Blankets**

The mulch blankets shall be excelsior blankets or straw mats in accordance with 621.05(d) or 621.05(f).

**(b) Water Absorption Gels**

Water absorption gels developed for horticultural use shall be incorporated into the top 1 1/2 in. of the capping soil according to the manufacturer's recommendations. The Contractor shall supply a copy of the manufacturer's recommendation to the Engineer prior to the placement of the capping soil.

**(c) Capping Soil**

The capping soil shall be a type A4, A5, A6, or A7 AASHTO classification, that has a pH range of 6 to 7 and an organic content of 5 to 10% by volume or 2 to 3% by dry weight. The soil shall be tested by an approved laboratory and the results shall be furnished to the Engineer prior to the placement of the soil.

**Construction Requirements**

All slopes steeper than 3:1 designated for seeding shall be ripped to a depth of 2 in. and then covered with a 6 in. layer of capping soil. The capping soil shall be evenly spread over all areas and shall have the water absorption gels incorporated. The capping soil shall be tracked into place such that the cap adheres to the existing soil and forms the desired contours for the slope. All debris in the capping soil shall be in accordance with 203.09. All areas shall be fine graded to produce a smooth surface which conforms to the contours and cross sections desired.

**~~Method of Measurement~~**

- Existing soils stripped and stockpiled for use as a capping soil will be measured as common excavation in accordance with 203.27. Capping soil obtained from off the right-of-way will be measured as borrow in accordance with 203.27. Erosion control blankets will be measured in accordance with 621.13. Water absorption gels will not be measured for payment.

**~~Basis of Payment~~**

- Existing soils stripped, stockpiled, and then redistributed as a capping soil will be paid for as common excavation in accordance with 203.28. Capping soil obtained from off the right-of-way will be paid for as borrow in accordance with 203.28. Erosion control blankets will be paid for in accordance with 621.14.

- The cost of the water absorption gel shall be included in the cost of the erosion control blanket.

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715-R-732 PIPE CULVERTS, AND STORM AND SANITARY SEWERS

(Revised 07-15-21)

The Standard Specifications are revised as follows:

SECTION 715, BEGIN LINE 24, DELETE AND INSERT AS FOLLOWS:

Materials shall be in accordance with the following:

B Borrow .....	211904.06*
Concrete.....	702
Flowable Backfill.....	213
Geotextiles .....	918.02
Pipe Joint Sealant.....	907.11
Reinforcing Bars .....	910.01
Rubber Type Gaskets .....	907.13
Straps, Hook Bolts, and Nuts.....	908.12
Structure Backfill .....	904

*\* B borrow consisting of ACBF or GBF shall not be used within 2 ft of the free water level.*

The maximum particle size of backfill material for corrugated pipe shall be less than 1/2 the corrugation depth.

SECTION 715, BEGIN LINE 334, DELETE AND INSERT AS FOLLOWS:

**715.09 Backfilling**

All pipe trenches shall be backfilled with structure backfill ~~or flowable backfill~~. Structure backfill shall be placed in accordance with 211. ~~Flowable backfill shall be placed in accordance with 213.07 as shown on the plans or as directed.~~ Structure backfill nominal sizes 2 in. and 1 1/2 in. shall not be used as pipe backfill on any pipe with exterior ribs, corrugations, or other profile.

*If a pipe is to be backfilled using one of the flowable backfill options, design calculations shall be submitted in accordance with 105.02, either proving the pipe will not float or detailing the methods to be taken to prevent the pipe from floating during installation of the flowable backfill. Prior to placing one of the flowable backfill options for structure backfill, all standing water shall be removed from the trench. If ~~the~~ water cannot be removed from the trench, one of the non-flowable structure backfill options shall be used ~~in lieu of flowable~~ to backfill to an elevation 2 ft above the ~~ground~~water. The remainder of the trench shall be backfilled as shown on the plans.*

*Where material other than structure backfill is allowed and used for backfilling, it shall be of such nature that compacts readily. The portion around and for 6 in. above the top of the pipe shall be free from large stones. The material shall be placed in layers not exceeding 6 in. loose measurement, and each layer shall be compacted thoroughly by means of mechanical tamps.*

*Whenever a fine aggregate or dense graded backfill is placed on top of a coarse graded backfill, geotextile, in accordance with 918.02(a), Type 2A shall be used between the different backfill materials.*

*Backfill for slotted drain pipe and slotted vane drain pipe shall consist of class A concrete on both sides of the pipe. During the backfilling and paving operations, the slot shall be covered to prevent infiltration of material into the pipe.*

All pipes, except underdrains, will be visually inspected for acceptance a minimum of 30 days after the completion of backfill operations. Pipes that cannot be visually inspected shall be video inspected for acceptance using equipment in accordance with 718.07. The Engineer will determine the sections of pipe to be video inspected.

For pipes that were video inspected, a copy of the video inspection shall be provided in a format acceptable to the Engineer. The video inspection shall be provided prior to performing the mandrel testing or if mandrel testing is not required, prior to acceptance of the pipe.

