



MARYLAND TRANSIT ADMINISTRATION

MARYLAND DEPARTMENT OF TRANSPORTATION

Martin O'Malley, Governor • Anthony G. Brown, Lt. Governor
Darrell B. Mobley, Acting Secretary • Ralign T. Wells, Administrator

TO: All Planholders
FROM: Maryland Transit Administration
SUBJECT: **ADDENDUM NO. 2**
Contract No.: T-1164-0140
Langley Park Transit Center
DATE: January 4, 2013

Enclosed and effective this date is Addendum No. 2 to the subject Contract. This change (does not) delay the Bid Opening Date of January 23, 2013. It makes revisions to the bid form and answers questions submitted by vendors.

The Bidder shall acknowledge receipt of this Addendum by completing and returning this form with the bid package.

All other terms and conditions remain unchanged.

Sincerely,


Joseph B. Johnson, Procurement Officer
Construction/Installation Section &
Professional Services Section
Procurement Division

Acknowledgement of receipt of ADDENDUM # 2 to Solicitation #T-1164-0140

Vendor Name: _____

Authorized Representative's Signature

Date

ADDENDUM NO.: 2
DATE: 1/4/13
CONTRACT NO.: T-1164-0140

The following additions, deletions, and modifications are hereby made a part of the Contract Documents of Langley Park Transit Center, Contract No.: T-1164-0140.

Item No.	Page	Modification
I. QUESTIONS & ANSWERS		
1		See Attachment
II. BID FORM		
1	Bid Form	Revised Bid Form See Attachment

Langley Park Transit Center Addendum 2

Specifications:

Bid Form - revised Bid Form as follows:

- Actual Estimated Prices are included in bid items 001- Mobilization, 002-Misc. Work Allowance, and 003-Quality Assurance & Quality Control
- A new bid item 009 was inserted for Motor Vehicle in accordance with Section 01523 Engineer's Field Office Type 3 Measurement and Payment Clause. The Bid Form Description of bid item 008 was revised to be "Engineer's Field Office", in accordance with Section 01523 Engineer's Field Office Type 3 Measurement and Payment Clause.

Plans:

- No changes to plans

Questions raised by bidders:

- 01) In respects to the Notice to Contractors, Item 18 - Use of Bidder's Own Forces, we are requesting that the self-perform requirement be reduced from 50% to 15-25%. There are many different large trade packages on this job including construction management, earthwork, utilities, concrete, curtain wall, canopies, mechanical and electrical making it difficult for any contractor to perform more than 15-25% of the work with its own forces.

We ask for you to respond to this question prior to others as it will affect whether or not our firm and many others will be able to bid on this project.

MTA cannot reduce this to 25%

- 02) Keller Brothers, Inc. attended the pre bid meeting today for Langley Park Transit Center and is very interested in bidding the project, however the bidder's own forces requirement (Item 18 of the Notice to Contractors) states that at least 50% of the work on site must be performed by our own forces. Is this a requirement that the state would consider waiving or is this something you take a hard line on? As a general contractor we typically perform about 10 to 15% of the work on our projects with our own forces and are unable to devise a scenario where 50% of the work is done by Keller Brothers, which I'm sure is the story with many other GC's as well. Please let me know if this is a request you would consider. If 50% in-house forces is a requirement you will not waiver on, we will likely have to pass on this project. Please let me know as soon as possible so we can determine if we should proceed in bidding the project.

MTA cannot reduce this to 15%

- 03) Request to include Larson PE by Alucoil North America, Manning, SC metal composite wall panels as an approved equal in section 07421, paragraph 2.

MTA will review any product submitted by the awarded contractor for its compliance with our design requirements given in the specifications and design documents. Paragraph 2 refers to the "basis of design" product, but contractors may select other products that meet or exceed the basis of design.

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
001	01130	Mobilization		LS		352,000.00
002	01210	Miscellaneous Work Allowance		ALL		625,400.00
003	01450	Quality Assurance and Quality Control		ALL		83,000.00
004	01500	Maintenance and Control of Traffic		LS		
005	01500	Temporary Orange Safety Fence	1,400	LF		
006	01500	Remove and Reset Temporary Orange Safety Fence	125	LF		
007	01500	Temporary Construction Fence Including Gates	1,500	LF		
008	01523	Engineer's Field Office		LS		
009	01523	Motor Vehicle		LS		
010	01550	Temporary Traffic Signs	700	SF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
011	01550	Temporary Precast Traffic Barrier	300	LF		
012	01550	Traffic Drums	150	EA		
013	01550	Arrow Panel	200	UD		
014	01550	Contingent Portable Variable Message Sign	50	UD		
015	01550	12 Inch White Removable Preformed Pavement Line Marking For Site Work	400	LF		
016	01550	Removal of Removable Preformed Markings-Any Width	400	LF		
017	01550	Removal of Existing Pavement Marking Lines, Any Width For Site Work	100	LF		
018	01550	Protection Vehicle (PV)	175	UD		
019	01550	Type III Barricade for Maintenance of Traffic	10	EA		
020	01730	Saw Cutting	3,000	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
021	01790	Demonstration and Training	-	LS		
022	01810	Commissioning	-	LS		
023	02080	Flowable Fill	10	CY		
024	02210	Test Pit Excavation For Site Work	20	CY		
025	02220	Site Demolition		LS		
026	02220	Remove, Salvage, Storage and Reinstall Existing Parking Light	2	EA		
027	02220	Remove, Salvage and Store 2 Shopping Center Advertisement Signs		LS		
028	02230	Site Clearing		LS		
029	02315	Class 1 Excavation	8,000	CY		
030	02315	Class 1A Excavation	500	CY		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
031	02315	Class 3 Excavation	200	CY		
032	02315	Select Borrow Excavation	500	CY		
033	02315	Common Borrow Excavation	200	CY		
034	02320	Furnished Subsoil	500	CY		
035	02370	Stabilized Construction Entrance	60	TON		
036	02370	Recondition Stabilized Construction Entrance	10	TON		
037	02370	Silt Fence	780	LF		
038	02370	Inlet Protection	8	EA		
039	02370	Temporary Asphalt Berm	40	TON		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
040	02370	Portable Sediment Tank	3	EA		
041	02370	Temporary Seeding	50	LBS		
042	02370	Silt Fence on Pavement	85	LF		
043	02372	Soil Stabilization Matting	100	SY		
044	02510	2 Inch Water Service Pipe & Fittings	210	LF		
045	02510	3 Inch DIP Water Service Pipe & Fittings	10	LF		
046	02510	2 Inch Curb Stop and Box	1	EA		
047	02510	Connect to Existing 3 Inch Water Service	1	EA		
048	02511	Rainwater Harvesting System		LS		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
049	02530	4 Inch Gravity Sewer Pipe & Fittings	175	LF		
050	02530	4 Inch Sanitary Cleanout	4	EA		
051	02530	Connect to Existing 4 Inch Sanitary Sewer Hose Connection	1	EA		
052	02620	3 Inch PVC Pipe Schedule 80	30	LF		
053	02620	4 Inch PVC Pipe Schedule 80	125	LF		
054	02620	6 Inch PVC Pipe Schedule 80	285	LF		
055	02620	8 Inch PVC Pipe Schedule 80	190	LF		
056	02630	12 Inch Reinforced Concrete Pipe Class IV	4	LF		
057	02630	15 Inch Reinforced Concrete Pipe, Class IV	359	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
058	02630	27 Inch Reinforced Concrete Pipe, Class IV	52	LF		
059	02630	SHA STD 5 Foot COG Inlet	2	EA		
060	02630	SHA STD 5 Foot COS Inlet	1	EA		
061	02630	SHA STD 10 Foot COG Inlet	1	EA		
062	02630	P.G. Co. STD Type A 10 Inlet	1	EA		
063	02630	Special Inlet I-5		LS		
064	02630	Special Inlet I-3		LS		
065	02630	Special Curb Opening Structure	10	EA		
066	02630	Modified SHA STD Type K Inlet	3	EA		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
067	02630	SHA STD Shallow Manhole	5	EA		
068	02630	Water Quality Manhole	-	LS		
069	02640	Micro-Bioretention Facility MB-1		LS		
070	02640	Micro-Bioretention Facility MB-2		LS		
071	02640	Micro-Bioretention Facility MB-3		LS		
072	02640	Micro-Bioretention Facility MB-4		LS		
073	02640	Bio-Swale Facility BS-1		LS		
074	02720	4 Inch Graded Aggregate Base Course	10,555	SY		
075	02720	6 Inch Graded Aggregate Base Course	2,058	SY		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
076	02745	Hot Mix Asphalt Superpave 9.5 mm for Surface, PG 76-22, HDFV, Level 2	337	TON		
077	02745	Hot Mix Asphalt Superpave 19.0 mm for Base, PG 64-22, Level 2	107	TON		
078	02745	Hot Mix Asphalt Superpave 9.5 mm for Wedge and Leveling PG 64-22, Level 2	5	TON		
079	02745	Price Adjustment for Asphalt Binder	20,000	EA		
080	02747	HMA Pavement Milling Variable Depth (0" to 3" Depth)	1,368	SY		
081	02750	9 Inch Plain Portland Cement Concrete Pavement Apron, Mix No. 7	193	SY		
082	02750	9 Inch Plain Portland Cement Concrete Pavement (MD 193), Mix No. 7	558	SY		
083	02750	12 Inch Portland Cement Reinforced Concrete Pavement, Mix No.7	3,815	SY		
084	02750	Special 12 Inch Portland Cement Reinforced Concrete Pavement Mix, No. 7	61	SY		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
085	02751	Special Portland Cement Concrete Traffic Barrier for Platform B		LS		
086	02765	5 Inch White Lead Free Reflective Thermoplastic Pavement Markings	900	LF		
087	02765	5 Inch Yellow Lead Free Reflective Thermoplastic Pavement Markings	2,500	LF		
088	02765	10 Inch White Lead Free Reflective Thermoplastic Pavement Markings	490	LF		
089	02765	12 Inch White Preformed Thermoplastic Pavement Markings	110	LF		
090	02765	24 Inch White Preformed Thermoplastic Pavement Markings	40	LF		
091	02765	White Preformed Thermoplastic Pavement Markings, Legends and Symbols	170	SF		
092	02765	Removal of Existing Pavement Letters Symbols, Arrows and Numbers	66	SF		
093	02765	5 Inch White Nontoxic Waterborne Pavement Markings	800	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
094	02765	5 Inch Yellow Nontoxic Waterborne Pavement Markings	1000	LF		
095	02765	12 Inch White Nontoxic Waterborne Pavement Markings	300	LF		
096	02766	Snowplowable Raised Pavement Markers	6	EA		
097	02768	5 Inch Decorative Portland Cement Concrete Sidewalk	2,274	SF		
098	02768	6 Inch Decorative Portland Cement Reinforced Concrete Bus Platforms with Scored Surface	7,136	SF		
099	02768	12 Inch Decorative Portland Cement Reinforced Concrete Pavement	160	SY		
100	02769	Detectable Warning Surface	240	SF		
101	02770	Type A Combination Concrete Curb and Gutter	632	LF		
102	02770	Modified Type A Combination Concrete Curb and Gutter	2,604	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
103	02770	Type Z Combination Concrete Curb and Gutter	740	LF		
104	02770	Type A Concrete Curb	400	LF		
105	02770	4 Foot Modified Monolithic Concrete Median	260	LF		
106	02770	4 Foot Concrete Median End Treatment	45	LF		
107	02770	Monolithic P.C. Concrete Traffic Island – Curblines 7		LS		
108	02775	5 Inch Concrete Sidewalk	7,448	SF		
109	02810	Irrigation System		LS		
110	02826	Ornamental Metal Fence Variable Height (2 to 4 feet)	112	LF		
111	02826	Ornamental Metal Fence-5 feet	200	LF		
112	02826	Ornamental Fence 42 Inch Height	80	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
113	02826	Salvage and Reinstallation of Existing Ornamental Metal Fence, Variable Height (2' to 4')	64	LF		
114	02826	Salvage and Reinstallation of Existing Ornamental Metal Fence 5' Height	248	LF		
115	02890	Sheet Aluminum Signs For Transit Center	200	SF		
116	02890	Square Tubular Steel Posts and Square Tubular Perforated Steel Posts for Transit Center Signs	250	LF		
117	02890	Square Tubular Steel Anchor Base for Transit Center	1	EA		
118	02891	Sheet Aluminum Sign for Public Roads	100	SF		
119	02891	Wood Sign Supports 4 Inch x 4 Inch on Public Roads	190	LF		
120	02891	Wood Sign Supports 4 Inch x 6 Inch on Public Roads	100	LF		
121	02892	Freestanding Map/Information Display Unit	2	EA		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
122	02892	Passenger Information Display Sign	7	EA		
123	02892	Column-Mounted Map/Information Display	11	EA		
124	02893	Cast-Bronze Pin-Mounted Sign	2	EA		
125	02894	Bike Racks	20	EA		
126	02895	Remove Existing Ground Mounted Sign and Supports	110	SF		
127	02920	Furnishing and Placing Topsoil (4 Inch Depth)	600	SY		
128	02920	Seeding and Mulching	100	SY		
129	02920	Sodding	600	SY		
130	02920	Overseeding	50	LBS		
131	02920	Refertilizing	100	LBS		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
132	02920	Additional Watering of Seeded and Mulched and Sodded Areas	20	M GAL		
133	02930	Syringa Reticulata 'Ivory Silk' – Ivory Silk Japanese Tree Lilac	8	EA		
134	02930	Acer Rubrum 'Armstrong' – Armstrong Red Maple (3.5" cal)	7	EA		
135	02930	Acer Rubrum 'Armstrong' – Armstrong Red Maple (5" cal)	5	EA		
136	02930	Rhus Aromatica 'Gro-Low' – "Gro-Low" Fragrant Sumac	311	EA		
137	02930	Myrica Pensylvannica-Northern Bayberry	27	EA		
138	02930	Hypericum calycinum-Aaronsbeard	865	EA		
139	02930	Panicum Virgatum-Switchgrass	190	EA		
140	02930	Schizachyrium Scoparium-Little Blustem	142	EA		
141	02930	Mulching 3 Inch Depth	1000	SY		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
142	02930	Watering Trees and Shrubs	20	M GAL		
143	03300	Cast -IN-Place Concrete	10	CY		
144	10430	Bus Platform Canopy Shelter Structures for Platform A		LS		
145	10430	Bus Platform Canopy Shelter Structures for Platform B		LS		
146	10430	Bus Platform Canopy Shelter Structures for Platform C		LS		
147	10430	Bus Platform Canopy Shelter Structures for Platform D		LS		
148	13000	Facility Building		LS		
149	13001	Transit Center Canopy Roof Structure		LS		
150	16120	#10 THWN	6,500	LF		
151	16120	#8 THWN	2,640	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
152	16130	1 Inch Galvanized Rigid Steel Conduit	300	LF		
153	16130	1 ½ Inch Galvanized Rigid Steel Conduit	300	LF		
154	16135	1 Inch PVC Conduit SCH 80 Direct Buried	1,500	LF		
155	16135	1 ½ Inch PVC Conduit SCH 80 Direct Buried	320	LF		
156	16135	2-Way, 1 ½ Inch PVC Conduit SCH 80 Concrete Encased	130	LF		
157	16135	2-Way, 4 Inch PVC Conduit SCH 80 Concrete Encased	80	LF		
158	16135	4-Way, 1 ½ Inch PVC Conduit SCH 80 Concrete Encased	40	LF		
159	16135	3-Way, 1 Inch PVC Conduit SCH 80 Concrete Encased	80	LF		
160	16135	4-Way, 1 Inch PVC Conduit SCH 80 Concrete Encased	10	LF		
161	16135	5-Way, 1 Inch PVC Conduit SCH 80 Concrete Encased	100	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
162	16135	6-Way, 1 ½ Inch PVC Conduit SCH 80 Concrete Encased	25	LF		
163	16135	7-Way, 1 Inch PVC Conduit SCH 80 Concrete Encased	40	LF		
164	16135	12-Way, 1 Inch PVC Conduit SCH 80 Concrete Encased	40	LF		
165	16135	16 Way 1 Inch PVC Conduit SCH 80 Concrete Encased	25	LF		
166	16145	Lighting Control Devices		LS		
167	16520	FIXTURE A	27	EA		
168	16520	FIXTURE B	39	EA		
169	16520	FIXTURE P	3	EA		
170	16520	FIXTURE P1	3	EA		
171	16520	Concrete Foundations for Poles-Fixture	6	EA		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
172	16786	Photovoltaic Electric Generating System		LS		
173	17410	Test Pit Excavation	21	CY		
174	17420	12" White Preformed Thermoplastic Pavement Markings	2,000	LF		
175	17422	Removal of Existing Pavement Marking Lines Any Width	1,380	LF		
176	17450	Concrete for Traffic Signal Foundation	22	CY		
177	17451	Ground Rod – 3/4 Inch Dia. X 10 Foot Length	18	EA		
178	17452	2 Inch SCH 80 Rigid PVC Conduit – Trenched	205	LF		
179	17452	3 Inch SCH 80 Rigid PVC Conduit – Trenched	480	LF		
180	17452	4 Inch SCH 80 Rigid PVC Conduit – Trenched	385	LF		
181	17452	2 Inch SCH 80 Rigid PVC Conduit – Slotted	128	LF		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
182	17452	4 Inch SCH 80 Rigid PVC Conduit - Slotted	775	LF		
183	17453	Electrical Utility Service Equipment	2	EA		
184	17455	Cable – 1 Conductor No. 2 AWG, 3 Wire	1,540	LF		
185	17455	Cable – 1 Conductor No. 8 AWG, 3 Wire	60	LF		
186	17455	No. 6 AWG Stranded Bare Copper Ground Wire	1,098	LF		
187	17455	12-Pair Communication Cable, Jellyfilled (Underground)	1,620	LF		
188	17455	Electrical Cable – 2 Conductor (No.14 AWG)	4,265	LF		
189	17455	Electrical Cable – 5 Conductor (No.14 AWG)	4,110	LF		
190	17455	Electrical Cable – 7 Conductor (No.14 AWG)	4,414	LF		
191	17456	Furnish and Install Electrical Handhole	13	EA		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
192	17457	Wood Sign Support 4 Inch x 6 Inch	108	LF		
193	17458	Sheet Aluminum Signs	459	SF		
194	17459	12 Inch LED Vehicular Traffic Signal Head Section	108	EA		
195	17460	LED 16 Inch Countdown Pedestrian Signal Head	15	EA		
196	17461	Video Interface Equipment	3	EA		
197	17461	Eight Phase (Fully Actuated) Controller and Cabinet – Base Mount	2	EA		
198	17462	Steel Pole with Twin 50 Foot Mast Arms	2	EA		
199	17462	Steel Pole with a Single 38 Foot Mast Arm	1	EA		
200	17462	Steel Pole with a Single 50 Foot Mast Arm	1	EA		
201	17462	Steel Pole with Twin 50 Foot and 70 Foot Mast Arms	1	EA		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
202	17462	10 Foot Breakaway Pedestal Pole	12	EA		
203	17465	Relocate Existing Signs on Structures	11	SF		
204	17466	Cut, Clean, Galvanized Cap Traffic Signal Structure	2	EA		
205	17467	2-Wire Central Control Unit	4	EA		
206	17467	Audible/Tactile Pedestrian Pushbutton	24	EA		
207	17470	Relocate Existing Camera	1	EA		
208	17472	Remove and Dispose of Material and Equipment		LS		
209	17473	Video Detection Camera and Cable (Any Length)	18	EA		
210	17475	250 WATT H.P.S. Lamp & Luminaire	3	EA		
211	17476	15 Foot Lighting Arm on Signal Structure	2	EA		

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
212	17476	20 Foot Lighting Arm On Signal Structures	1	EA		
213	17480	Adjust Handhole to Grade	3	EA		

Total Price: \$

Basis of Award: Total amount of items 001 thru 214 (figures)

(words)

214		Insurance Premium (Contingency)	LS	LS	LS	
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This amount will only be added to the base bid in the event that the bidder is excluded from the wrap-up insurance program or the program is terminated mid-term. The Insurance Premium Worksheet must be attached to the bid.



MARYLAND TRANSIT ADMINISTRATION

MARYLAND DEPARTMENT OF TRANSPORTATION

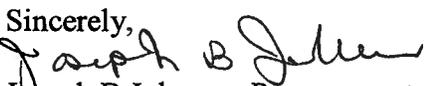
Martin O'Malley, Governor • Anthony G. Brown, Lt. Governor
Darrell B. Mobley, Acting Secretary • Ralign T. Wells, Administrator

TO: All Planholders
FROM: Maryland Transit Administration
SUBJECT: **ADDENDUM NO. 1**
Contract No.: T-1164-0140
Langley Park Transit Center
DATE: November 30, 2012

Enclosed and effective this date is Addendum No. 1 to the subject Contract. This change (does not) delay the Bid Opening Date of January 23, 2013. This addendum revises (Appendix I) in response associated to vendor's request for authenticity. Pages missing from (Appendix I) have now been added.

The Bidder shall acknowledge receipt of this Addendum by completing and returning this form with the bid package.

All other terms and conditions remain unchanged.

Sincerely,

Joseph B Johnson, Procurement Officer
Construction/Installation Section &
Professional Services Section
Procurement Division

Acknowledgement of receipt of ADDENDUM # 1 to Solicitation #T-1164-0140

Vendor Name: _____

Authorized Representative's Signature

Date

ADDENDUM NO.: 1
DATE: 11/30/12
CONTRACT NO.: T-1164-0140

The following additions, deletions, and modifications are hereby made a part of the Contract Documents of Langley Park Transit Center, Contract No.: T-1164-0140.

Item No.	Page	Modification
I. APPENDICES		
1	APPENDIX I	Appendix I – Revisions made to include missing pages from this section.

APPENDIX I

CONTRACT NO. T-1164-0140

**MARYLAND STATE HIGHWAY ADMINISTRATION
SPECIAL PROVISIONS**

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Lane Closure Schedule & MOT Specifications
Maintenance of Traffic Specifications (Supplement/Modifications to Standard 104)
CATEGORY 100
PRELIMINARY

1 of 3

SECTION 104 — MAINTENANCE OF TRAFFIC

104.01 TRAFFIC CONTROL PLAN (TCP)

104.01.01 DESCRIPTION.

149 **DELETE:** The fourth paragraph sentence "Refer to contract Documents for Work Restrictions." in its entirety.

INSERT: The following.

Work Restrictions. The Engineer reserves the right to modify or expand the methods of traffic control or working hours as specified in the Contract Documents. Any request from the Contractor to modify the work restrictions shall require written approval from the Engineer at least 72 hours prior to implementing the change. The Contractor shall submit a copy of the original work restrictions with the written request.

Work is not permitted on the holidays, or work day preceding and following holidays indicated below with an "X":

- New Year's Day, January 1
- Martin Luther King's Birthday, the third Monday in January
- President's Day, the third Monday in February
- Good Friday
- Easter Weekend
- Memorial Day, the last Monday in May
- Independence Day, July 4
- Labor Day, the first Monday in September
- Columbus Day, the second Monday in October
- Veteran's Day, November 11
- Thanksgiving Day, the fourth Thursday in November
- Christmas Day, December 25

TEMPORARY LANE OR SHOULDER CLOSURE SCHEDULE			
ROADWAY	# LANE(S) / SHOULDER CAN BE CLOSED	DAY OF THE WEEK	CLOSURE PERIOD (TIME OF DAY)
Eastbound MD 193	1/1	Monday-Friday	9:00 AM – 3:00 PM
	2/1	Sunday-Thursday	10:00 PM – 5:00 AM (Next Day)
Westbound MD 193	1/1	Monday-Friday	9:00 AM – 3:00 PM
	2/1	Sunday-Thursday	10:00 PM – 5:00 AM (Next Day)
Northbound MD 650	1/1	Monday-Friday	9:00 AM – 3:00 PM
	2/1	Sunday-Thursday	10:00 PM – 5:00 AM (Next Day)
Southbound MD 650	1/1	Monday-Friday	9:00 AM – 3:00 PM
	2/1	Sunday-Thursday	10:00 PM – 5:00 AM (Next Day)

149 **ADD:** The following after the last paragraph, "Any monetary savings...and the Administration."

When closing or opening a lane on freeways, expressways, and roadways with posted speed ≥ 55 mph, a work vehicle shall be closely followed by a protection vehicle (PV) during installation and removal of temporary traffic control devices. The PV shall consist of a work vehicle with approved flashing lights, either a truck-mounted attenuator (TMA) with support structure designed for attaching the system to the work vehicle or a trailer truck-mounted attenuator (TTMA) designed for attaching the system to the work vehicle by a pintle hook and an arrow panel (arrow mode for multilane roadways and caution mode on two-lane, two-way roadways).

The work vehicle size and method of attachment shall be as specified in the TMA/TTMA manufacturer's specification as tested under NCHRP and/or MASH Test Level 3.

When a temporary lane or shoulder closure is in effect, work shall begin within one hour after the lane is closed. Any delay greater than one hour with no work in progress shall require the Contractor to remove the lane/shoulder closure at no additional cost to the Administration. The Contractor's Traffic Manager shall attend Pre-Construction and Pre-Paving Meetings and shall discuss traffic control and the Traffic Control Plan including procedures to be implemented for lane closures.

All closures shall be in conformance with the approved TCP and under the direction of the Contractor's Traffic Manager and the Engineer.

Lane Closure Schedule & MOT Specifications

Maintenance of Traffic Specifications (Supplement/Modifications to Standard 104)

Workers and equipment, including temporary traffic control devices needed for setting up a lane closure or restriction, are prohibited in the lane/shoulder to be closed or restricted before the time permitted in the Contract work restrictions, unless otherwise noted below or as approved by the Engineer.

Temporary traffic control devices to be used for lane/shoulder closure may be placed on the shoulder of the roadway by workers no earlier than 30 minutes prior to actual time lane/shoulder closure or restriction is permitted. When temporary traffic control devices are being installed, all work vehicles involved in the installation shall display flashing lights that provide a 360-degree visibility of the vehicles. These lights shall remain on until the full installation of TTC devices is complete. Temporary traffic signs may be displayed to traffic at this time.

Workers shall not enter a lane open to traffic. Workers may be present on shoulders to prepare for lane closure setup no earlier than 30 minutes prior to actual time lane/shoulder closure or restriction is permitted. During preparation for the lane closure, all work vehicles present at the site and involved in the installation of the lane closure or restriction shall display flashing lights that provide 360-degree visibility of the vehicles. These lights shall remain on until the full implementation of the road closure or restriction is complete.

All temporary lane or shoulder closures shall be restored at the end of the closure period and no travel lane shall be reduced to less than 11 ft on expressways, freeways and 10 ft on other roadways. Prior to opening the closed lane or shoulder, the Contractor shall clear the lane or shoulder of all material, equipment, and debris.

Failure to restore full traffic capacity within the time specified will result in a deduction being assessed on the next progress estimate in conformance with the following.

This is in addition to the requirements specified in TC-4.02.

ASSESSED DEDUCTIONS FOR OTHER ROADS	
ELAPSED TIME, (MINUTES)	DEDUCTION
<i>For 1 Lane Closures</i>	
1 - 10	\$ 300.00
Over 10	\$150.00 per minute (In addition to the original 10 minute deduction)
<i>For 2 or more Lane Closures</i>	
1 - 10	\$ 600.00
Over 10	\$300.00 per minute (In addition to the original 10 minute deduction)



**CATEGORY 100
PRELIMINARY**

SECTION 104 — MAINTENANCE OF TRAFFIC

104.07 ARROW PANEL (AP).

104.07.01 DESCRIPTION.

159 **DELETE:** The second and third paragraphs “Furnish APs that are.....units unless otherwise specified” and “APs shall have bothdimmer device is operational.

104.07.03 CONSTRUCTION.

160 **ADD:** The following after the first paragraph.

Furnish APs that are self-contained, vehicle-mounted or portable, and approved. Use self-contained trailer units unless otherwise specified.

Provide APs that have both manual and automatic dimmer devices capable of reducing the light intensity by 50 percent. Periodically clean the photocells in order to prevent malfunctioning of the brightness control. Dimmer devices are mandatory during night operation. The devices shall include a fail-safe system that ensures maximum brightness during daytime operations and a reduction in brightness of up to 50 percent during periods of darkness, regardless of which dimmer device is operational.

The AP’s shall provide full illumination within at least a 24-degree cone perpendicular to the panel face.

Power Supply. The AP shall operate from a solar powered electrical system and consist of battery power and solar array panels, and be capable of providing power supply to the AP for 21 consecutive days without auxiliary charge.

ADD: The following after the Arrow Panel Lamp Options table.

Arrow Board Type	Minimum Size	Minimum Legibility Distance	Minimum Number of Elements
A	48x24 in.	½ mile	12
B	60x30 in.	¾ mile	13
C	96x48 in.	1 mile	15
D	None*	½ mile	12

* Length of arrow equals 48 in. width of arrowhead equals 24 in.



Maryland Department of Transportation
State Highway Administration

SPECIAL PROVISIONS INSERT
104 — MAINTENANCE OF TRAFFIC

CONTRACT NO. T-1164-0140
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DELETE: (b) "Aim the AP at approaching.....that the display is level".

INSERT: (b) "Aim the AP at approaching traffic in conformance with the minimum legibility distances specified above. Ensure that the display is level".

SPECIAL PROVISIONS

CONTRACT NO. T-1164-0140

104.11 — TEMPORARY PAVEMENT MARKINGS

1 of 3

**CATEGORY 100
PRELIMINARY**

SECTION 104 — MAINTENANCE OF TRAFFIC

166 **DELETE**: Section 104.11 TEMPORARY PAVEMENT MARKINGS. in its entirety.

INSERT: The following.

104.11 TEMPORARY PAVEMENT MARKINGS.

104.11.01 DESCRIPTION. Furnish, install, and remove temporary pavement markings as specified in the Contract Documents or as directed by the Engineer. These markings shall include lines, letters, numbers, arrows, and symbols.

104.11.02 MATERIALS.

Removable Preformed Pavement Marking Material	Refer to the
Nontoxic Lead Free Waterborne Pavement Markings	Contract Documents
Black Out Tape	QPL

104.11.03 CONSTRUCTION.

104.11.03.01 Quality Assurance/Quality Control. Quality control testing shall be completed by the Contractor's Administration certified technicians. The Engineer will complete the quality assurance checks in conformance with MSMT 729 by performing the Nighttime Visibility Evaluations.

104.11.03.02 Warranty Period. The Contractor shall maintain and be responsible for any defects in the pavement markings for a period of 180 days from the date of application. The Contractor shall replace the pavement markings as necessary within this period as directed by the Engineer at no additional cost to the Administration. Refer to GP-5.11.

104.11.03.02 Application and Removal. The pavement markings shall be applied in conformance with the manufacturer's recommendations and the Contract Documents. Markings shall be applied in the same direction as the flow of traffic. The markings shall be located as specified in the Contract Documents or as directed by the Engineer.

Pavement markings may be applied to either new or existing paved surfaces. When applied to newly paved surfaces, the markings shall be placed before traffic is allowed on the pavement. Nontoxic lead free waterborne pavement markings shall be used for all temporary pavement markings except for the final surface. However, the Contractor may use removable preformed pavement markings at no additional cost to the Administration.

When at the "end of season", the temperatures are too low to allow the placement of removable tape on the final surface, a written exception request may be submitted to the Engineer to allow the use of nontoxic lead free waterborne paint in lieu of removable tape until the following striping season.

SPECIAL PROVISIONS
104.11 — TEMPORARY PAVEMENT MARKINGS

CONTRACT NO. T-1164-0140
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When it is appropriate to shift lanes, all nonapplicable pavement markings within the travel way and adjacent to the travel way as directed by the Engineer shall be completely removed.

Surface Condition. Prior to application of pavement markings, the pavement surface shall be clean, dry, and free of all contaminants, including curing compound, dirt, and loose particles. Residual pavement markings shall be removed. Loose or poorly constructed markings shall also be removed.

Pavement Marking Removal. All removable preformed pavement markings shall be completely removed prior to application of the permanent markings. On stage construction or final surfaces of portland cement concrete pavements, any objectionable adhesive residue shall be removed by water blasting or other methods as may be approved by the Engineer. Open flame is prohibited to remove adhesive residue, or any pavement markings. The Contractor shall remove all nonapplicable pavement markings so that there is no damage to the existing or final surface.

Retroreflectance. The initial retroreflectance readings for temporary pavement markings shall be a minimum of 250 and 150 millicandellas/lux/square meter for white and yellow, respectively. The Engineer will monitor the pavement markings in conformance with MSMT 729 during the Contractor's 180 day period of responsibility.

104.11.04 MEASUREMENT AND PAYMENT. Payment for Removable Preformed Pavement Markings, Removal of Removable Preformed Pavement Markings, Nontoxic Lead Free Waterborne Pavement Marking Paint, and the Removal of Existing Pavement Markings will be measured and paid for using one or more of the items listed below and as specified in the Contract Documents.