*Type 3 pipes in accordance with 715.02(c) are excluded from the mandrel testing and video inspection requirements.*

For pipe not requiring mandrel testing that is determined to be unacceptable by the Engineer, the unacceptable pipe shall be replaced between the nearest pipe joints or to the nearest structure, or a remediation plan shall be prepared by a professional engineer and submitted to the Engineer for final determination.

After the visual or video inspection, the Contractor shall check pipe deflection by performing a mandrel test as directed on pipes manufactured from materials listed in the following table. The Engineer will determine the runs of pipe installations to be mandrel tested with a minimum of 10% of the total length of each material to be inspected.

Pipes Required <del>ing</del> to Be Mandrel Tested <del>ing</del>	
Pipe Material	Standard Specifications
Corrugated Polyethylene Pipe *	907.17(b)
Corrugated Polypropylene Pipe	907.19
Profile Wall Polyethylene Pipe	907.20
Smooth Wall Polyethylene Pipe	907.21
Profile Wall PVC Pipe *	907.22
Smooth Wall PVC Pipe	907.23
* When used as underdrain pipe, mandrel testing will not be required.	

The mandrel shall have a minimum of nine arms or prongs and a diameter that is 95% of the nominal pipe diameter. The Contractor shall provide a proving ring that is 95% of the nominal pipe diameter for each mandrel.

The Contractor shall pull the mandrel through the pipe by hand. If the mandrel does not pass through the pipe, the Contractor shall measure and report the minimum diameter of the deficient pipe to the Engineer.

If the minimum diameter of the deficient pipe is between 92.5% and 95.0% of the nominal pipe diameter, the Contractor shall provide an evaluation of the deficient pipe prepared by a professional engineer. The evaluation shall consider the severity of the deflection and its effects on structural integrity, environmental conditions, and the design service life of the pipe. A report summarizing the evaluation and including the professional engineer's recommendation for acceptance, remediation, or replacement of the pipe shall be submitted to the Engineer for final determination.

If the minimum diameter of the deficient pipe is equal to or less than 92.5% of the nominal pipe diameter, the deficient pipe shall either be replaced or a remediation plan shall be prepared by a professional engineer and submitted to the Engineer for final determination.

The deficient pipe shall be replaced if the professional engineer's remediation plan recommends replacement of the pipe or if the pipe has been damaged.

Deficient pipe shall at a minimum be replaced between the nearest pipe joints or to the nearest structure. Replaced or remediated pipe sections shall be mandrel tested a minimum of 30 days after the completion of backfill operations.

~~Commercial and private drive pipes are excluded from the mandrel testing and video inspection requirements.~~

~~Where material other than structure backfill or flowable backfill is allowed and used for backfilling, it shall be of such nature that compacts readily. That portion around and for 6 in. above the top of the pipe shall be free from large stones. This material shall be placed in layers not to exceed 6 in., loose measurement, and each layer compacted thoroughly by means of mechanical tamps. Where coarse aggregate is used for structure backfill, geotextile shall be installed.~~

~~An adequate earth cover, as shown on the plans, shall be placed over the structure before heavy equipment is operated over it.~~

~~Backfill for slotted drain pipe and slotted vane drain pipe shall consist of class A concrete on both sides of the pipe. During the backfilling and paving operations, the slot shall be covered to prevent infiltration of material into the pipe.~~

SECTION 715, BEGIN LINE 529, DELETE AND INSERT AS FOLLOWS:

~~- Video inspection for pipe will be measured by the linear foot as determined by the electronic equipment.~~

~~-~~

~~- Geotextile used to wrap for backfill material will not be measured for payment.~~

~~-~~

SECTION 715, BEGIN LINE 667, DELETE AND INSERT AS FOLLOWS:

~~- The cost of concrete, grating, pipe tubing, reinforcing bars, aggregate leveling bed, hardware cloth, and necessary incidentals, for construction of grated box end sections will be included in the cost of the grated box end section.~~

~~-~~

~~- Geotextile required for coarse aggregate to be placed on top of the structure backfill~~



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720-R-646 CURB INLET CASTING

(Revised 04-25-21)

The Standard Specifications are revised as follows:

SECTION 910, AFTER LINE 404, INSERT AS FOLLOWS:

*Where a 6 in. curb height is specified, a monolithic frame and curb box may be used in place of one with modular components, provided the monolithic casting's dimensions match those shown on the plans.*

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## 801-C-157 CERTIFICATION OF TEMPORARY TRAFFIC CONTROL DEVICES

(Revised 05-23-13)

**Category I Devices**

The Contractor shall certify that the following temporary traffic control devices to be used do not exceed the maximum values shown in the table below, and are considered crashworthy at Test Level 3 in accordance with NCHRP 350.

Device	Composition	Max. Weight	Max. Height
Single Piece Traffic Cones	Rubber	20 lb	36 in.
	Plastic	20 lb	48 in.
Tubular Markers	Rubber	13 lb	36 in.
	Plastic	13 lb	36 in.
Single Piece Drums	High Density Plastic	77 lb	36 in.
	Low Density Plastic	77 lb	36 in.
Delineators	Plastic, Fiberglass	N/A	48 in.

No lights, signs, flags, or other auxiliary attachments are included in the weight of the devices listed above. Reflective sheeting or reflective buttons are included on delineators. Maximum weights, including ballast, do not exceed the values shown in the table. "Single piece" refers to the construction of the body of the drum exclusive of a separate base, if any.

Type A or type C warning lights in accordance with the following specifications will be allowed on drums if they are firmly attached with vandal resistant 1/2 in. diameter by 4 in. cadmium plated steel bolt with nut and a 1 1/2 in. high cup washer.

1. The weight shall be no more than 5 lb.
2. The lens diameter shall be 7 to 8 in.
3. The height of the light shall be 11 to 14 in.

**Category II Devices**

Category II temporary traffic control devices include type III barricades, vertical panels, portable sign standards, and other light-weight traffic control devices.

Category II temporary traffic control devices shall be in accordance with the NCHRP 350, Test Level 3.

A form will be provided at the preconstruction conference for the Contractor to complete and return to the Engineer prior to the placement of category I or II traffic control devices.

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## 801-R-542 WORKSITE ADDED PENALTY SIGNS

(Revised 03-16-17)

Worksite Added Penalty signs shall be placed as shown on the plans or as directed by the Engineer. The signs shall typically be placed in advance of the first Road Construction Ahead signs at either end of the project. The actual location and quantity of the signs will be determined by the Engineer in coordination with the Worksite Traffic Control Supervisor.

The XW2-6-A Worksite Added Penalty sign, 78 in. by 42 in., shall be installed on all projects in all cases not otherwise described below.

The XW2-6 Worksite Added Penalty sign, 60 in. by 36 in., shall only be installed on projects in urban areas that have a posted speed limit of 35 MPH or less and also meet one of the following conditions:

1. The existing surfaces outside the edge of pavement make installation of driven posts impractical, or
2. The width of the Right-of-Way outside of the edge of pavement is not sufficient to accommodate the larger XW2-6-A, Worksite Added Penalty sign, 78 in. by 42 in.

The XW2-6a-B Speeding and XW2-6b-B Reckless Driving signs, 48 in. by 48 in., shall be used in series with each other and shall only be used on projects that meet one of the following conditions:

1. Rural projects where the width of the Right-of-Way outside of the edge of pavement is not sufficient to accommodate the larger XW2-6-A Worksite Added Penalty sign, 78 in. by 42 in., or
2. Contracts using only moving operations where construction signs are set and removed each day to accommodate the changing location of the work.

The XW2-6a-A Speeding and XW2-6b-A Reckless Driving signs, 36 in. by 36 in., shall be used in series with each other and shall only be used on projects in urban area where the width of the Right-of-Way outside of the edge of pavement is not sufficient to accommodate the larger XW2-6-A Worksite Added Penalty sign, 78 in. by 42 in.

Worksite Added Penalty, Speeding, Reckless Driving signs will be measured and paid for as Construction Sign, Type A in accordance with 801.17 and 801.18.

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801-T-150d

## 801-T-207 TEMPORARY TRAFFIC BARRIERS

*(Revised 09-15-22)*

The Standard Specifications are revised as follows:

SECTION 801, BEGIN LINE 418, DELETE AND INSERT AS FOLLOWS:

**(b) Connection**

Type 1 and type 3 barrier sections shall be connected as follows:

**1. Smooth Bar Hooks**

- 1a. The adjacent barrier sections shall be placed end to end, with sufficient overlapping of the smooth bar hooks to allow placement of the connecting bolt or threaded rod and the top spacer.
- 2b. The adjacent barrier sections shall then be moved in opposite directions for a sufficient distance to develop the maximum contact between the smooth bar hooks and the connecting bolt or threaded rod.
- 3c. The bottom spacer and nut shall then be placed as shown on the plans. The nut shall be sufficiently tightened to eliminate all gaps between the adjacent bolt heads, spacers, nuts, and washers which form the connection.

**2. J-J Hook**

- a. *The adjacent barrier sections shall be placed in accordance with the manufacturer's recommendations such that the J-J hooks are engaged.*
- b. *The adjacent barrier sections shall then be moved in opposite directions for a sufficient distance to develop the maximum separation between the barrier sections.*

SECTION 801, BEGIN LINE 436, DELETE AND INSERT AS FOLLOWS:

~~Type 1 and type 3 precast units which have previously been cast meeting earlier Department standards may be used. The Contractor will be allowed to mix type 1 and type 3 units in a run as long as the units are in good condition and the connecting devices are compatible. If units meeting earlier Department standards are used, a 1 in. bolt will be allowed to link the units together. The spacer detail shall, however, be in accordance with the current standard. Units cast after March 1, 2003 shall be linked with the 1 1/4 in. bolt.~~

Type 2 temporary traffic barriers shall be connected as recommended by the barrier manufacturer.