The payment will be full compensation for furnishing, placing, complete removal of lines, letters, numbers, arrows, symbols, and the removal of all residue. In addition, payment will cover maintenance and replacement during the 180 day period, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Removal and replacement of temporary pavement markings required beyond the 180 day period will be measured and paid for at the Contract unit price for the pertinent temporary pavement marking item.

Temporary markings replaced during the 180 day period as a result of plowing (as determined by the Engineer) will be paid for at the Contract unit price for the pertinent temporary marking item.

- (a) Nontoxic Lead Free Waterborne Pavement Marking Paint-in width specified-per linear foot.
- (b) Removable Preformed Pavement Line Markings-in width specified-per linear foot.
- (c) Removable Preformed Letters, Symbols, Arrows, and Numbers per each.
- (d) Removal of Removable Preformed Pavement Markings-any width-per linear foot.
- (e) Removal of Removable Preformed Letters, Symbols, Arrows and Numbers per each.
- (f) Removal of Existing Pavement Line Markings-any width per linear foot.

SPECIAL PROVISIONS

CONTRACT NO. T-1164-0140

104.11 — TEMPORARY PAVEMENT MARKINGS

3 of 3

- (g) Removal of Existing Letters, Symbols, Arrows, and Numbers per each.
- (h) Black Out Tape Lines-in width specified-per linear foot.
- (i) Removal of Black Out Tape Lines-any width-per linear foot.



CATEGORY 100
PRELIMINARY

SECTION 104 — MAINTENANCE OF TRAFFIC

104.12 DRUMS FOR MAINTENANCE OF TRAFFIC.

104.12.02 MATERIALS.

169 **ADD:** The following to the end of the first paragraph.

Drums may include recycled plastic content. The drum base may contain up to 100 percent recycled content.

104.12.03 CONSTRUCTION.

ADD: The following to the end of the third paragraph.

Damaged drums shall be recycled to the extent possible. The disposition of the damaged drums shall be provided prior to payment for any replacement drums.

104.12.04 MEASUREMENT AND PAYMENT.

ADD: The following to the end of the second paragraph.

A disposition as specified in 104.12.03 is required prior to payment.



CATEGORY 100
PRELIMINARY

SECTION 104 — MAINTENANCE OF TRAFFIC

104.31 ACCESSIBLE PEDESTRIAN MAINTENANCE OF TRAFFIC.

104.31.01 DESCRIPTION. Provide and maintain an accessible pedestrian route, to the “maximum extent feasible”, throughout the project’s limits. When an existing pedestrian access route within the public right of way is blocked by construction, alteration, or maintenance activity, an alternate accessible pedestrian route shall be provided.

The phrase to the “maximum extent feasible” applies in areas where the nature of an existing facility or site conditions makes it virtually impossible to comply fully with applicable accessibility standards through a planned alteration. In these circumstances, the alternate accessible pedestrian route shall provide the maximum physical accessibility that is feasible, or a design waiver must be approved by SHA’s Office of Highway Development.

104.31.02 MATERIALS. Not applicable

104.31.03 CONSTRUCTION. The following considerations shall be taken into account when addressing accessible pedestrian maintenance of traffic:

- (a) All pedestrians, including persons with disabilities, shall be provided with a reasonably safe, convenient and accessible path that replicates as much as practicable the existing pedestrian facilities.
- (b) The width of the existing pedestrian facility should be maintained if practical. When it is not possible to maintain a minimum width of 60 in. throughout the entire length of the pedestrian route, a minimum width of 36 in. shall be provided with 60 x 60 in. passing zones at least every 200 ft, to allow individuals in wheelchairs to pass.
- (c) Traffic control devices and other construction materials and features shall not intrude into the usable width of the sidewalk, temporary pathway or other pedestrian facility.
- (d) Signs and other devices mounted lower than 7 ft above the temporary pedestrian pathway shall not project more than 4 in. into accessible pedestrian route.
- (e) A smooth, continuous hard surface shall be provided throughout the entire length and width of the pedestrian route throughout construction. There shall be no curbs or vertical elevation changes greater than 1/4 in. in grade or terrain that could cause tripping or be a barrier to wheelchair use. Vertical elevation differences between 1/4 in. and 1/2 in. shall be beveled at a maximum 2:1 slope.



SPECIAL PROVISIONS INSERT
104.31 — ACCESSIBLE PEDESTRIAN MAINTENANCE
OF TRAFFIC

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- (f) When channelization is used to delineate a pedestrian pathway, a continuous detectable edging should be provided throughout the length of the facility such that pedestrians using a white cane can follow it. Edging should protrude at least 6 in. above the surface of the sidewalk or pathway with the bottom of the edging a maximum of 2.5 in. above the surface
- (g) Temporary ramps shall be provided when an alternate pedestrian route crosses a curb and no permanent ramps are in place. The width of the ramp shall be a minimum of 36 in. and the slope of the ramp shall not exceed 12:1. Temporary detectable warning mats must be installed at street crossings and signalized entrances.
- (h) When possible, an accessible pedestrian route shall be provided on the same side of the street as the disrupted route. When it is not feasible to provide a same-side accessible pedestrian route an accessible pedestrian detour route shall be provided.
- (i) Information regarding closed pedestrian routes, alternate crossings, and sign and signal information shall be communicated to pedestrians with visual disabilities by providing devices such as audible information devices, accessible pedestrian signals or barriers and channelizing devices that are detectable to the pedestrians traveling with the aid of a white cane or who have low vision.
- (j) It is desirable that pedestrians cross to the opposite side of the roadway at intersections rather than mid-block. Appropriate signing shall be placed at the intersections.
- (k) Access to transit stops shall be provided and maintained at all times.

104.31.04 MEASUREMENT AND PAYMENT. Unless otherwise specified, Accessible Pedestrian Maintenance of Traffic will not be measured but the cost will be incidental to the Lump Sum item for Maintenance of Traffic. The payment will be full compensation for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

SPECIAL PROVISIONS

CONTRACT NO. t-1164-0140

107 — CONSTRUCTION STAKEOUT

1 of 1

**CATEGORY 100
PRELIMINARY**

SECTION 107 CONSTRUCTION STAKEOUT

195 **107.03 CONSTRUCTION.**

ADD: 107.03.10 Highway Traffic Signals. For installation of Highway Traffic Signals, arrange a meeting with the Engineer and representatives from the Traffic Operations Division to stakeout all items indicated on the sketches, plans, and in the Special Provisions. This meeting shall occur prior to any work after the notice to proceed. No work shall proceed before the stakeout is approved by the Engineer.

199 **107.04 MEASUREMENT AND PAYMENT.**

ADD: Intersection Utility Stakeout. Intersection Utility Stakeout for Traffic Control Devices will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.



**CATEGORY 100
PRELIMINARY**

209 **DELETE:** SECTION 111 — SAMPLING DEVICES AND TESTING EQUIPMENT in its entirety.

INSERT: The following.

SECTION 111 — SAMPLING DEVICES, TESTING AND SAFETY EQUIPMENT

DESCRIPTION. Furnish and maintain Sampling Devices and Testing and Safety Equipment with accessories that are required to sample and test materials used on the project. The sampling and testing and safety equipment will be used by Administration employees as directed by the Engineer. All equipment shall be as approved by the Office of Materials Technology. Furnish the sampling devices and testing equipment to the Engineer at least five days prior to commencement of work on the project. All equipment shall remain in the Engineers' possession until completion of all sampling and testing on the project. Unless otherwise specified, all testing equipment, accessories, and unused sampling devices and safety equipment will be returned to the Contractor at the completion of the project.

MATERIALS. Furnish all applicable sampling devices and containers required by the Administrations' Materials Manual, including all inserts, Sample Testing and Frequency Guide, and this Specification. Quantities will be designated by the Engineer at the preconstruction meeting.

CONSTRUCTION.

Testing Equipment Requirements. Maintain the equipment in good working condition and submit a written certification to the Administration stating when the testing equipment was last calibrated or inspected by an Administration approved testing agency. Ensure that the equipment is calibrated at the frequency required for that type of equipment as specified in the test method and AASHTO R18.

If any testing equipment or accessories are stolen, become defective, or for any other reason do not function as intended, replace with an equal or better unit at no additional cost to the Administration within eight hours after notification.

Sampling Devices and Testing Equipment with Accessories. The following is a general list for sampling devices and testing equipment to be furnished by the Contractor for the specified testing. Contact the Office of Materials Technology, Materials Management Division with any questions concerning the requirements for Sampling Devices, Testing Equipment, and Accessories. The devices, testing equipment, and accessories will be randomly inspected during Independent Assurance Audits.

(a) Sampling Devices from the Administration's Materials Manual.

(1) Soil bags (able to hold at least 35 lb).

(2) Screw top cans - 1 qt.



SPECIAL PROVISIONS INSERT

111 — SAMPLING DEVICES, TESTING AND SAFETY EQUIPMENT

- (3) Friction top cans - 1 qt and 1 gal.
- (4) Plastic jar - 1 gal.
- (5) Flow panels for joint sealer.
- (b) Testing Equipment and Accessories from the Administration's Materials Manual - Determination of Moisture Content of Aggregates (MSMT 251).
 - (1) Electric hot plate or a gas burner, including bottle and fuel.
 - (2) Scale or balance conforming to M 231, Class G2.
 - (3) Metal container, such as large frying pan or equivalent.
 - (4) Pointing trowel or large spoon.
- (c) Field Determination of the Amount of Stabilization Agent in Bases and Subbases (MSMT 254).
 - (1) Scale or balancing conforming to M 231, Class G 100 having a capacity of at least 100 lb/sample containers.
 - (2) Bench brush.
 - (3) Large spoon or scoop.
 - (4) Sampling mat consisting of a sheet of plywood or canvas with a surface of at least 1 yd².
 - (5) Tape measure.
- (d) Field Determination of Moisture Density Relations of Soils (MSMT 351). Refer to MSMT 350.
- (e) Hot Applied Joint Materials Sealer and Crack Filler (MSMT 404). Flow panels (brass panel may be used in lieu of a tin panel).
- (f) In-Place Density of Embankment, Subbase, Base, Surface and Shoulder Material (T 99, T 180, T 191, and MSMT 350).
 - (1) Cylindrical compaction molds, 1/30 and 1/13.33 ft³.
 - (2) Compaction rammers, 5.5 and 10 lb.
 - (3) 12 in. straightedge.
 - (4) Scale or balance conforming to M 231, Class G 100, having a capacity of at least 100 lb.



SPECIAL PROVISIONS INSERT

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111 — SAMPLING DEVICES, TESTING AND SAFETY EQUIPMENT

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- (5) Two 10 in. pie pans.
- (6) 12 in. frying pan.
- (7) 12 in. rocker set complete with pan.
- (8) One each of the following sieves conforming to M 92:

SIZE (in.)	SHAPE	SIZE OPENINGS
12	Square	2 in.
12	Square	3/4 in.
12	Square	No. 4
12	Square	No. 10
*8	Round	No. 10

* For density sand.

- (9) Field density plate with recess to accommodate sand cone apparatus.
 - (10) Steel pan, 12 x 30 in.
 - (11) Electric plate or gas burner, including bottle and fuel.
 - (12) Soil density pick.
 - (13) Precalibrated sand cone density apparatus.
 - (14) Spatula, 3 in.
 - (15) Two water pails.
 - (16) Bag of density sand.
 - (17) Stencil brush, bench brush, sprinkling can, large spoon, and sample shovel.
- (g) Sampling Hot Mix Asphalt prior to Compaction (MSMT 457) - Performed by the paving contractor).
- (1) A 25 ft measuring tape.
 - (2) Random selection cards numbered from 0 to width of the paving lane in 1 ft increments
 - (3) Sample boxes
 - (4) Spatula.
 - (5) Spray paint or other suitable marking material.



SPECIAL PROVISIONS INSERT

CONTRACT No. T-1164-0140

111 — SAMPLING DEVICES, TESTING AND SAFETY EQUIPMENT

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- (6) GPS equipment.
- (7) Masonry nails or equivalent.
- (8) Thermometers (50 to 550°F).
- (9) Square end shovel, fire shovel, or grain shovel.
- (10) Scoop.
- (11) 24 ft of 18 gauge mechanical wire or equivalent to tie through each hole of the plate template.

(h) Concrete Tests.

TEST	METHOD
Sampling	T 141
Making and Curing Concrete Test Specimens	T 23
Slump	T 119
Air Content - Pressure Method	T 152
Air Content - Volumetric Method	T 196
Temperature	T 309

- (1) Air meter, pressure type for conventional concrete and volumetric air meter (Roll-a-Meter) for lightweight Concrete.
- (2) Air Bulb.
- (3) Air pump.
- (4) Rubber mallet.
- (5) Slump cone with rod.
- (6) Steel straight edge.
- (7) Large and small scoop.
- (8) Trowel.
- (9) 3/8 in. diameter tamping rod.
- (10) Unit weight bucket for light weight concrete.
- (11) Sprinkle can or bucket for water.



SPECIAL PROVISIONS INSERT

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111 — SAMPLING DEVICES, TESTING AND SAFETY EQUIPMENT

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- (12) Postal scale (only for lightweight concrete).
- (13) Thermometer (0 to 220 F).
- (14) 4 x 8 in. cylinder molds (for compressive strength specimens).
- (15) 3 x 6 in. cylinder molds for latex concrete.
- (16) 6 x 12 in. cylinder molds for density (unit wt) of lightweight concrete and when otherwise specified.
- (17) Isopropyl alcohol for light weight concrete.
- (18) Protective gloves.
- (i) Other Measuring Devices.

- (1) Hand held pile driving monitoring device (as approved by the Engineer).

111.03.02 Safety Equipment. Approved Safety Equipment.

- (a) Fall Protection Devices for SHA Inspection Personnel.
- (b) Life vests where applicable.

111.04 MEASUREMENT AND PAYMENT. Sampling devices, testing equipment, and safety equipment will not be measured but the cost will be incidental to items of work for which they are required.

SPECIAL PROVISIONS

114 — TRUCK STAGING AREAS AND IDLING REQUIREMENTS

CONTRACT NO. T-1164-0140

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**CATEGORY 100
PRELIMINARY**

SECTION 114 — TRUCK STAGING AREAS AND IDLING REQUIREMENTS

114.01 DESCRIPTION. Locate truck staging areas and avoid unnecessary idling of construction equipment in order to reduce engine emissions and to provide air quality benefits to those who live or work in or adjacent to the construction site.

114.02 MATERIALS. Not applicable.

114.03 CONSTRUCTION. Establish truck staging areas for all vehicles waiting to load or unload materials at the job site. Locate and submit for review staging areas where emissions will have the least impact on sensitive areas and the public.

The Administration will review the selection of staging areas, whether within or outside the existing highway right-of-way, to avoid locations near sensitive areas or populations to the extent possible.

Sensitive areas include, but are not limited to, hospitals, schools, residences, motels, hotels, daycare facilities, elderly housing and convalescent facilities. All sources of emissions shall be located as far away as possible from fresh air intakes, air conditioners, and windows. The Engineer will approve staging areas before implementation.

Idling of all mobile construction equipment, including delivery trucks, shall be limited to five minutes except under any of the following circumstances:

- (a) When forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control.
- (b) When necessary to operate defrosting, heating, or cooling equipment to ensure the safety or health of the driver or passenger.
- (c) When necessary to operate auxiliary equipment that is located in or on the mobile source to accomplish the intended use of the mobile source.
- (d) To attain the recommended operating temperature.
- (e) When the outdoor temperature is below 32 F.
- (f) When undergoing maintenance that requires operation for more than five consecutive minutes.

SPECIAL PROVISIONS

114 — TRUCK STAGING AREAS AND IDLING REQUIREMENTS

CONTRACT NO. T-1164-0140

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The above requirements do not prohibit the operation of an auxiliary power unit or generator set as an alternative to idle the main engine of a motor vehicle operating on diesel fuel.

114.04 MEASUREMENT AND PAYMENT. All methods and procedures required to comply with these requirements will not be measured for payment but will be incidental to the pertinent contract items.



**CATEGORY 500
PAVING**

SECTION 504 — HOT MIX ASPHALT PAVEMENT

504.03 CONSTRUCTION

470 **DELETE:** 504.03.04 Tack Coat in its entirety.

INSERT: The following.

504.03.04 Tack Coat. Dry and clean the surface of all loose and foreign materials prior to application of the tack coat. Apply the tack coat uniformly across the surface as directed using an application rate of 0.01 to 0.05 gal/yd².

476 **DELETE:** 504.03.12 Thin Lifts and Wedge/Level Courses in its entirety.

INSERT: The following.