**(c) Anchorage**

~~Type 1 and type 3 temporary traffic barriers shall be anchored in accordance with the methods shown on the plans, at the locations described herein. Type 2 barriers shall be~~

~~anchored as recommended by the barrier manufacturer and at locations described herein.~~ Temporary concrete traffic barriers shall be anchored ~~when located on or within 60 ft of a bridge, and along tapered alignments~~ *at the locations shown on the plans*. Anchoring at locations in addition to those ~~described herein will~~ *shown shall* be required when directed. *Anchoring shall be in accordance with the NCHRP 350 or MASH crash test. The FHWA eligibility letter shall be provided to the Engineer prior to placing the barrier.*

Chemical anchor systems with removable bolts, or mechanical anchors may be used to anchor ~~type 1~~ barriers to bridge decks, concrete pavement, and concrete shoulders. Mechanical anchors may be ferrous or non-ferrous material. ~~All anchors shall have a shear strength of 10,000 lb and an ultimate pullout strength of 6,500 lb.~~

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## 801-T-232 TRAFFIC CONTROLS FOR CONSTRUCTION AND MAINTENANCE OPERATIONS

*(Revised 03-17-22)*

The Standard Specifications are revised as follows:

SECTION 107, BEGIN LINE 438, DELETE AND INSERT AS FOLLOWS:

Pavements and shoulders having an edge drop of more than 3 in. shall be delineated with drums in accordance with 801.09. Delineation shall be at a maximum spacing of 200 ft. The use of cones in accordance with 801.08 will be allowed as shown on the plans except cones shall not be used for ~~interstate lane restrictions~~ *shift or merge tapers on interstates and freeways and 42 in. cones may be used in tangent sections on interstates and freeways only when the use of drums would result in an effective lane width of less than 10 ft.*

SECTION 801, BEGIN LINE 294, DELETE AND INSERT AS FOLLOWS:

Cones shall be used only during temporary activities where portability is advantageous and they remain in place and do not create a hazard to traffic. The use of cones in lieu of drums will be allowed as shown on the plans except cones shall not be used for ~~interstate lane restrictions~~ *shift or merge tapers on freeways and 42 in. cones may be used in tangent sections on interstates and freeways only when the use of drums would result in an effective lane width of less than 10 ft.*

Tubular markers shall be used for separating two-lane two-way traffic *on non-freeways* as shown on the plans or as directed. *Tubular markers may be used to delineate a pavement drop-off on non-freeways when the use of drums would result in an effective lane width of less than 10 ft.*

SECTION 801, BEGIN LINE 932, DELETE AND INSERT AS FOLLOWS:

~~Temporary traffic barrier will be measured by the linear foot per the type specified. Anchored traffic barrier will be measured by the linear foot, separately from unanchored temporary concrete barrier per the type specified. End treatments, other than construction zone energy absorbing terminals, CZ, used on a type 1, type 2, or type 4 type 3 temporary traffic barrier will be measured by the linear foot as part of the barrier. All end treatments used on type 4 temporary traffic barrier will be measured by the linear foot as part of the barrier.~~

~~Construction zone energy absorbing terminals, CZ, used on type 1, or type 2, and or type 3 temporary traffic barriers will be measured by the number of terminals placed.~~

SECTION 801, BEGIN LINE 1000, DELETE AND INSERT AS FOLLOWS:

~~Temporary traffic barrier and anchored temporary traffic barrier will be paid for at the contract unit price per linear foot per the type specified. Payment will be made only once, regardless of the number of times the barrier is moved to accommodate different phases of traffic maintenance or construction operations as shown in the contract within each project. Payment will be made for Temporary Traffic Barrier placed in, or relocated to, a separate project.~~

~~End treatments, other than construction zone energy absorbing terminal, CZ, used on a type 1, type 2, type 4 temporary traffic barrier or type 3 will be paid for on a linear basis as part of the barrier. All end treatments used on type 4 temporary traffic barrier will be paid for on a linear basis as part of the barrier.~~

~~Construction zone energy absorbing terminal, CZ, when used with type 1, or type 2, or type 3 temporary traffic barriers will be paid for at the contract unit price per each for energy absorbing terminal, CZ, of the test level placed. Each unit will be paid for only once regardless of how many times it is moved within each project. Construction zone energy absorbing terminal, CZ, when used with type 2 or type 4 temporary traffic barriers will be paid for at the contract unit price per linear foot of type 2 or type 4 temporary traffic barrier. Payment will be made for construction zone energy absorbing terminal, CZ placed in, or relocated to, a separate project. Back up units will be paid for as energy absorbing terminal, CZ, of the test level placed, if they are placed in service due to non-repairable damage to the units already in service.~~

SECTION 801, BEGIN LINE 1039, DELETE AS FOLLOWS:

~~A temporary worksite speed limit sign assembly for continuous use includes two signs; each will be paid for at the contract unit price for construction sign.~~

SECTION 801, BEGIN LINE 1135, INSERT AS FOLLOWS:

- Temporary Worksite Speed Limit Sign Assembly \_\_\_\_\_ EACH  
- *type*

SECTION 801, BEGIN LINE 1138, DELETE AND INSERT AS FOLLOWS:

- ~~Each construction sign, barricade, temporary worksite speed limit sign assembly, road closure sign assembly, or flashing arrow sign will be paid for only once regardless of how many times each is moved, replaced, or how many times each is altered to change the sign message within each project. Payment will be made for signs placed in, or relocated to, a separate project. A Project Work Zone is defined as a segment of highway from the "Road Construction Ahead" sign to the "End Construction" sign. Payment will not be made for signs or barricades used for the convenience of the Contractor.~~

805-T-078 ELECTRICAL INSULATION SEALANT

*(Revised 05-18-17)*

The electrical insulation sealant for cable or wire splices as described in 805.05 shall be chosen from the following list:

- (a) Star brite liquid electrical tape, manufactured by Star brite, Inc.
  - (b) 3M Scotchkote Electrical Coating, manufactured by 3M Company
  - (c) 10 Plyseal Insulating Mastic, manufactured by Plymouth Rubber Europa S.A.
  - (d) or approved equal.
-

## 805-T-191 MAGNETOMETERS AND MICROLOOP DETECTORS

(Revised 04-25-21)

**Description**

This work shall consist of furnishing and installing magnetometer or microloop vehicle detection, as specified in the plans.

**Materials**

Materials for microloop detectors shall be selected from the QPL of Traffic Signal and ITS Devices. The microloop detectors selected shall be capable of counting vehicles in addition to detecting vehicle presence.

Each microloop detector location shall include the following items:

1. Non-invasive probe, lead-in cable and carriers for microloop detector as shown on the plans;
2. 3-in. diameter schedule 80 HDPE conduit containing the probes, lead-in cable and carriers;
3. Buried service wire encapsulation kit compatible with microloop detector for all splicing between the lead-in cable and the home run cable;
4. Installation kit, one for each conduit containing probes;
5. All mounting hardware, conduit bushings, wiring, connectors, grounding wires, ground rods, and grounding cables necessary to complete the microloop detector location installation.

**Testing**

Before installation of magnetometer or microloop probes the Contractor shall confirm the adequacy of the magnetic field intensity, to be sure that the range is suitable for their operation.

The Contractor shall demonstrate that the microloop count data recorded in the controller's detector log is within 5% of count data obtained visually over a 15-minute period for every detector installation. The test shall be performed by the Contractor in the presence of the Engineer. If detector sensitivity or calibration settings are adjusted in order to meet this test, the new settings shall be recorded on the wiring diagram in the cabinet.

**Installation**

Arrangement of probes shall be located at maximum distance from metal objects as per manufacturer's recommendation. Probes shall be installed with their long dimension vertical, and with the cable end at the top. Probes shall be firmly supported, so the lateral and vertical motion is restricted. Probes shall be connected in series. The splice shall be soldered by means of hot iron, or pouring or dripping without flames, with rosin core solder and shall be insulated and waterproofed in accordance with the manufacturer's specifications.

Conduit for the microloop detector probes shall be directionally pushed beneath the pavement at the depth and slope determined by the manufacturer to ensure proper carrier and probe installation. The Contractor shall repair any damage to the pavement that occurs during the

installation. The microloop detector probe location in each lane shall be per the manufacturer's recommendation.

**Method of Measurement**

- Magnetometer detector and microloop detector probe will be measured by the number of units installed.

- Conduit and signal cable will be measured in accordance with 805.15.

**Basis of Payment**

- If specified as pay items, magnetometer detector and microloop detector probe will be paid for at the contract unit price per each.

- Conduit and signal cable will be paid for in accordance with 805.16.

- Payment will be made under:

**Pay Item**

**Pay Unit Symbol**

- <u>Magnetometer Detector .....</u>	<u>EACH</u>
- <u>Microloop Detector Probe .....</u>	<u>EACH</u>

- The cost of coring the pavement, sealant, and all work necessary for proper installation and operation of the in-pavement sensors shall be included in the cost of magnetometer detector.

- The cost of the detector unit, lead-in cable, and all work necessary for proper installation shall be included in the cost of magnetometer detector or microloop detector probe.

- The cost of all hardware and work required to provide and install signal cable from microloop detector probe, including extra-low voltage (home-run), from the handhole adjacent to the detector probe to the controller cabinet shall be included in the cost of signal cable.

901-M-061 PCC MATERIALS

*(Adopted 07-15-21)*

The Standard Specifications are revised as follows:

SECTION 901, BEGIN LINE 179, DELETE AND INSERT AS FOLLOWS:

**1. Requirements**

The fly ash shall be in accordance with AASHTO M 295 for class C or class F, with the following exceptions:

Loss on Ignition, LOI, max. % .....	34
Autoclave Expansion or Contraction, max. % .....	0.5
Fineness: Amount retained when wet-sieved on No. 325 (45 µm) sieve, max. % .....	30

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901-M-064 PACKAGED PATCHING PRODUCTS

(Adopted 12-17-21)

The Standard Specifications are revised as follows:

SECTION 603, BEGIN LINE 12, DELETE AND INSERT AS FOLLOWS:

~~Concrete, Packaged Dry.....901.08~~  
 Farm Field/Woven Wire .....910.18(a)  
 Fence Posts.....910.13  
 Gates.....910.18(d)  
*Packaged Patching Products* .....901.08  
 Tension Wire.....910.18(b)1

SECTION 710, BEGIN LINE 36, DELETE AS FOLLOWS:

~~A type B certification in accordance with 916 shall be provided for the packaged patching products. The certification shall be submitted to the Department’s Concrete Engineer at least 14 calendar days prior to application of the materials.~~

SECTION 802, BEGIN LINE 22, DELETE AND INSERT AS FOLLOWS:

**802.02 Materials**

Materials shall be in accordance with the following:

Concrete .....702 ~~or 901.08~~  
 Fasteners.....919.01(d)  
 Overhead Sign Structure .....910.19  
*Packaged Patching Products* .....901.08  
 Reinforcing Bars .....910.01  
 Sign Posts.....910.14  
 Traffic Signs.....919.01

SECTION 901, BEGIN LINE 548, DELETE AND INSERT AS FOLLOWS:

**901.08 Packaged, Dry, Combined Materials for Mortar and Concrete Patching Products**

*Packaged patching products shall be selected from the Department’s QPL of Rapid Setting Patch Materials. A packaged patching product may be added to the QPL by completing the requirements in ITM 806, Procedure F.*

~~These materials~~ *Packaged patching products shall be in accordance with ASTM C387. All packages shall be identified as conforming to ASTM C387. The markings shall also show the kind and type of material, the net weight in each bag, the yield in cubic feet or yield in square feet per inch of thickness, and the amount of water recommended for mixing to produce a 2 in. to 3 in. slump.*

The following exceptions to ASTM C387 shall apply for packaged patching products used in accordance with 710. ~~The limits of the following shall be shown on the type B certification.~~

Physical Test	Specification	Requirements
---------------	---------------	--------------

Compressive Strength, min. 24 h 28 days	ASTM C109 on 2 in. cubes (neat)	2,000 psi 5,000 psi
Length Change, max. 28 days (air storage) 28 days (water storage)	ASTM C157, modified C928	-0.09% +0.03%
Slant/Shear Bond Strength, min. 28 days	ASTM C882 modified*	2,000 psi
Modulus of Elasticity Minimum @ 28 days Maximum @ 28 days	ASTM C469	3,000,000 psi 5,000,000 psi
* Product scrubbed into substrate or as recommended by the manufacturer.		

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904-M-059 AGGREGATES

(Revised 09-15-22)

The Standard Specifications are revised as follows:

SECTION 904, BEGIN LINE 152, DELETE AND INSERT AS FOLLOWS:

**(f) Mineral Filler for SMA**

Mineral filler shall consist of dust produced by crushing stone, portland cement, or other inert mineral matter having similar characteristics. Mineral filler shall be in accordance with the gradation requirements of 904.02(h) for size No. 16 or as approved by the Engineer. Mineral filler shall be in accordance with ITM 203 or from an ACBF slag source. The sieve analysis of mineral filler shall be conducted in accordance with AASHTO T 37 except as noted in 904.067. Mineral filler shall be non-plastic in accordance with AASHTO T 90.

SECTION 904, BEGIN LINE 280, DELETE AND INSERT AS FOLLOWS:

**(f) Sampling and Testing**

Sampling and testing will be in accordance with the following AASHTO, ASTM, and ITMs.

Amount of Material finer	
than No. 200 (75 µm) Sieve*.....	AASHTO T 11
Brine Freeze and Thaw Soundness .....	ITM 209
Clay Lumps and Friable Particles .....	AASHTO T 112
Control Procedures for Classification of Aggregates.....	ITM 203
Crushed Particles.....	ASTM D5821
Dolomite Aggregates.....	ITM 205
Flat and Elongated Particles .....	ASTM D4791
Freeze and Thaw Beam Expansion .....	ITM 210
Lightweight Pieces in Aggregates*.....	AASHTO T 113
Los Angeles Abrasion .....	AASHTO T 96
Micro-Deval Abrasion.....	AASHTO T 327
Polished Resistant Aggregates.....	ITM 214
Sampling Aggregates* .....	AASHTO T 2
Sampling Stockpiled Aggregates .....	ITM 207
Scratch Hardness.....	ITM 206
Sieve Analysis* .....	AASHTO T 27
Soundness* .....	AASHTO T 103, AASHTO T 104
Specific Gravity and Absorption*.....	AASHTO T 85
Unit Weight and Voids in Aggregates .....	AASHTO T 19

\*Except as noted in ~~904.06~~904.07

SECTION 904, BEGIN LINE 342, INSERT AS FOLLOWS:

**(f) Sizes of Riprap**

Gradation Requirements					
Percent Smaller					
Size, in.	Revetment	Class 1	Class 2	Uniform A	Uniform B

30			100		
24		100	85 - 100		
18	100	85 - 100	60 - 80		
12	90 - 100	35 - 50	20 - 40		
8				100	
6	20 - 40	10 - 30	0 - 20	35 - 80	95 - 100
3	0 - 10	0 - 10	0 - 10		35 - 80
1				0 - 20	0 - 20
Depth of Riprap, min.	18 in.	24 in.	30 in.		