504.03.12 Thin Lifts and Wedge/Level Courses. When the HMA course is determined by the Engineer to be a thin lift in accordance with the "Thin Lift Mix Design Identification Table" in Section 904.04.03, construct a 400 to 500 ft control strip on the first day of paving to determine optimum pavement density.

Using an asphalt density gauge in accordance with the manufacturer's recommendation, take readings from the control strip in 5 random locations to determine roller patterns and the number of passes needed to obtain optimum density. Optimum density is defined as when the average density does not change by more than 1.0 percent between successive roller passes and the percent density is between 90.0 and 97.0.

Core the five random gauge reading locations to verify the gauge calibration and to determine the percent pavement density. The cores will be tested by the contractor's QC laboratory and results will be verified by the Office of Materials Technology. The QA cores will be saved by the contractor and made available to the Administration for retesting until the end of the project or as otherwise determined.

On the first day of paving, the target optimum density will be determined using the density gauge readings from the control strip; verified by the core results. The lot average density from the five control strip cores will be used as the target optimum density.

Take a minimum of 10 QC/QA gauge readings daily from random locations per day's paving per mix or two per 500 tons of paving per mix; whichever yields the higher



frequency of locations. A density lot is defined as a day's paving per mix. A subplot shall not exceed 500 tons. A paving day shall begin with a new lot and sublots.

For the remainder of the project, any lot average 2.0 percent or more below optimum and below 92 percent shall require a new control strip to be constructed, tested and approved before paving continues.

Take a minimum of 2 QA cores daily when production is in excess of 500 tons per location, or when successive days of less than 500 tons production totals 1000 tons or greater. If the average of the two density gauge readings and the average of the two respective QA core densities are within 3.0 lb per cubic foot, the Administration will accept all the daily density gauge readings. If they do not compare within 3.0 lb per cubic foot, a new control strip will be run and the density gauge recalibrated.

Wedge/Level courses placed at variable thicknesses shall be tested and accepted in accordance with this Thin Lift specification. Incentives are not applicable.

504.04 MEASUREMENT AND PAYMENT.

478 **DELETE: 504.04.01 Price Adjustment for Asphalt Binder** in its entirety.

INSERT: The following.

504.04.01 Price Adjustment for Asphalt Binder. A Price Adjustment (PA) will be made to provide additional compensation to the Contractor or a credit to the Administration for the fluctuation in the cost of asphalt binder.

For adjustment purposes, the prevailing base index price will be the price specified for PG 64-22 Asphalt Binder posted at www.roads.maryland.gov (Business Center /Contracts Bids and Proposals) at time of bid opening. Cost differentials between PG 64-22 and a binder specified shall be included in the price bid per ton for Hot Mix Asphalt. A historical database will be maintained by the Administration.

The PA will be made when the index price for the month of placement increases or decreases more than 5 percent of the prevailing base index price. Computations will be as follows:

$$\text{Percent Change} = ((P_p - P_b) / P_b) \times 100$$

$$PA = T \times Q \times ((P_p - (D \times P_b)))$$

Where:



SPECIAL PROVISIONS INSERT
504 — HOT MIX ASPHALT PAVEMENT

CONTRACT NO. T-1164-0140
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- PA = Price Adjustment for the current month
- T = Design target asphalt content expressed as a decimal
- Q = Quantity of Hot Mix Asphalt placed for the current month
- Pp = Index price for PG 64-22 Asphalt Binder per ton for the month of placement
- D = 1.05 for increases over 5 percent; 0.95 for decreases over 5 percent
- Pb = Prevailing base index price for PG 64-22 Asphalt Binder per ton

PA resulting in increased payment to the contractor will be paid under the item Price Adjustment for Asphalt Binder. The item amount will be established by the Administration and shall not be revised by the Contractor. PA resulting in a decreased payment will be deducted from monies owed the Contractor.

- 479 **DELETE:** 504.04.02 Price Adjustments for Hot Mix Asphalt Mixture and Pavement Density in its entirety.

INSERT: The following.

504.04.02 Payment Adjustments for Pavement Density and Hot Mix Asphalt Mixture. Payment adjustments for pavement density will be based on individual subplot core test data for a given lot and the lot average density as specified in this section and Table 504A. Payment reductions for density and for mixture will be made by adjusting the payment for Hot Mix Asphalt. Incentive payments will be made using the Contract items for Pavement Density and Hot Mix Asphalt Mixture. The item amounts established by the Administration shall not be revised. Payment reductions for density will be waived for portions of the pavement where a poor foundation is determined as the cause for inadequate density.



TABLE 504A		
Dense Graded HMA Mixes – Percent of Maximum Density		
Lot Average % Minimum	No Individual Sublot Below %*	Pay Factor (DF)
94.0	94.0	1.050
93.8	93.7	1.045
93.6	93.4	1.040
93.4	93.1	1.035
93.2	92.8	1.030
93.0	92.5	1.025
92.8	92.2	1.020
92.6	91.9	1.015
92.4	91.6	1.010
92.2	91.3	1.005
92.0	91.0	1.000
91.8	90.8	0.990
91.6	90.6	0.980
91.4	90.4	0.970
91.2	90.2	0.960
91.0	90.0	0.950
90.8	89.8	0.940
90.6	89.6	0.930
90.4	89.4	0.920
90.2	89.2	0.910
90.0	89.0	0.900
89.8	88.8	0.890
89.6	88.6	0.880
89.4	88.4	0.870
89.2	88.2	0.860
89.0	88.0	0.850
88.8	87.8	0.840
88.6	87.6	0.830
88.4	87.4	0.820



SPECIAL PROVISIONS INSERT
504 — HOT MIX ASPHALT PAVEMENT

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88.2	87.2	0.810
88.0	87.0	0.800
Less than 88.0	87.0	0.750 or rejected by Engineer

Note 1: When any test data is above 97.0, the Engineer may reject the lot. When not rejected, the lot will receive a pay adjustment in accordance with the following:

- (a) When the density lot average is above 97.5, the pay factor = 0.750.
- (b) When 3 subplot densities are above 97.0, the pay factor = 0.950.
- (c) When 4 or more subplot densities are above 97.5, the pay factor = 0.750.

Note 2: Pay incentive or pay disincentive will not be paid for placements identified as wedge/level courses or thin lift courses.

*Note 3: When the Contractor's core specific gravity data does not compare with the Administration's core specific gravity data, only the Administration's single subplot values and lot average value will be used in acceptance decision.

*Note 4: The average subplot values and the lot average will be used in acceptance decision.

Acceptance of a mixture lot will be in conformance with Sections 904, 915, and MSMT 735. A composite pay factor (CPF) for asphalt content and gradation will be based on the total estimated percent of the lot that is within Specification limits as computed using the quality level analysis in conformance with MSMT 735.

Payment adjustments will be computed as follows:

$$\text{Density Lot Payment Adjustment} = (\text{DF} - 1) \times (\text{AP}) \times (\text{TL})$$

$$\text{Mix Design Lot Payment Adjustment} = (\text{MF} - 1) \times (\text{AP}) \times (\text{TL})$$

where:

MF = Mixture pay factor [0.55 + (0.5 x CMPWSL)]
Refer to MSMT 735 for CMPWSL.

DF = Density pay factor from Table 504A.

AP = Adjusted/applicable unit price per 504.04.01.

TL = Applicable tonnage per lot.

An in-place density lot containing material with a pay factor of less than 1.000 may be accepted at the reduced pay factor provided the pay factor for density is at least 0.800, and there are no isolated defects.

A mixture lot containing material with a pay factor of less than 1.000 may be accepted at the reduced pay factor provided the composite pay factor for asphalt content and grading is at least 0.750, and there are no isolated defects.



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State Highway Administration*

SPECIAL PROVISIONS INSERT
504 — HOT MIX ASPHALT PAVEMENT

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An in-place density lot containing nonconforming material that fails to obtain at least a 0.800 pay factor and a mixture lot containing nonconforming material that fails to obtain at least a 0.750 pay factor for asphalt content and gradation will be evaluated to determine acceptance. Lots that are rejected shall be replaced.

Lots with less than five Quality Control or Quality Assurance samples per in-place density lot will not be evaluated for incentive payment.

When less than three mix samples have been obtained at the time of the acceptance sampling or at the time a lot is terminated, the Engineer will determine if the material in a shortened lot will be considered a part of the previous lot or whether it will be accepted based on the individual test data.



SPECIAL PROVISIONS INSERT
520 — PLAIN AND REINFORCED PORTLAND CEMENT
CONCRETE PAVEMENTS

CONTRACT NO. T-1164-0140

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CATEGORY 500
PAVING

SECTION 520 — PLAIN AND REINFORCED PORTLAND
CEMENT CONCRETE PAVEMENTS

520.03 CONSTRUCTION.

506 **ADD:** The following after 520.03.16.

520.03.17 Dowel Bar Placement Checks. After the placement of the PCC pavement is complete and cured, the alignment and placement of the dowel bars will be checked by the Administration using a non-destructive test method. A random representative sample of joints will be tested to determine conformance with the following:

- (a) **Vertical Skew.** The vertical skew shall be no greater than 1/2 in. tolerance over a 12 in. length of dowel bar.
- (b) **Horizontal Skew.** The horizontal skew shall be no greater than 1/2 in. tolerance over a 12 in. length of dowel bar.
- (c) **Depth of Dowel Bar.** The dowel bar shall be located within the middle third of the slab thickness.
- (d) **Joint.** The joint saw cut shall be in the middle third of the dowel bar length.

When a dowel bar is tested and does not conform to all of the above, it is then in non-conformance or misaligned. After testing is complete, the percentage of those dowel bars not meeting the above will be determined. Deficiency will be subject to a reduced payment as specified in 520.04. This is in addition to the reduced pay for slab thickness.

520.04 MEASUREMENT AND PAYMENT.

506 **ADD:** The following after 520.04.01.

520.04.02 Dowel Bar Misalignment Price Adjustment. Payment for the percentage of dowel bars accepted at a reduced price for not conforming to the proper alignment will be adjusted by the factors shown in the following table. Alignment is determined by procedures specified in 520.03.17. This shall be a reduced price for the portland cement concrete pavement item in addition to any reduction due to pavement thickness.



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SPECIAL PROVISIONS INSERT
520 — PLAIN AND REINFORCED PORTLAND CEMENT
CONCRETE PAVEMENTS

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DOWEL BAR PRICE ADJUSTMENT	
Percent of Misaligned Dowel Bars *	Percent of Payment, Contract Unit Price **
0.0 to 30.0	100
30.1 to 40.0	90
40.1 to 50.0	80
Greater than 50.0	Corrective action or pay reduction as determined by the Engineer

*This is the percentage of all dowel bars tested.

**This price adjustment is to the PCC price and not for the dowel bars. This is in addition to any price adjustment for pavement thickness.

CATEGORY 500
PAVING

SECTION 550 — PAVEMENT MARKING PAINT

550.01 DESCRIPTION. Furnish and apply nontoxic lead free waterborne pavement marking paint to pavement surfaces as specified in the Contract Documents or as directed by the Engineer. These markings includes lines (striping), legends (letters and numbers) and symbols.

550.02 MATERIALS. Paint is a nontoxic lead free waterborne pavement marking and is a non-durable material. All Paint Pavement Marking material shall be selected from the Qualified Products List.

Nontoxic Lead Free Waterborne
Pavement Marking Material

951.01

550.03 CONSTRUCTION.

550.03.01 Quality Control / Quality Assurance. Refer to Section 549.

550.03.02 Application. The location, width, and type of marking shall be as specified in the Contract Documents or as directed by the Engineer.

- (a) **Temperature.** The markings shall be applied when the paint, ambient and surface temperature, and relative humidity conform to the manufacturer's recommendations.
- (b) **Glass Beads.** The Contractor shall apply the Maryland Blend gradation of glass beads uniformly across the surface of the stripe, at the rate of 7 to 9 lb/gal of paints.
- (c) **Thickness.** The paint shall be applied at a wet film thickness of 18 ± 1 mils.
- (d) **Color.** The color of the dry markings shall match Federal Standard 595 (38907 - yellow or 37925 - white). The Contractor shall make available the specified color chips for the Engineer's use to visually determine that the waterborne material matches the specified color.
- (e) **No-Track.** The paint shall conform to 60 second no-track requirements. The no-track condition shall be determined by passing over the applied line at approximately 30 degrees with a standard passenger car or pickup truck. When viewed from a distance of 50 ft, the pavement surface shall show no evidence of the paint being picked up and redeposited on the pavement by the vehicle.
- (f) **Retroreflectance.** The minimum retroreflectance shall be 150 millicandelas/lux/square meter for yellow and 250 millicandelas/lux/square meter for white as determined in conformance with MSMT 729.

SPECIAL PROVISIONS
550 — PAVEMENT MARKING PAINT

CONTRACT NO. T-1164-0140
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550.03.03 Application Equipment. The equipment used for application of the paint shall be approved by the Engineer prior to start of work, and shall be capable of applying waterborne traffic paint that has been approved by the Administration. The Contractor shall provide access to the paint application equipment for inspection by the Engineer.

The paint carriage on the left side of the paint truck shall have three paint and bead guns. The paint carriage on the right side of the paint truck shall have two paint and bead guns.

All 10 in. lines shall be applied using two paint and bead guns. Raising the paint carriage in order to paint these lines with one paint gun and bead gun is prohibited.

The footage counters used to measure pavement markings shall be calibrated, and a notarized certification shall be submitted to the Engineer as part of the Quality Control Plan.

Temperature gauges shall be calibrated every six months and a copy of the calibration certification shall be submitted to the Engineer as part of the Quality Control Plan.

The applicator shall apply the surface dressing beads to the wet paint marking by means of a pressurized bead dispenser or other mechanical conveying method not dependent upon gravity for uniform application. The bead dispenser shall be equipped with an automatic cutoff system that will stop the flow of the paint material whenever there is a disruption in the application of the beads so that all markings placed shall be covered with a uniform layer of surface dressing beads.

Application equipment shall be capable of applying the markings at multiple width settings ranging from 4 to 12 in.

The applicator shall provide a method for cleanly cutting off stripe ends and shall be capable of applying all longitudinal pavement markings.

The equipment shall be mobile and maneuverable to the extent that straight lines can be followed and all standard curves can be made in true arcs.

All parts of the equipment shall be thoroughly cleaned of foreign material or different colored material prior to the introduction of a new batch of material.

550.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all pavement preparation, furnishing and placing of markings, testing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Refer to 549.04.

Pavement Marking Paint will be measured and paid for at the Contract unit price for one or more of the following items:

- (a) Pavement Marking Paint lines (striping) will be measured and paid for at the Contract unit price per linear foot for the color and width specified.
- (b) Pavement Marking Paint Legends (letters and numbers) and Symbols will be measured and paid for at the Contract unit price per square foot. The square foot pay quantity for Legends (letters and numbers) and Symbols will be as specified in the Administrations Standard Details.

CATEGORY 500
PAVING

SECTION 553 — LEAD FREE REFLECTIVE THERMOPLASTIC
PAVEMENT MARKINGS

553.01 DESCRIPTION. Prepare and apply lead free reflective thermoplastic pavement markings to roadway surfaces as specified in the Contract Documents or as directed by the Engineer.

553.02 MATERIALS.

Lead Free Reflective Thermoplastic Pavement Markings 951.02

553.03 CONSTRUCTION.

553.03.01 Quality Assurance/Quality Control. Refer to 549.03.01.

553.03.02 Application Equipment. An oil or air jacketed kettle shall be utilized for uniform melting and heating of the thermoplastic material. The kettle shall provide continuous mixing and agitation of the material. The kettle and the applicator shall be equipped with an automatic thermostatic device to provide positive temperature control.

The equipment shall be constructed so that all mixing and conveying parts, up to and including the application apparatus, maintains the material at the specified temperature. Conveying parts of the applicator between the reservoir and the application apparatus shall be constructed to prevent clogging and accumulation. The applicator shall be capable of containing a minimum of 600 lb of molten thermoplastic material.

The kettle and applicator shall be constructed and arranged to conform to the requirements of the National Board of Fire Underwriters (NBFU), the National Fire Protection Association (NFPA), and State and local authorities.

Temperature gauges shall be calibrated every six months and a copy of the calibration certification shall be submitted to the Engineer.

The applicator shall apply the surface dressing beads to the molten thermoplastic marking by means of a pressurized bead dispenser or other mechanical conveying method not dependent upon gravity for uniform application. The bead dispenser shall be equipped with an automatic cutoff system that will stop the flow of the thermoplastic material whenever there is a disruption in the application of the beads so that all markings placed shall be covered with a uniform layer of surface dressing beads.

Application equipment shall be capable of applying the markings at multiple width settings ranging from 4 to 12 in. as specified in the Contract Documents.