The maximum dimension of individual pieces shall not be greater than three times the minimum dimension *and no dimension shall exceed the maximum size listed for the respective size of riprap*. The riprap will be visually inspected for size, shape, and consistency.

SECTION 904, AFTER LINE 358, DELETE AND INSERT AS FOLLOWS:

**904.06 B Borrow**

*The material used for special filling shall be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter and shall be known as B borrow. It shall consist of suitable sand, gravel, or crushed stone ACBF, GBF, or other approved material. The material shall contain no more than 10% passing the No. 200 (75  $\mu$ m) sieve and shall be otherwise suitably graded. The ratio of the fraction passing the No. 200 (75  $\mu$ m) sieve to the fraction retained on the No. 30 (600  $\mu$ m) sieve shall not exceed one-fifth. The use of an essentially one-size material will not be allowed unless approved. B borrow containing greater than 3% by dry weight organic material will not allowed.*

*Sieve analysis and organic material will be performed in accordance with AASHTO T 11 and AASHTO T 267.*

**904.067 Exceptions to AASHTO Standard Methods**

**(a) Exceptions to AASHTO T 2**

Stockpile sampling shall be in accordance with ITM 207, unless otherwise approved.

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## 918-M-060 GEOSYNTHETIC MATERIALS

(Adopted 05-20-21)

The Standard Specifications are revised as follows:

SECTION 918, BEGIN LINE 35, DELETE AND INSERT AS FOLLOWS:

**(b) Geotextile Properties for Underdrains, *Subsurface Drains*, and *Drainage Filtration Applications***

Test	Method, ASTM	Requirements <sup>(1) (2)</sup>				
		Type 1A	Type 1B	Type 2A	Type 2B	Type 3
Grab Tensile Strength, min.	D4632	80 lb	200 lb	160 lb	200 lb	200 lb
Grab Elongation	D4632	> 50%	< 50%	> 50%	< 50%	< 50%
CBR Puncture Strength, min.	D6241	175 lb	600 lb	410 lb	750 lb	1,100 lb
Deterioration in Tensile Strength due to UV Degradation 500 hrs, min.	D4355 D6637	70% strength retained	70% strength retained	70% strength retained	70% strength retained	90% strength retained
Apparent Opening Size, AOS	D4751	≤ No. 50 sieve, for soils ≥ 40% passing the No. 200 sieve	≤ No. 40 sieve, for soils < 40% passing the No. 200 sieve	≤ No. 70 sieve, for soils ≥ 40% passing the No. 200 sieve	≤ No. 30 sieve, for soils < 40% passing the No. 200 sieve	≤ No. 40 sieve
Permittivity	D4491	≥ 1.2 sec <sup>-1</sup>	≥ 2.1 sec <sup>-1</sup>	≥ 0.8 sec <sup>-1</sup>	≥ 0.9 sec <sup>-1</sup>	0.90 sec <sup>-1</sup>
Notes:						
(1) All values are minimum average roll values (MARV) as determined in accordance with ASTM D4354 in the weaker principal direction, except AOS size is based on maximum average roll value.						
(2) Type 3 value is a maximum average roll value (Max ARV) as determined in accordance with ASTM D4354.						

**(c) Geotextile Properties for Pavement or Subgrade Stabilizations**

Test	Method, ASTM	Requirements <sup>(1)</sup>			
		Type 1A	Type 1B	Type 2A	Type 2B
Grab Tensile Strength, min.	D4632	200 lb	300 lb	290 lb	400 lb
Wide Width Tensile, @ 5% Strain, min.	D4595	n/a	n/a	1,200 lb/ft	2,400 lb/ft
Grab Elongation	D4632	≤ 50%	< 50%	≤ 50%	< 50%
CBR Puncture Strength, min.	D6241	175 lb	600 lb	410 lb	750 lb
Trapezoid Tearing Strength, min.	D4533	75 lb	110 lb	n/a	n/a
Deterioration in Tensile Strength due to UV Degradation 500 hrs, min.	D4355 D6637	70% strength retained	70% strength retained	70% strength retained	70% strength retained
Apparent Opening Size, AOS, min.	D4751	No. 50 sieve	No. 40 sieve	No. 30 sieve	No. 30 sieve
Soil Retention, Pore Size, O <sub>50</sub> /O <sub>95</sub> , min.	D6767	n/a	n/a	290/380	100/350
Permittivity, min.	D4491	0.05 sec <sup>-1</sup>	0.050 sec <sup>-1</sup>	0.50 sec <sup>-1</sup>	0.40 sec <sup>-1</sup>
Note:					

<sup>(1)</sup> All values are minimum average roll values (MARV) as determined in accordance with ASTM D4354 in the weaker principal direction, except AOS size is based on maximum average roll value.

**(d) Geotextile Properties for Moisture Management**

Type, IMA geotextile shall consist of woven polypropylene filaments, wicking filaments and shall be in accordance with the following:

Test	Method, ASTM	Requirements
		Type IMA
Wide Width Tensile Strength, min. Machine direction Cross machine direction	D4595 <sup>3</sup>	5,280 lbs/ft 5,280 lbs/ft
Wide Width Tensile Strength, @ 2% Strain, min. Machine direction Cross machine direction	D4595 <sup>3</sup>	480 lbs/ft 1,080 lbs/ft
Apparent Opening Size, AOS, min.	D4751	No. 40 sieve
Flow Rate	D4491 <sup>3</sup>	30 gal./min/ft <sup>2</sup>
Wicking Requirement Wet Front Movement <sup>1</sup> 24 minutes, min.	C1559 <sup>2</sup>	6 in. Vertical Direction
Wicking Requirement Wet Front Movement <sup>1</sup> 983 minutes. Zero Gradient, min.	C1559 <sup>2</sup>	73 in. Horizontal Direction
Permittivity, min.	D4491 <sup>3</sup>	0.4 sec <sup>-1</sup>
Notes: 1. 'STP': Standard Temperature and Pressure 2. Modified, time 3. Minimum average roll values shall be in accordance with ASTM D4759		

**(e) Geotextile Properties for Silt Fence**

Test	Method, ASTM	Requirements <sup>(1)</sup>	
		Wire Fence Supported	Self Supported
Grab Strength	D4632	90 lb	90 lb
Elongation @ 45 lb	D4632		50% max.
Apparent Opening Size <sup>(2)</sup>	D4751	No. 20 sieve	No. 20 sieve
Permittivity <sup>(2)</sup>	D4491	0.01 sec <sup>-1</sup>	0.01 sec <sup>-1</sup>
Ultraviolet Degradation at 500 hrs	D4355	70% strength retained	70% strength retained
<sup>(1)</sup> The value in the weaker principal direction shall be used. All numerical values will represent the minimum average roll value. Test results from a sampled roll in a lot shall be in accordance with or shall exceed the minimum values shown in the above table. The stated values are for non-critical, non-severe conditions. Lots shall be sampled in accordance with ASTM D4354. <sup>(2)</sup> The values reflect the minimum criteria currently used. Performance tests may be used to evaluate silt fence performance if deemed necessary by the Engineer. Note: All values are minimum average roll values (MARV) as determined in accordance with ASTM D4354.			

**918.03 Geomembrane**

This material shall consist of a geomembrane fabricated from high density polyethylene, HDPE, consisting of strong, rot resistant, chemically stable long-chain synthetic polymer materials, dimensionally stable with distinct and measurable openings. The manufacturer shall submit the tests for the intended use to the Department.

SECTION 918, BEGIN LINE 72, INSERT AS FOLLOWS:

**918.05 Geogrid**

Geogrid shall be a biaxial or multi axial of a regular network of connected polymer tensile elements with aperture geometry sufficient to enable significant mechanical interlock with the surrounding material. The material shall be polypropylene, ASTM D 4101 (97% minimum) and Carbon Black, ASTM D 1603 (0.5% minimum). The geogrid structure shall be dimensionally stable and shall be able to retain its geometry under construction stresses. The geogrid structure shall have a resistance to damage during construction, ultraviolet degradation, and all forms of chemical and biological degradation encountered in the soil being placed.

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## 922-T-196 CONTROLLER CELLULAR MODEM

(Revised 04-25-21)

The Standard Specifications are revised as follows:

SECTION 922, AFTER LINE 519, INSERT AS FOLLOWS:

**8. Cellular Modems**

**a. Service Provider**

*All data, power and antenna cables, and all supplemental hardware shall be provided. The modem shall be compatible with the Department's current cellular carriers/providers, the traffic control device communications software, and the closed loop communications software that it is supplied for.*

**b. Modem Hardware**

*Cell modems shall be selected from the QPL of Traffic Signal and ITS Devices.*

**c. Modem Antenna**

*The modem antenna shall be selected from the QPL of Traffic Signal and ITS Devices. The antenna connectors for cellular service, GPS, and WiFi shall be configured to connect to the cellular modem.*

**d. Modem Software**

*The modem configuration shall be editable and viewable with MS-Windows provided software or with proprietary software that is included and designed to run on a MS-Windows operating system. The software shall auto-detect connection parameters and display settings when connected.*

**e. Installation and Support**

~~*The Department will supply the SIM card for the cellular modem.*~~

*The serial number shall be clearly labeled on the exterior of the modem. The cellular modem shall be installed, configured, and tested to allow data communication directly to a secondary controller. All data, power and antenna cables, and all supplemental mounting hardware shall be installed. The modem shall be powered by the cabinet power supply from a terminal location on the cabinet back panel or the power distribution panel. The antenna shall be mounted externally and the mounting location shall include a watertight seal.*

*The cellular modem shall include three years of product and licensing support, from the date of installation, to ensure all features are enabled. The cellular modem shall be preloaded onto the Department's Traffic Management Enterprise Cloud Manager, ECM, account.*