The applicator shall provide a method for cleanly cutting off stripe ends and shall be capable of applying all longitudinal pavement markings.

SPECIAL PROVISIONS
553 — LEAD FREE THERMOPLASTIC MARKINGS

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The equipment shall be mobile and maneuverable to the extent that straight lines can be followed and all standard curves can be made in true arcs.

All parts of the equipment shall be thoroughly cleaned of foreign material or different colored material prior to the introduction of a new batch of thermoplastic material.

553.03.03 Cleaning Pavement Surfaces. Refer to 549.03.02.

553.03.04 Application. The ambient and surface temperatures shall be at least 50 F and rising at the time of application.

Thermoplastic pavement markings shall be sprayed onto the pavement surface. Only the spray method of application shall be permitted. Gore areas, crosswalks, small intersections, roundabouts, and other areas which preclude the application of the markings with truck mounted equipment will be exempt from the spray application requirement.

Thermoplastic pavement markings shall conform to the following:

- (a) **Temperature.** The molten material temperature shall be between 400 and 440 F unless otherwise recommended by the manufacturer, and approved by the Engineer.
- (b) **Primer.** A primer shall be used if thermoplastic is applied to portland cement concrete. Any primer used shall be compatible with the thermoplastic material.
- (c) **Thickness.** The pavement markings shall yield a solid thickness range of 80 to 95 mils above the roadway surface across the middle two-thirds of the line width when tested as specified in MSMT 729. Variation from this range will be used for the price adjustment specified in 553.04.01.
- (d) **Glass Beads.** Glass beads shall be uniformly applied to the surface of the molten thermoplastic at the minimum rate of 7 to 9 lb/100 ft², as specified in MSMT 729.
- (e) **Color.** The color of the dry markings shall match Federal Standard 595 (13538 - yellow or 17886 - white). The Contractor shall supply the specified color chips for the Engineer's use to visually determine that the thermoplastic material matches the specified color.
- (f) **Retroreflectance.** Refer to MSMT 729. The millicandellas/lux/square meter values taken anytime within the first 30 days shall conform to the following:

RETROREFLECTANCE

COLOR	RETROREFLECTIVITY	CORRECTIVE ACTION
White	equal to or greater than 250	None
Yellow	equal to or greater than 150	
White	less than 250	Necessary corrective actions, including grinding if necessary, and re-tracing
Yellow	less than 150	

SPECIAL PROVISIONS
553 — LEAD FREE THERMOPLASTIC MARKINGS

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(g) **Width.** Refer to 549.03.01(a).

(h) **Alignment.** Refer to 549.03.01(a).

(i) **Layout Markings.** Refer to 549.03.01(a).

553.03.05 Quality Control Test Strip. Refer to 549.03.03.

553.03.06 Responsibility. Section 549.

553.03.07 Observation Period. Section 549.

553.04 MEASUREMENT AND PAYMENT. Refer to 549.04. The reflectometer will become the property of the Contractor at the completion of the project.

553.04.01 Price Adjustment for Film Thickness. The unit price for Lead Free Reflective Thermoplastic Pavement Markings will be per striped linear foot based on MSMT 729 calculations for thickness, and will be adjusted in conformance with the following:

MIL THICKNESS	PERCENT OF PAYMENT - UNIT PRICE
80 – 95 (a)(b)	100
75 – 79	90
70 – 74	88
65 – 69	82
60 – 64	72
Less than 60	Retrace to achieve a thickness of 80 to 95 mils. Retrace thickness shall be 30 mils min (b).

(a) The Engineer may require the Contractor to remove excess material thickness.

(b) Removal of excess material and retracing pavement markings shall be performed at no additional cost to the Administration.

SPECIAL PROVISIONS

556 — PREFORMED THERMOPLASTIC PAVEMENT MARKINGS

CONTRACT NO. T-1164-0140

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CATEGORY 500 PAVING

**SECTION 556 — PREFORMED
THERMOPLASTIC PAVEMENT MARKINGS**

556.01 DESCRIPTION. Furnish and install heat applied preformed thermoplastic pavement marking symbols, legends, and lines as specified in the Contract Documents or as directed by the Engineer.

556.02 MATERIALS.

Preformed Thermoplastic is a durable pavement marking material. All Preformed Thermoplastic Pavement Marking material shall be selected from the Qualified Products List.

Heat Applied Permanent Preformed
Thermoplastic Pavement Marking Material

951.06

556.03 CONSTRUCTION.

556.03.01 Quality Assurance/Quality Control. Section 549.

556.03.02 Application. The location, width, and type of marking, shall be as specified in the Contract Documents or as directed by the Engineer.

Applying pavement markings over longitudinal joints is prohibited; they shall preferably be offset 2 in. from them.

Thermoplastic Pavement Marking shall conform to the following:

- (a) **Temperature.** The markings shall be applied when the thermoplastic, ambient, and surface temperature, and relative humidity conform to the manufacturer's recommendations.
- (b) **Color.** The color of the dry markings shall match Federal Standard 595 (13538 - yellow or 17886 - white). The Contractor shall supply the specified color chips for the Engineer's use to visually determine that the thermoplastic material matches the specified color.
- (c) **Primer.** When specified by the manufacturer, a primer shall be used if thermoplastic is applied to Portland cement concrete.
- (d) **Retroreflectance.** The minimum retroreflectance shall be 150 millicandelas/lux/square meter for yellow and 250 millicandelas/lux/square meter for white as determined in conformance with 549.03.

SPECIAL PROVISIONS

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556 — PREFORMED THERMOPLASTIC PAVEMENT MARKINGS

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556.03.05 Packaging. The material shall be handled for shipping, unloading and storage as recommended by the manufacturer. Each shipping package shall be marked with the following information:

- (a) Manufacturer's name.
- (b) Description of item.
- (c) Date of manufacture.
- (d) Contractor's name.
- (e) Purchase order number.
- (f) Lot number.
- (g) Color.

556.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all pavement preparation, furnishing and placing of markings, testing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Preformed Thermoplastic Pavement Marking Legends (letters and numbers) and Symbols will be measured and paid for at the Contract unit price per square foot. The square foot pay quantity for Legends (letters and numbers) and Symbols will be as specified in the Administrations Standard Details

Preformed Thermoplastic Pavement Marking lines will be measured and paid for at the Contract unit price per linear foot for the color and width specified.

**CATEGORY 500
PAVING**

SECTION 557 – SNOWPLOWABLE RAISED PAVEMENT MARKERS

557.01 DESCRIPTION. Furnish and install new Snowplowable Raised Pavement Markers (SRPM) and replacement components as specified in the Contract Documents or as directed by the Engineer.

557.02 MATERIALS.

Castings	Qualified Products List / 951.05
Pavement Marker Reflector Lenses	Qualified Products List / 951.05
Epoxy	951.05

Snowplowable Raised Pavement Markers are durable materials.

557.03 CONSTRUCTION.

Casting. Recycled iron castings are prohibited.

Placement. Snowplowable Raised Pavement Markers shall be installed and located as specified in the Contract Documents and in conformance with the Maryland Manual of Uniform Traffic Control Devices (MdMUTCD).

General Installation Requirements.

- (a) The Contractor shall install the SRPM no later than two weeks after the completion of the final surface or as directed by the Engineer.
- (b) At the time of installation, the road surface and ambient temperature shall be as specified in the manufacturers' recommendations. Installing markers on wet pavement surfaces as determined in MSMT 729 is prohibited.
- (c) At the time of installation, the Contractor shall have on the jobsite all the materials necessary to complete the installation.
- (d) The quality control test strip containing a minimum of 10 groove cuts spaced as specified in the Contract Document shall be constructed to verify the accuracy and ability of the equipment and personnel. The contractor shall replace at no additional cost to the Administration any incorrect groove cuts and any incorrect casting placements within the test strip.
- (e) At the time of installation, SRPM castings delivered with Pavement Marker Reflector Lens affixed should be free of dirt, dust, oil, grease, rust, moisture, or any foreign matter that will impair adhesion to the pavement. Any residual material that inhibits retroreflectivity of the reflector lens shall be removed without damage to the lens surface. It shall be the contractor's responsibility to clean each contaminated casting by sand blasting, wire

SPECIAL PROVISIONS

557 — SNOWPLOWABLE RAISED PAVEMENT MARKERS

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brushing or other procedure approved by the Engineer to remove all foreign matter prior to installation. The use of chemicals to remove rust from the castings is prohibited.

- (f) The contractor shall replace at no additional cost to the Administration any incorrect groove cut and any incorrect casting placement. An additional test strip may be required by the Engineer in the event of incorrect installations. Incorrect installations, as determined by the Engineer, shall be corrected and repaired by the contractor at no additional cost to the Administration.

Pavement Marker Reflector Lens. Reflector lenses for pavement markers shall be the same color as the adjacent pavement marking except the back side shall be as follows;

- (a) One-Way Applications: The backside for One-Way Markers shall be red or blank as specified in the Contract Documents or as directed by the Engineer.
- (b) Two-Way Applications: The backside for Two-Way Markers shall be the same color as the adjacent pavement marking.

The pavement marker reflector lens shall be imprinted with the model/batch number and the manufacturers' name.

Castings. The casting shall be imprinted with the model number and the manufacturer's name.

New Installation.

- (a) The SRPM shall be installed in accordance with manufacturer's recommendations and D 4383. The installed height shall not exceed 0.25 in. above the road surface. The surface of the keel and web shall be free of scale, dirt, oil, grease or any other contaminant which may reduce its bond to the epoxy adhesive. All requirements of the manufacturer's installation instructions shall be met.
- (b) The groove cut for the casting shall be the appropriate dimensions to allow 0.125 in. movement side to side of the casting. All leveling lugs on the casting must contact the pavement. The leading and trailing edges of the casting must lie below the pavement surface and the casting properly seated. All other requirements of the manufacturer's installation instructions shall be met.
- (c) Lenses used shall be of a type specifically manufactured and approved for use as SRPM reflector lenses. Lenses that are manufactured exclusively for recessed pavement markers are not permitted as substitutes for SRPM reflector lenses.

Replacement.

- (a) Casting Replacement. The re-use of damaged or removed castings is prohibited.
- (b) Pavement Marker Reflector Lens Replacement. The Contractor shall remove and dispose of any damaged reflector lens and replace with a new lens. Previously installed undamaged

SPECIAL PROVISIONS

557 — SNOWFLOWABLE RAISED PAVEMENT MARKERS

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castings which are missing a reflector lens shall have a new reflector lens installed. The replacement lenses shall be installed per manufacturer's written instructions.

- (c) Casting Groove Cut Replacement and Accuracy. The re-use of existing groove cuts is prohibited; castings shall only be installed in new groove cuts. Previously used groove cuts shall be permanently patched in accordance with applicable sections of 504, 505 and 522 or

as directed by the Engineer. The location of the replacement groove cut shall be within 10 percent longitudinally in front (with the direction of traffic) and no lateral deviation exceeding 1½ in.

Casting Adhesive. The epoxy adhesive used to fasten the castings to the pavement surface shall conform to D 4383-05 Table X1.1.

Reflector Lens Adhesive in Casting. The adhesive used to fasten the reflector lens to the casting shall meet the manufacturers' recommendations.

Quality Assurance/Quality Control. Section 549.

Observation Period. The Contractor shall replace at no additional cost to the Administration, any SRPM or Pavement Marker Reflector Lenses found to be damaged, non-retroreflective or missing due to improper installation or manufacturing defects within 180 days after opening to traffic.

557.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all pavement preparation, furnishing and placement of SRPM's, testing, removal, groove cutting, repair and all materials, labor, equipment, tools and all incidentals necessary to complete the work.

- (a) Snowplowable Raised Pavement Markers will be paid for at the Contract unit price per each. Furnishing and installing SRPM includes the casting, reflector, adhesive and grooving.
- (b) Removal of existing Castings, excluding any incorrect installation by the Contractor, and repair of Groove Cuts will be paid for at the Contract unit price per each.
- (c) Replacement of Pavement Marker Reflector Lenses will be paid for at the Contract unit price per each.

**CATEGORY 500
PAVING****SECTION 565 — REMOVAL OF EXISTING PAVEMENT MARKINGS**

565.01 DESCRIPTION. Remove existing pavement markings (lines, letters, numbers, arrows, and symbols) during temporary or permanent traffic shifts, and repairing any roadway areas damaged during the removal process. This Specification does not apply to raised or recessed pavement markers. Temporary blackout tape shall be applied when existing pavement markings will require salvaging for reuse after completion of temporary traffic shifts necessary to perform work specified in the Contract Documents. Refer to 104.11.02.

565.02 MATERIALS. Not applicable.

565.03 CONSTRUCTION. The Contractor shall layout and apply all new pavement markings (temporary or permanent) as specified in Section 549 before any removal of existing pavement markings begin.

565.03.01 Quality Control/Quality Assurance. At least two weeks prior to the start of pavement markings removal, the Contractor shall submit a Quality Control Plan (QCP) to the Engineer for review. The QCP shall contain (as a minimum) the following information:

- (a) How the Contractor proposes to perform the work while ensuring conformance with the Specifications.
- (b) Proposed method of removal based on road conditions, type and number of equipment to be used, manpower expectations, and time frame to complete the work based on maintenance of traffic (MOT) restrictions.
- (c) Location and quantity of markings to be removed.
- (d) Protective shielding plan and containment system, particularly in the case of markings that may contain toxic materials.

The QCP shall also detail when, how, and what corrective actions will be taken for unsatisfactory construction practices and deviations from the Contract Documents. Any deviation from the QCP shall be cause for immediate suspension of work. Operations shall not resume without the Engineer's approval.

565.03.02 Quality Control Test Strip. Prior to the beginning of work, the Contractor shall demonstrate the removal method to the Engineer for approval. A minimum of 100 ft of existing pavement markings shall be removed as a test strip at a location determined by the Engineer. If the method does not work or shows signs of damaging the road surface, then another method

SPECIAL PROVISIONS

565 — REMOVAL OF EXISTING PAVEMENT MARKINGS

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shall be tried. Additional control strips will be required. The preferred method is that which least damages the roadway and completely removes the markings.

565.03.03 Methods of Removal. The following removal methods are based on the pavement condition and type of marking material:

- (a) **Manual.** A scraper or putty knife shall be used to lift tape from the pavement surface. Open flame for tape removal is prohibited.
- (b) **High Pressure Water Blasting.** A high pressure water blast shall be used to break the bond between the marking material and the pavement surface. The water blast may contain fine grit.
- (c) **Alternate Methods.** Abrasive blasting or grinding methods shall be submitted for approval to the Office of Materials Technology prior to use.

565.03.04 Cleaning Pavement Surfaces. Immediately behind the removal operation, a vacuum equipped street sweeper capable of removing all loose material shall be used to remove all dust and debris generated by the removal process prior to returning the area to traffic. The Contractor shall prevent debris from draining into inlets and waterways, and all debris shall be collected and disposed of on an approved spoil area or landfill.

565.03.05 Alignment. Removal shall be performed in a straight and uniform manner, and shall follow the longitudinal alignment of the markings with a lateral deviation of no more than 1 in. in any 10 ft section. Affected area shall not exceed 1/2 in. on either side of the existing marking. The depth shall be uniform throughout, 1/8 in. or less, with no gouge areas in the pavement surface. If a second pass is necessary to completely remove the markings, the edges of the groove shall be feathered to a width of 1.25 in. on each side for every additional 1/8 in. of depth.

565.03.06 Corrective Action. Any pavement surface damaged beyond the requirements specified herein by the Contractor's operations shall be repaired or repaved as determined by the Engineer at no additional cost to the Administration.

565.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for the removal of the markings, pavement clean up, test strips, protective shielding, containment, disposal of marking material and pavement debris, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Removal of the existing pavement markings will be measured and paid for at the Contract unit price for one or more of the following items:

- (a) Removal of Existing Pavement Marking Lines per linear foot, any width.

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- (b) Removal of Existing Pavement Marking Letters, Symbols, Arrows, and Numbers per square foot.

**CATEGORY 800
TRAFFIC**

**AUDIBLE/TACTILE PEDESTRIAN PUSHBUTTON
STATION AND SIGNS**

DESCRIPTION. Furnish and install self-contained Audible/Tactile Pedestrian Pushbutton Station and Signs, as specified in the Contract Documents or as directed by the Engineer.

MATERIALS. Audible/Tactile Pedestrian Pushbutton Station and Signs and all component parts must meet the latest edition of the National Electrical Manufacturers Association (NEMA) Standards and Underwriters Laboratory (UL), as applicable .

Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware. The serial number and model number shall be etched, stamped, molded, or attached using metallic self-adhesive labels. The use of adhesive backed paper labels is not acceptable.

CONSTRUCTION. Audible/Tactile Pedestrian Pushbutton Station and Signs will be designed to mount near or at the bottom of the pedestrian display mounting post. The pushbutton assembly for the audible signal may replace or supplement an existing pedestrian signal pushbutton.

Audible/Tactile Pedestrian Pushbutton Station and Signs shall be designed as follow:

- (1) A single base unit at the traffic control cabinet must be able to control 2 to 12 (maximum of 3 per phase) push button stations.
- (2) Only a single 2 - conductor cable will be required from traffic controller cabinet per each pushbutton to operate all pushbutton features.
- (3) Each station will have a 2-in. button with a tactile raised directional arrow on the button.
 - (a) It shall be possible to change the arrow direction to one of four directions.
 - (b) Arrow/button shall vibrate during the walk period following a push of the button.
- (4) The push button station frame shall be cast aluminum with mounting holes for a 5 in. by 7.75 in. or larger pedestrian sign.

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Audible/Tactile Pedestrian Pushbutton Station and Signs will have the following features.

- (1) Locating tone
- (2) 5 walk sound choices that shall be field selectable.
- (3) 3 pedestrian clearance sound choices that shall be field selectable.
- (4) A Direction of Travel message shall be standard with extended push.
- (5) An Information message shall be optional with extended push.

The audible sounds emitted by the Audible/Tactile Pedestrian Pushbutton Station and Signs shall have the following properties

- (1) All audible sounds shall emanate from the push button station.
- (2) All audible sounds for all push button stations shall be synchronized.
- (3) Each audible feature shall have independently-adjustable minimum and maximum volume limits.
- (4) All sounds shall automatically adjust over a 60 dB range to compensate for ambient noise levels.
- (5) All volumes and optional features shall be settable using a handheld infrared device with password security. The infrared device shall be capable of updating/setting all push button stations, or the intersection from a single pushbutton station (Global updating).
- (6) The ability to mute sounds at all crosswalks except activated crosswalks.

The system shall have user-selectable multiple language capability.

The system shall be able to play an emergency preemption message.

The system shall be able to self-test its buttons and to report any faults to the traffic controller.

Warranty. Audible/Tactile Pushbutton Station and Signs shall be warranted by the Manufacturer for a period of 24 months from the date of delivery.

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Compatibility Testing: Audible/Tactile Pushbutton Station and Signs manufacturers shall certify that their modules meet the Load Switch and Signal Conflict Monitor Compatibility testing requirements found in the most recent, formally-adopted version of the specification titled "Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules," published by the Institute for Transportation Engineers (ITE).

MEASUREMENT AND PAYMENT. Audible/Tactile Pedestrian Pushbutton Station and Signs will be measured and paid for at the contract unit price each. The payment will be full compensation for furnishing, programming, delivery to the specified signal shop for testing, pick up, and installing the push button stations, signs, all cables, labor, equipment, tools, and incidentals necessary to complete this work.

Audible/Tactile Pedestrian 2-wire Central Control Unit will be measured and paid for at the contract unit price per each. The payment will be full compensation for furnishing, programming delivery to the specified signal shop for testing, pick up, and installing the Audible/Tactile Pedestrian Base unit and all cables, labor, equipment, tools, and incidentals necessary to complete this work.

CATEGORY 800
TRAFFIC

CATALOG CUTS AND WORKING DRAWINGS

DESCRIPTION. Prepare and transmit submittals to demonstrate the performance of the work in accordance with the Contract Documents. Submittal schedules, catalog cuts, shop drawings, installation methods, manufacturer's certifications, photometric data and working drawings shall be furnished on all Contractor furnished items for highway signing, sign lighting, highway lighting and traffic signals. Stakeouts of the sign locations shall be submitted for all sign structure locations as specified in the Contract Documents

MATERIALS. Not Applicable.

CONSTRUCTION.

Submittal Requirements. Submittals shall be scheduled and coordinated with the Contractor's construction schedule. A complete submittal schedule and list of required submittals shall be submitted with the first submittal, but no later than three days after the pre-construction conference. The schedule for submission of submittals shall be arranged so that related equipment items are submitted concurrently.

The Engineer may require changes to the submittal schedule to permit concurrent review of related equipment. Shop drawings for closely related items such as a sign and ITS support structures shall be submitted together.

Submittal Documents. Drawings shall be neat in appearance, legible and explicit to enable proper review. D size plans shall still be legible when reduced to one half size. They shall be complete and detailed to show fabrication, assembly and installation details, wiring and control diagrams, catalog data, pamphlets, descriptive literature, and performance and test data. They shall be accompanied by calculations or other sufficient information to provide a comprehensive description of the structure, machine or system provided and its intended manner of use. If drawings deviate from the Contract Documents, advise the Engineer in writing with the submittal and state the reason for the deviation.

No portion of the work requiring a Contractor's drawing shall be started nor shall any materials be fabricated, delivered to the site, or installed prior to the approval or qualified approval of the drawings. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved Contractor's drawings shall be at the Contractor's risk. The Administration will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

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CATALOG CUTS AND WORKING DRAWINGS

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Shop drawings shall show types, sizes, accessories, layouts including plans, elevations and sectional views, component, assembly and installation details, and all other information required to illustrate how applicable portions of the Contract requirements will be fabricated and installed. In case of fixed mechanical and electrical equipment, layout drawings drawn to scale, shall be

submitted to show required clearances for operation, maintenance and replacement of parts. Manufacturer's certified performance curves, catalog cuts, pamphlets, descriptive literature, installation and application recommendations, shall be provided and indicate conformance to the Contract Documents. Certifications shall be originals. Certification shall also be sent to the Office of Materials and Technology (OMT) as required in the Contract Documents.

Manufacturer's catalog, product and equipment data shall include materials type, performance characteristics, voltage, phase, capacity, and similar data along with wiring diagrams when applicable. Indicate catalog, model and serial numbers representing specified equipment. Provide complete component information to verify all specified required items. Installation recommendations and instructions shall provide written Manufacturer's detail step by step preparation and installation of the materials, and products including recommended tolerances and space for maintenance and operation.

Catalog cuts for sign luminaires shall have photometric data attached for each sign to be illuminated. Photometric printouts shall include the sign number, the illumination on a one foot square grid covering the entire sign face, the average illumination, the maximum to minimum uniformity ratio, and a working drawing for the sign face attached.

Catalog cuts for roadway luminaires shall have photometric data attached as specified in the Contract Documents.

Submit working drawings as required for changes, substitutions, contractor design items, and Contractor designed methods of construction. Requirements for working drawings will be listed in appropriate Specification Sections and in Special Provisions. Drawings shall be accompanied by calculations or other information to completely explain the structure, machine or system described and its intended use. Review and approval of such drawings by the Engineer shall not relieve the Contractor from his responsibility with regard to the fulfillment of the terms of the Contract.

Working drawings and calculations as submitted shall be sealed, dated and signed by a Professional Engineer registered in the State of Maryland.

The review and approval of Contractor's drawings by the Administration shall not relieve the Contractor from his responsibility with regard to the fulfillment of the terms of the Contract. The Contractor shall be responsible for the verification and accuracy of all dimensions and insuring that all Contractor furnished items are compatible, and conform to all design and performance criteria.

SPECIAL PROVISIONS
CATALOG CUTS AND WORKING DRAWINGS

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All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.

Submittal Process. Each drawing submitted shall have affixed to it the following Certification Statement, signed by the Contractor:

"By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and pertinent data and I have checked and coordinated each item with other applicable approved drawings and Contract requirements."

With the first submittal, include a submittal schedule, listing by Specification Section number, all submittals required and approximate date submittal will be forwarded.

Each submittal having catalog descriptions, shop drawings, working drawings, photometric data, manufacturer's certifications, method of construction and manufacturer's installation recommendations shall be submitted to:

Chief, Traffic Operations Division
Maryland State Highway Administration
7491 Connelley Drive
Hanover, Maryland 21076

Each submittal shall have a transmittal page that indicates the Contractor's and Subcontractor's address and phone numbers. Submittals containing multiple items need the transmittal only on the exterior of each package. For original submittals, and each subsequent resubmittal that may be required, 9 copies will be submitted for projects administered by the District, and 6 copies will be submitted for projects administered by Office Of Traffic and Safety. A separate copy shall be forwarded to the Engineer.

All submittals for approval shall have the following identification data, as applicable, contained thereon or permanently adhered thereto.

- (a) Drawing title, drawing number, TIMS number, TOD number, revision number, and date of drawing and revision.
- (b) Applicable Contract Drawing Numbers and Specification Section and Paragraph Numbers.

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CATALOG CUTS AND WORKING DRAWINGS

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The first page of every catalog description, working drawing and material certification shall be stamped in red with the following. All pertinent Contract Document information shall be filled in the spaces provided.

MARYLAND STATE HIGHWAY ADMINISTRATION	
SUBMITTAL PACKAGE # _____	DATED _____
CONTRACT # _____	LOCATION _____
PROJECT DESC.	
ITEM # _____	THIS ITEM CONTAINS _____ PAGES
ITEM DESCRIPTION	
<input type="checkbox"/> ACCEPTED	
<input type="checkbox"/> ACCEPTED AS NOTED	
<input type="checkbox"/> REJECTED - REVISE & RESUBMIT	
REVIEWERS NAME _____	DATE _____

Indicate the submittal package by sequential numbering and date of submittal. Catalog, product data or brochure submittals containing various products, sizes and materials shall be underscored or highlighted to indicate the salient features required to meet the specifications. Likewise, items not applicable to the Contract shall be marked "not applicable" or crossed out.

If one or more of the items in a submittal are not approved, resubmittal of only the unapproved items is required, highlighted to show the particular item being resubmitted. Resubmittals shall bear original submittal number and be lettered sequentially.

Three copies of all Contractor's drawings will be returned to the Contractor.

Each submittal shall be in accordance with the submission schedule. Allow thirty days for checking and appropriate action by the Engineer.

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CATALOG CUTS AND WORKING DRAWINGS

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Contractor's submittals will be returned, marked with one of the following classifications:

ACCEPTED: no corrections, no marks

ACCEPTED AS NOTED: a few minor corrections. Item shall be installed in accordance with the corrected drawings.

REJECTED - REVISE & RESUBMIT: requires corrections or is otherwise not in accordance with the Contract Documents. No items shall be fabricated. Correct and resubmit drawings as per original submission. Allow thirty days for checking and appropriate action by the Engineer.

MEASUREMENT AND PAYMENT. Catalog cuts, manufacturer's certifications, photometric data and working drawings will not be measured but the cost will be incidental to the pertinent items specified in the Contract Documents.

CATEGORY 800
TRAFFIC

GALVANIZED TRAFFIC SIGNAL PEDESTAL POLES AND
TRANSFORMER BASES

DESCRIPTION. Furnish and install galvanized traffic signal pedestal poles and transformer bases at locations specified in the Contract Document or as directed by the Engineer.

MATERIALS. Design shall meet 2001 edition of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals except as noted. All welding shall conform to American Welding Society (AWS) Structural Welding Code D1.1 - Steel, Tubular Structures.

Determine each pedestal pole's height by the total height of the pedestal pole including the transformer base.

- (a) 10 ft pole height consists of a 103 in. steel shaft with a steel base plate plus a 17 in. transformer base.
- (b) 14 ft pole height consists of a 151 in. steel shaft with a steel base plate plus a 17 in. transformer base.
- (c) 20 ft pole height consists of a 240 in. steel shaft with a steel base plate plus a 17 in. transformer base.

Each pedestal pole furnished shall consist of a design from a steel shaft with a steel base plate, transformer base and all miscellaneous hardware.

- (a) The pedestal pole shaft shall be fabricated of one length and shall have one longitudinal weld, parallel to the long axis of the pedestal pole shaft, with no transverse welds. The longitudinal weld shall be finished to form a smooth outside surface and the wall of the pedestal pole shaft shall be uniform in thickness including the welded area. The pedestal pole shaft shall be round or multi-sided (less than eight sides not acceptable) in cross section. 14 ft units shall be uniformly tapered from butt to tip with a 1 in. reduction in diameter for each 7 ft in length (0.14 in./ ft). 10 ft unit shall not be tapered.
 - (1) 10 ft pedestal pole shaft shall be 4-1/2 in. outside diameter, Schedule 40 pipe, and conform to A 501.
 - (2) All 14 ft pedestal poles shall be 7-1/2 in. outside diameter at the base and shall

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be made of 11 gauge (0.119 in.) thickness steel conforming to A 595, Grade A or equivalent.

- (3) All 20 ft pedestal poles shall be 7-1/2 in. outside diameter at the base and shall be made of 3 gauge (0.25 in.) thickness steel conforming to A 595, Grade A or equivalent
- (b) The base plate material shall meet the requirements of A 709, Grade 36. The base plate shall be secured to the lower end of the pedestal pole shaft by two continuous electric arc welds. The base plate shall telescope the pedestal pole shaft with one weld on the inside of the base plate at the end of the pedestal pole shaft. The remaining weld shall be located on the outside of the base plate at the top of the pedestal pole shaft. The weld connection shall develop the full strength of the adjacent pedestal pole shaft to resist bending action. All bases plate shall be fabricated with the holes for anchor bolts to the size and location dimensions as shown in MD-818.16 and 818.17.
- (c) 14 ft pedestal poles shall be furnished with entrance ways for cable as noted in the contract documents. These holes must be factory drilled and a straight tapped coupling, conforming to Underwriters Laboratory's UL-6 Specification, for 2 in. rigid conduits, must be installed for each hole. A nipple with a unitized hexagonal fitting and integral inside radius on one end must then be installed and fully seated on the interior side of the coupling. Location and installation of the coupling shall be as shown in MD-818.17.
- (d) All pedestal poles and hardware, except materials manufactured from stainless steel or cast aluminum, shall be hot dipped galvanized. The galvanized coating shall conform to the thickness, adherence and quality requirements of A 123 and A 153 for hardware. Threaded components shall be chased and cleaned after galvanizing. All internally threaded components shall be tapped oversize the minimum amount required to permit assembly on the coated externally threaded fastener. Internally threaded components shall be provided with a lubricant which shall be clean and dry to the touch.
- (e) Each pedestal pole shall be furnished with a removable domed cap, fabricated from cast aluminum, circumferentially attached to the side of the pole with three hex head type 304 stainless steel bolts (1/4 in. - 20 UNC).
- (f) Each pedestal pole shall have an identification plate mechanically attached 6 in. above the pedestal pole base plate and oriented so that the identification plate may be read from a ground observation position.
- (g) Recessed hub type, galvanized malleable iron plugs shall be inserted flush into all

couplings.

Transformer Bases

- (a) All transformer bases shall be approved by FHWA as meeting breakaway under NCHRP 350.
- (b) Each transformer base must be furnished with four hex head bolts, four hex head nuts and all associated hardware as shown on the appropriate detail for fastening the pedestal pole base plate to the top of the transformer base. All bolts shall conform to A 325 specifications and must be galvanized.

Anchor Bolts

- (a) Each pedestal pole anchor bolt shall be made of steel conforming to M 314, Grade 55 S1
- (b) Anchor bolt threads shall be of cut thread design with a minimum 6 in. of threads at the top.
- (c) The template and anchor plates shall be as shown on MD801.01.
- (d) The diameter of the anchor bolt shall be stamped into the top of the threaded end of each anchor bolt.
- (e) Each anchor bolt shall be provided with two attached heavy hex nuts and two attached flat washers.
 - (1) Anchor bolt nuts shall conform to A 194, grade 2 or 2H, or A 563, D or DH.
 - (2) All nuts shall be tapped oversize the minimum amount required to permit assembly on the coated externally threaded fastener.
 - (3) Washers shall conform to F 436.
- (f) All nuts, washers, and the top 12 in. of all anchor bolts shall be hot dipped or mechanically galvanized. The galvanized coating shall conform to the thickness, adherence and quality requirements of A 123 or A 153 for hardware.

All high strength bolts (of a given length), nuts (of a given size) and washers (of a given diameter) shall be from the same manufacturing lot per each requisition of materials. The use of foreign made fasteners is prohibited.

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CONSTRUCTION.

Refer to 818.03

MEASUREMENT AND PAYMENT.

Pedestal poles will be measured and paid for at the Contract unit price per each type of pole furnished and installed. The payment will be full compensation for furnishing and installing pedestal poles, breakaway base and all materials , labor, equipment, tools and incidentals necessary to complete work.

Anchor bolts will be measured and paid for as specified in Section 801.

Tag Detail

Mfg: _____ [1] Contract #: _____ [2]
Pole Diameter: _____ [3] Height: _____ [4] Gauge: _____ [5]
Anchor Bolts: _____ [6] Bolt Circle: _____ [7]

Tag Reference

- [1] Name of the manufacturer of the pedestal pole.
- [2] Administration Contract Number of the pedestal pole.
- [3] Pole outside diameter at the base: 4-½ in. O.D. or 7-½ in. O.D.
- [4] Pole height¹: 10ft' , 14ft, 20 ft
- [5] Pole gauge: Schedule 40 or 11 GA
- [6] Anchor bolt size: 1 in. Dia. x 40 in. Length
- [7] Bolt circle diameter: 11 in. Dia.

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¹Pole height includes the height of the pedestal pole and transformer base. Typically, the transformer base is 17 in. in height which corresponds to 10 ft pole having a height of 103 in.; and a 14 ft having a height of 151 in

800 TRAFFIC
LED COUNTDOWN PEDESTRIAN SIGNALS

DESCRIPTION. Furnish and install self-contained LED Pedestrian Countdown Signals, as specified in the Contract Documents or as directed by the Engineer.

MATERIALS. LED Pedestrian Signals and all component parts must meet the latest edition of the National Electrical Manufacturers Association (NEMA) Standards and Underwriters Laboratory (UL), as applicable. In addition, LED Pedestrian Countdown signals must meet the requirements set forth in the most recent, formally-adopted version of the specification titled "Pedestrian Traffic Control Signal Indications (PTCSI) - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules," published by the Institute for Transportation Engineers (ITE). All LED Pedestrian Countdown Signals must be certified by the manufacturer to meet or exceed all requirements of that specification over their entire 5-year warranty period. Serial numbers and model numbers, if available, must be permanently engraved on all removable components and hardware. The serial number and model number must be etched, stamped, molded, or attached using metallic self-adhesive labels. The use of adhesive backed paper labels is not acceptable.

CONSTRUCTION.

LED Countdown Signal Modules.

- (a) LED countdown modules must fit into existing 16-inch traffic signal housings built to PTCSI standards without modification to the housing.
- (b) The LED countdown module must be a single, self-contained device, not requiring on-site assembly for installation into existing traffic signal housing.
- (c) The assembly of the LED countdown module must be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- (d) The signal module must be protected by a ¼ inch thick non-glare UV treated polycarbonate face lens.
- (e) The signal must have 2 individual sets of wires for electrical connections. One set for the hand/man section and another for the countdown section. Each set must be made of three secured, color coded (blue, red, white), 36 inches long, 600V, 16 AWG jacketed wires, rated for service at +105°C.

Environmental

- (a) The LED countdown module must be rated for use in the ambient operating temperature range of -40°C (-40°F) to +74°C (+165°F).
- (b) Completely seal the LED countdown module against dust and moisture intrusion per the requirements of NEMA Standard 250 – 1991 sections 4.7.2.1 and 4.7.3.2 for type 4 enclosures to protect all internal components.

Chromaticity

- (a) The measured chromaticity coordinates for the white walking Person and the Portland Orange Hand and Digits must conform to the chromaticity requirements of section 8.04 and figure 1 of the PTC SI standard.
- (b) The chromaticity measurements must remain unchanged over the input line voltage range of 80 VAC to 135 VAC.

Display

- (a) The LED countdown signal module must consist of a double overlay message combining the symbols of a Hand and walking Person and two “7 segment” digits forming the time display.
- (b) Arrange the Pedestrian icon LEDs to form solid icon symbols. The shape of the symbols must conform to the standard symbols for pedestrian signals.
- (c) Distribute the LED's evenly in each Pedestrian icon. The distance between each LED shall be evenly spaced.
- (d) The Hand/Person symbols must be at least 10" high and 6.5" wide and must incorporate sufficient LED's to assure adequate luminous intensity.
- (e) The countdown digits must be at least 9" high and must be made of 2 rows of at least 144 LED's.
- (f) The Portland Orange LED's must be of the latest AlIn GaP technology and the white LED's of the latest In GaN technology.
- (g) Interconnect the individual LED light sources so that a catastrophic failure of a single LED will result in a total loss of not more than 3 LED's or 5% of the signal light output.

Drive circuitry

- (a) The LED drive current shall be regulated to compensate for line voltage fluctuations over the range of 80VAC to 135 VAC. The luminous output shall not vary more than 1% over the voltage range and shall not be perceptible to the human eye.
- (b) The drive circuitry must include voltage surge protection to withstand high-repetition noise transients and low-repetition high-energy transients as stated in section 2.1.6, NEMA Standard TS-2, 1992.
- (c) The on-board circuitry must meet FCC title 47, Sub-Part B, Section 15 regulations concerning the emission of electronic noise.
- (d) The circuitry shall ensure compatibility and proper triggering and operation of load switches and conflict monitors in signal controllers currently in use by the procuring traffic

SPECIAL PROVISIONS
LED COUNTDOWN PEDESTRIAN SIGNAL MODULES

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- authority.
- (e) The countdown signal shall not be activated by input signals under 80 VAC.
 - (f) The "countdown" portion of the signal must have a high "off state" input impedance to ensure it does not prevent the conflict monitor from detecting an open load failure on the pedestrian signals. The input impedance of the countdown signal shall be such as to produce a load switch leakage voltage above 25 VAC to the conflict monitor for up to 4 units per channel.
 - (g) The countdown signal drive circuitry must not suffer any damage when subjected to defective load switches providing a half wave signal output.
 - (h) Typical power consumption of the countdown display must not exceed 5 watts with a power factor greater than 90%.

Countdown Function.

- (a) The countdown module must be compatible with all types of traffic controllers.
- (b) The countdown timer module must have a micro-processor capable of recording it's own time when connected to a traffic controller.
- (c) When connected, the module must blank out the display during the initial cycle while it records the countdown time using the Walk & D/Walk signal indications.
- (d) The display of the number of remaining seconds shall begin only at the beginning of the pedestrian change interval.
 - (1) After the countdown displays "zero," the display must remain dark until the beginning of the next countdown.
 - (2) The countdown pedestrian signal must display the number of seconds remaining until the termination of the pedestrian change interval.
 - (3) Countdown displays shall not be used during the walk interval, nor during the yellow change interval of a concurrent vehicular phase.
- (d) The countdown timer module shall continuously monitor the traffic controller for any changes to the pedestrian phase time and re-program itself automatically if needed.
- (e) The countdown module shall register the time for the walk and clearance intervals individually and shall begin counting down from the start of the clearance time or the sum of both interval times if selected.

- (f) If the walk interval is pre-empted (emergency vehicle), the countdown module shall skip the remaining walk time and begin the clearance interval countdown to reach 0 at the same time as the flashing hand becomes solid.
- (g) If the clearance interval is pre-empted (train), the countdown module shall skip the remaining clearance time and reach 0 at the same time as the flashing hand becomes solid.
- (h) In the cycle following a pre-emption call, the signal shall display the correct time and not be affected by the reduced previous cycle. The countdown must always reach 0 at the same time as the flashing hand becomes solid.
- (i) When the flashing hand becomes solid, the module will display "0" for one second and then blank-out.
- (j) The countdown timer must be capable of timing 2 consecutive complete pedestrian cycles outputted by the traffic controller (no steady hand signal between cycles).
- (k) The countdown module must have an internal conflict monitor preventing any possible

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LED COUNTDOWN PEDESTRIAN SIGNAL MODULES

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conflicts between the Hand/Person signal indications and the time display. It shall be impossible for the countdown to display any time during a solid hand indication.

- (l) The countdown module shall have accessible dip-switches for the following user selectable options:
 - (1) Display 0 during stand-by.
 - (2) Turn on all LEDs for testing
 - (3) "Coordinated" mode, (displays clearance time only)
 - (4) Disable countdown display.
- (m) The LED module shall have a removable plug on the rear of the unit to allow for easy access to dip switches.
- (n) If the pedestrian change interval is interrupted or shortened as a part of a transition into a preemption sequence, the countdown pedestrian signal display must be discontinued and go dark immediately upon activation of the preemption transition.

Housing. Countdown Pedestrian Signals must be have a single piece cast aluminum case housing, a lens, and a single piece cast aluminum swing down door frame.

(a) The maximum overall dimension of the signal shall be 18.5" W x 18.75" H x 9" D. (470 x 476 x 229 mm), including the visor and hinges. The distance between the mounting surfaces of the upper and the lower openings shall be 15.75" (400 mm).

(b) The case shall be one piece corrosion resistant aluminum alloy die casting, complete with integrally cast top, bottom, sides and back.

(1) Four integrally cast hinge lug pairs, two at the top and two at the bottom of each

case, shall be provided for operation of the swing down door.

(2) When properly mated to other pedestrian signal components and mounting hardware, the case shall provide a dustproof and weatherproof enclosure and shall provide for easy access to and replacement of all components.

(3) The case shall be mounted via upper and lower openings, suitable for either post top or bracket mounting. The openings must accommodate standard 1.5" (39 mm) pipe brackets. The bottom opening of the case must

have

a shurlock boss integrally molded into the case. The dimension of the shurlock

boss shall be:

- (a) Outside diameter 2.625" (667 mm)
- (b) Inside diameter 1.969" (50 mm)
- (c) Number of teeth 72
- (d) Angle of teeth 90°
- (e) Depth of teeth 5/64" (2 mm) inch.

A shurlock boss of the same dimensions shall be an option for the top opening of the case. The radial angular grooves of the shurlock boss, when used with the shurlock fittings, shall provide positive positioning of the entire signal to eliminate rotation or misalignment of the signal.

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LED COUNTDOWN PEDESTRIAN SIGNAL MODULES

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- (c) The door frame shall be a one piece corrosion resistant aluminum alloy die casting, complete with two hinge lugs cast at the bottom and two latch slots cast at the top of each door.
 - (1) The door must be attached to the case by means of two Type 304 stainless steel spring pins.
 - (2) Two stainless steel hinged bolts with captive stainless steel wingnuts and washers must be attached to the case with the use of stainless steel spring pins.
 - (3) Latching or unlatching of the door must require no tools.

Warranty. Manufacturers shall provide a written warranty with the following minimum provisions:

- (a) LED countdown signal modules shall be replaced, repaired or purchase value refunded if the module fails to function as intended due to workmanship or material defects within the first 60 months from the date of delivery.
- (b) LED countdown signal modules which exhibit luminous intensities less than the minimum specified values within the first 60 months of the date of delivery shall be replaced, repaired or purchase value refunded.

Compatibility Testing: The LED Pedestrian Countdown Signal manufacturer shall certify that their equipment meets the Load Switch and Signal Conflict Monitor Compatibility testing requirements found in the most recent, formally-adopted version of the specification titled "Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules," published by the Institute for Transportation Engineers (ITE).

MEASUREMENT AND PAYMENT. LED Pedestrian Countdown Pedestrian Signals will be measured and paid for at the contract unit price each. The payment will be full compensation for furnishing and installing the signals, LED modules, equipment specified, all mounting hardware, labor, and incidentals necessary to complete this work.

CATEGORY 800
TRAFFIC
LED TRAFFIC SIGNAL MODULES

DESCRIPTION. Furnish and install self-contained LED signal head modules to be used in place of the incandescent lamp, reflector, socket, gasket, and lens assembly of standard vehicle signal sections, as specified in the Contract Documents or as directed by the Engineer.

MATERIALS. Manufacturers of Red and Green 8-in. and 12-in. LED traffic signal modules are required to file a statement with the Maryland Energy Administration, certifying that each signal to be sold or offered for sale in Maryland is in compliance with the State's energy efficiency standard. Information on this requirement can be found at the Maryland Energy Administration's website.

The modules shall employ a lens assembly that presents an appearance that is similar to those found on standard incandescent signals.

LED signal heads, and all component parts shall meet the latest edition of the National Electrical Manufacturers Association (NEMA). In addition, LED signals shall meet the requirements set forth in the most recent, formally-adopted version of the specification titled "Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules," published by the Institute for Transportation Engineers (ITE).

- (a) The manufacturer must certify all signals meet or exceed all requirements of that specification over their entire 5-year warranty period.
- (b) Permanently identify serial numbers and model numbers, if available, on all removable components and hardware. The serial number and model number shall be etched, stamped, molded, or attached using metallic self-adhesive labels. The use of adhesive backed paper labels is not acceptable.

CONSTRUCTION. LED modules shall fit in standard, incandescent vehicle traffic signal housings without modifications or the need for special tools, and shall be complete with a one-piece, integral lens assembly that is tinted for the appropriate color.

Design. LED traffic signal modules shall have:

- (a) A printed circuit board inclusive of all of the LEDs and required circuit components.
- (b) Minimum 39- in. wire leads, minimum # 20 AWG, 600 volt, 105 C, with strain relief and spade terminals. Screw-type terminals shall not be allowed.
- (c) A rigid housing for protection in shipping, handling and installation:
- (d) A one piece neoprene gasket shall be used to seal out water and contaminants.

Assembly Techniques.

- (a) The LEDs within the modules shall be mounted and soldered to a printed circuit board.
- (b) LED signal modules shall be watertight when properly installed in traffic signal housings.
- (c) LED signal modules shall utilize the same mounting hardware used to secure a standard incandescent lens and gasket assembly, and shall only require a screwdriver or basic installation tools to complete the mounting.
- (d) LED signal module assemblies shall weigh less than 5 Lb.
- (e) LED signal modules may not protrude into the signal visor area more than two and three-quarters of an in. in depth.
- (f) LED signal modules shall be marked 'TOP' or have an up arrow to designate the proper orientation of the signal module in the traffic signal housing.
- (g) LED signal module housings shall utilize an integral metal layer in their design and construction.
- (h) LED signal modules shall utilize the latest technology in thermal management..

Lenses. Make lenses for ball type modules of ultraviolet stabilized polycarbonate, and incorporate facets that serve to enhance the optical efficiency of the LED traffic signal module. Individual *lens-lets* or external lens facets shall not be permitted.

- (a) The ball type signals shall incorporate a diffuser-type lens system that serves to collimate the light emitted by the LEDs. The lens and diffuser system shall focus the collimated light, to meet ITE intensity and distribution standards.
- (b) LED signals shall almost perfectly approximate the appearance of an incandescent traffic signal to the motorist.
 - (1) The face of the ball LED lamps shall appear to the motorist as uniform in illumination, and have a wide viewing angle that makes it suitable for installation on wide boulevards.
 - (2) The external lens surface for all vehicle signals shall be smooth, with no raised features, so as to minimize the collection of dirt, diesel smoke, and other particulate contaminants, and to facilitate periodic cleaning.
 - (3) The lens shall be keyed to the housing of the LED signal module to insure the proper orientation and to avoid possible rotation during any handling.
 - (4) Hard coat external lenses to prevent an accumulation of dust and dirt.
 - (5) For LED turn arrow signals, the LED arrow lens may be a replaceable part without the need to replace the complete LED arrow.

Optical. The light intensity, chromaticity, and distribution from eight and twelve-in. Red and Green, and eight-in. Yellow LED traffic signal modules shall meet all photometric values stated in the most recent, formally-adopted version of the specification titled "Vehicle Traffic Control Signal heads – Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules," published by the Institute for Transportation Engineers (ITE). Twelve-in. Yellow LED traffic signal modules shall meet the chromaticity requirements of the most recently-adopted ITE specification, with a minimum intensity of 1,500 candelas.

- (a) Red and Green LED signals shall be certified by the manufacturer to meet or exceed all requirements of that specification over their entire 5-year warranty period.
- (b) The light output from twelve-in. Yellow LED signals shall be the peak instantaneous intensity, measured at instant-on and at the highest intensity point.

Design.

- (a) The LEDs shall be connected in series-parallel strings.
 - (1) No more than 1 percent of the total luminosity of the entire signal module may be lost in the event of a single string failure.
 - (2) The failure of a single LED shall cause loss of light from only that LED.
 - (3) No loss of light output from the complete module assembly shall occur as a result of a single LED failure.
- (b) The control circuitry shall prevent the current flow through the LEDs in the off state to avoid any false indication as may be perceived by the human eye, during daylight and evening hours.
 - (1) The LED traffic signal module shall be operationally compatible with NEMA TS – 1 and NEMA TS – 2 conflict monitoring parameters.
 - (2) The intensity of the LED signal module shall not vary by more than 10percent over the allowable voltage range as specified in the electrical section below.

Electrical.

- (a) The Power factor shall be 0.90 or greater, at nominal rated voltage, at 25°C, after 60 minutes of operation.
- (b) Total harmonic distortion (THD) shall be less than 20 percent at rated voltage, at 25°C.
- ©All LED traffic signal modules shall be in compliance with FCC noise regulations and must meet the FCC Title 47, SubPart B Section 15 regulation.
- (d) The LED junction technology used in all signal modules shall not exhibit degradation of more than 30percent of the modules' initial light intensity following accelerated life testing (operating at 85 degrees C and 85percent humidity, for 1000 hours). Under no circumstances shall AlGaAs technology be acceptable.
- (e) The LED signal modules shall be connected directly to line voltage, 120 Volts AC nominal, and shall be able to operate over the voltage range of 80 VAC to 135 VAC.

- (f) Red and Green LED traffic signal modules shall consume no more than a nominal 15 watts for either the 8" or 12" signal. Yellow signal modules shall consume no more than 24 watts.
- (g) Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.
- (h) Low Voltage Turn OFF: There shall be no visible illumination from the LED signal module when the applied voltage is less than 50 VAC.
- (i) Turn-ON and Turn-OFF Time: A module shall reach 90percent of full illumination (turn-ON) within 75 msec of the application of the nominal operating voltage. The signal shall cease emitting visible illumination (turn-OFF) within 75 msec of the removal of the nominal operating voltage.

Compatibility Testing: The LED module manufacturer shall certify that their modules meet the Load Switch and Signal Conflict Monitor Compatibility testing requirements found in the most recent, formally-adopted version of the specification titled "Vehicle Traffic Control Signal heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules," published by the Institute for Transportation Engineers (ITE).

Electronic Failure Protection. To assure compatibility with NEMA TS1/TS2 controllers for both conflict monitoring and Red Fail, all signal colors (Red, Yellow, and Green) once energized, must turn off prior to 50VAC, and if the signal fails it shall present a high impedance on the input side of the signal.

Warranty. Manufacturers shall provide a written with the following minimum provisions:

- (a) Modules shall be replaced, repaired or purchase value refunded if the module fails to function as intended due to workmanship or material defects within the first 60 months from the date of delivery.
- (b) Modules which exhibit luminous intensities less than the minimum specified values within the first 60 months of the date of delivery shall be replaced, repaired or purchase value refunded.

SPECIAL PROVISIONS
800 LED TRAFFIC SIGNAL MODULE

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Miscellaneous. The manufacturers part number, date code, and electrical characteristics of the LED signal module shall be visible on the rear of the assembly.

MEASUREMENT AND PAYMENT. Self-contained LED signal head modules will be measured and paid for at the contract unit price each. The payment will be full compensation for the LED module, hardware, assembly, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

CATEGORY 800
TRAFFIC

MAST ARMS AND MAST ARM POLES -
SINGLE, TWIN AND TRIPLE

DESCRIPTION. Furnish and install galvanized traffic signal mast arms and mast arm poles at locations specified in the Contract Document or as directed by the Engineer.

MATERIALS. Design shall meet the 2001 edition of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals except as noted. All welding shall conform to American Welding Society (AWS) Structural Welding Code D1.1 - Steel, Tubular Structures.

Each mast arm(s) and mast arm pole structure furnished shall consist of a design from a steel pole shaft with a steel base plate and flange plate, steel mast arm shaft(s) with steel flange plate(s), four flange bolts per mast arm, four anchor bolts and miscellaneous hardware.

- (a) Manufacture the mast arms and mast arm poles from steel tubing conforming to A 595 Grade A or equal. Each mast arm and mast arm pole shall be fabricated of one length and shall have one longitudinal weld, parallel to the long axis of the mast arm or mast arm pole, with no transverse welds. Finish the longitudinal weld to form a smooth outside surface and the wall of the mast arms and mast arm poles shall be of uniform thickness including the welded area. The mast arms and mast arm poles shall be round or multi-sided (8 sides or more) in cross section and be uniformly tapered from butt to tip with a 1 in. reduction in diameter for each 7 ft in length (0.14 in./ ft). Mast arms shall be of two piece design for all mast arms 50 ft and 60 ft in length. Mast arms shall be of three piece design for all mast arms 70 ft in length. Any combination of two piece of 50 ft and 60 ft arms of the same butt diameter shall fit together and any combination of two or three piece of 60 ft and 70 ft mast arms in sequence shall fit together. The bolted splice for two or three piece mast arms shall be as specified in the Contract Document.
- (1) 50 ft mast arms shall have a butt section 30 ft in length.
 - (2) 60 ft and 70 ft mast arms shall have a butt section of 35 ft in length.
 - (3) 38 ft single piece mast arms shall be 9 in. outside diameter at the flange plate and made of 7 gauge (0.179 in.) thickness steel.

SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES

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- (4) 50 ft two piece mast arm butt sections shall be 10 in. outside diameter at the flange plate and made of 3 gauge (0.250 in.) thickness steel.
 - (5) 60 ft two piece and 70 ft three piece mast arm butt sections shall be 12.5 in. outside diameter at the flange plate and made of 3 gauge (0.250 in.) thickness steel.
 - (6) All extension sections of two and three piece mast arms shall be made of 7 gauge (0.179 in.) thickness steel.
 - (7) Single 27 ft mast arm pole designed with a 38 ft mast arm length shall be 12 in. outside diameter at the base plate and made of 7 gauge (0.179 in.) thickness steel.
 - (8) Single 27 ft mast arm pole designed with a 50 ft mast arm length shall be 13 in. outside diameter at the base plate and made of 3 gauge (0.250 in.) thickness steel.
 - (9) Single 27 ft mast arm pole designed with 60 ft or 70 ft mast arm lengths shall be 15 in. outside diameter at the base plate and made of zero gauge (0.312 in.) thickness steel.
 - (10) Twin 27 ft mast arm poles designed with 50 ft mast arm lengths shall be 13 in. outside diameter at the base plate base and made of 3 gauge (0.250 in.) thickness steel.
 - (11) Twin 27 ft mast arm poles designed with mast arm lengths for one mast arm of 50 ft and the remaining mast arm of 60 ft or 70 ft shall be 15 in. outside diameter at the base plate and made of zero gauge (0.312 in.) thickness steel.
 - (12) Triple 27 ft mast arm pole designed with mast arm lengths for one mast arm of 38 ft, second mast arm of 60 or 70 ft and the third mast arm of 50 ft shall have 15 in. outside diameter at the base plate and made of zero gauge (0.312 in.) thickness steel.
- (b) The material for mast arm pole base plate shall conform to A 709, Grade 36 and shall be of sufficient size and strength. Secure the base plate to the lower end of the mast arm pole by two continuous electric arc welds. The base plate must telescope the mast arm pole with one weld on the inside of the base plate at the end of the mast arm pole shaft. Locate the remaining weld on the outside of the base plate, around the circumference of the mast arm pole. The weld connection shall develop the full strength of the adjacent mast arm pole shaft to resist bending action. Fabricate all base plates with the holes for anchor bolts to the size and location dimensions as shown on the appropriate detail.

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MAST ARMS AND MAST ARM POLES

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- (c) All mast arms and mast arm poles must be furnished with flange plate(s) as noted in the details. Connect these attachments, including the bolts, in such a manner as to develop the minimum guaranteed yield and ultimate tensile strength for the mast arm and mast arm pole. This assembly shall be capable of transferring the maximum moment being carried by the mast arm without distortion or rotation of the mast arm or the attachment. Connect flange plate(s) by the use of 4 bolts. The size of the plates and bolts shall be as shown in the details. Furnish four (1-1/2 in. O.D.) rubber grommets for each mast arm to accommodate signal heads wiring access.
- (d) Secure the mast arm flange plate to the lower end of the mast arm pole by two continuous electric arc welds. The mast arm flange plate shall telescope the mast arm with one weld located on the inside of the flange plate at the end of the mast arm. Locate the remaining weld on the outside surface of the flange plate around the circumference of the mast arm pole. The weld connections shall develop the full strength of the adjacent mast arm to resist bending action.
- (e) Mast arm flange plates and mast arm pole flange plates surfaces shall be plane to within 1/16 in. and shall be free of any buildup of galvanizing (drips, runs, etc.) which would prevent intimate contact between the connecting surfaces.
- (f) Weld access hole frames into the mast arm pole as detailed in MD 818.11. A galvanized steel cover, conforming to A 709, Grade 36 shall cover the access hole frame. Secure the access hole cover's top to the access hole frame by a hinge fabricated from 0.063 in. stainless steel using a 0.120 in. diameter stainless steel hinge pin. Secure the hinge to the access hole frame with 2 (1/4 in. - 20 UNC) hex head stainless steel bolts. Secure the hinge access hole cover by 2 (1/4 in. - 20 UNC) hex head stainless steel bolts and lock nuts. Provide a slotted opening at the bottom of the access hole cover to allow for attachment of a furnished (1/4 in. - 20 UNC) hex head stainless steel bolt into the access hole frame face.
- (g) A 3/8 in. diameter X 1 in. stud copper servit post for two #6 AWG stranded wire shall be furnished into the bottom of the access hole frame.
- (h) Provide mast arm poles with entrance ways for cable as noted on the appropriate detail. These holes shall be factory drilled and a straight tapped coupling, conforming to Underwriters Laboratory's UL-6 Specification, for 3 in. rigid conduits, shall be installed for each hole. A nipple with a unitized hexagonal fitting and integral inside radius on one end shall then be installed and fully seated on the interior side of the coupling. Location and installation of the coupling shall be as shown in the details.

SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES

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- (i) Install "J" hooks as follows, located 1 ft above the highest mast arm T dimension.
 - (1) Weld a single "J" hook inside the pole for single mast arm poles.
 - (2) Weld two "J" hooks inside the pole for twin mast arm poles and triple mast arm poles.
- (j) Hot dip galvanize all mast arms, mast arm poles, access hole frames and hardware, except materials manufactured from stainless steel or cast aluminum. The galvanized coating shall conform to the thickness, adherence and quality requirements of A 123 or A 153 for hardware. Chase and clean threaded components after galvanizing. Tap all internally threaded components the minimum amount required to permit assembly on the coated externally threaded fastener. Provide internally threaded components with a lubricant which shall be clean and dry to the touch.
- (k) Furnish each mast arm pole with four removable ornamental anchor bolt covers made of cast aluminum. Bolt holes for attaching the bolt covers to the base plate shall be drilled at the location obtained by following the diagonal line of the base plate until it intersects the bolt circle diameter, then proceeding tangentially from the bolt circle diameter a distance equal to the Anchor Bolt Center to Bolt Slot Center Distance as provided in the MD 818.14. Attachment to the base shall be made using hex head stainless steel bolts (1/4 in.- 20 UNC).
- (l) Furnish each mast arm extension section and mast arm pole with a removable domed cap, fabricated from cast aluminum, circumferentially attached to the outside of the pole shaft or mast arm end with 3 hex head stainless steel bolts (1/4 in.- 20 UNC). All mast arm caps shall have inside diameter one in. Larger than the outside diameter of mast arm end.
- (m) Each mast arm and mast arm pole shall have an identification plate mechanically attached, oriented such that the identification plate may be read from a ground observation position.
 - (1) Single piece mast arms and the butt section of two and three piece mast arms shall have the identification plate attached 6 in. above the flange plate.
 - (2) Each extension section of two and three piece mast arms shall have the identification plate attached 6 in. from the larger diameter end.
 - (3) Poles shall have the identification plate attached 6 in. above the bottom flange plate.
- (n) Insert recessed hub type, galvanized malleable iron plugs flush into all mast arm pole couplings.

SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES

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Anchor Bolts.

- (a) Make each mast arm pole anchor bolt of steel in accordance with F1554, Grade 55 S1.
- (b) Anchor bolt threads shall be of cut thread design with a minimum 9 in. of threads at the top and bottom.
- (c) The template and anchor plates shall be as shown the contract documents.
- (d) Stamp the diameter of the anchor bolt into the top of the threaded end of each anchor bolt.
- (e) Provide each anchor bolt with two anchor bolt nuts and two flat washers.
 - (1) Anchor bolt nuts shall conform to A 194 grade 2 or 2H or A 563 D or DH.
 - (2) Tap all nuts oversize the minimum amount required to permit assembly on the coated externally threaded fastener.
 - (3) Washers shall conform to F436.
- (f) Hot dip or mechanically galvanize all nuts, washers and the top 12 in. of all anchor bolts. The galvanized coating shall conform to the thickness, adherence and quality requirements of A 123 or A 153 for hardware.

All high strength bolts (of a given length), nuts (of a given size) and washers (of a given diameter) shall be from the same manufacturing lot per each requisition of materials. The use of foreign made fasteners is prohibited!

Alternate Design. Alternate mast arm and mast arm pole designs will be considered provided the following qualifications are observed:

- (a) Alternate mast arm designs may use sectional construction provided each section has a minimum length of 30 ft except for the outer most section.
- (b) Overlap between sections shall be a minimum 18 in.
- (c) Bolt circle diameters shall be as specified in the Contract Document.
- (d) Alternate post designs may be straight (not tapered) sections and shall have a base diameter equal to, or no greater than 1 in. more than, those values shown on the typicals.

SPECIAL PROVISIONS

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MAST ARMS AND MAST ARM POLES

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- (e) All alternate design must be structurally equivalent to the original design and as approved by the Engineer.

CONSTRUCTION

Refer to 818.03

MEASUREMENT AND PAYMENT

MEASUREMENT AND PAYMENT. Furnish and install poles for mast arm(s) and mast arm(s) will be measured and paid for at the contract unit price per each type of pole and mast arm(s) size as specified in the Contract Document. The payment will be full compensation for furnishing & installing all materials including labor, equipment, materials, tools and incidentals necessary to complete the work.

Anchor bolts will be measured and paid for as specified in section 801.

**SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES**

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Tag Details

Single Mast Arm Pole

Mfg:	<u> [1] </u>	Contract. #:	<u> [2] </u>
Pole Height:	<u> [3] </u>		
Arm Sizes:	<u> [4] </u>		
Anchor Bolts:	<u> [5] </u>	Bolt Circle:	<u> [8] </u>
Flange Bolts:	<u> [7] </u>		

One Piece Mast Arm

Mfg:	<u> [1] </u>	Contract #:	<u> [2] </u>
Arm Length:	<u> [6] </u>		
Flange Bolts:	<u> [7] </u>		

Two or three Piece Mast Arm - Butt Section

Mfg:	<u> [1] </u>	Contract #:	<u> [2] </u>
Butt For Arms:	<u> [4] </u>		
Flange Bolts:	<u> [7] </u>		
Connection Bolt:	<u> [9] </u>		

SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES

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**Two or three Piece Mast Arm –
Extension Section**

Mfg:	<u> 11 </u>	Contract #:	<u> 121 </u>
Extension Arm:	<u> 161 </u>		
Connection Bolt:	<u> 191 </u>		

**Twin Mast Arm Pole
(Identical Size Flange Plates)**

Mfg:	<u> 11 </u>	Contract #:	<u> 121 </u>
Pole Height:	<u> 131 </u>		
Arm Sizes:	<u> 141 </u>		
Anchor Bolts:	<u> 151 </u>	Bolt Circle:	<u> 181 </u>
Flange Bolts:	<u> 171 </u>		

**SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES**

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**Twin Mast Arm Pole
(Different Size Flange Plates)**

Mfg:	<u> 11 </u>	Contract #:	<u> 121 </u>
Pole Height:	<u> 131 </u>		
Left Arm Sizes:	<u> 141 </u>		
Right Arm Sizes:	<u> 141 </u>		
Anchor Bolts:	<u> 151 </u>	Bolt Circle:	<u> 181 </u>
Left Arm Flange Bolts:	<u> 171 </u>		
Right Arm Flange Bolts:	<u> 171 </u>		
Pole Type	<u> 1101 </u>		

SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES

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Triple Mast Arm Pole
(Different Size Flange Plates)

Mfg:	<u>[1]</u>	Contract #:	<u>[2]</u>
Pole Height:	<u>[3]</u>		
Left Arm Sizes:	<u>[4]</u>		
Center Arm Sizes:	<u>[4]</u>		
Right Arm Sizes:	<u>[4]</u>		
Anchor Bolts:	<u>[5]</u>	Bolt Circle:	<u>[8]</u>
Left Arm Flange Bolts:	<u>[7]</u>		
Center Arm Flange Bolts:	<u>[7]</u>		
Right Arm Flange Bolts:	<u>[7]</u>		

Tag Reference

- [1] Name of the manufacturer of the mast arm or mast arm pole.
- [2] Administration Contract Number of the mast arm or mast arm pole.
- [3] 27 ft height.

SPECIAL PROVISIONS
MAST ARMS AND MAST ARM POLES

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[4] Mast Arm Size and Orientation¹

<u>Pole Gauge Size</u>	<u>Indicate</u>
7 GA	38'
3 GA	50'
0 GA	60' or 70'

[5] Anchor Bolts

<u>Pole Gauge Size</u>	<u>Indicate</u>
7 GA	1-1/2" x 54" & 2 Washers
3 GA	1-3/4" x 66" & 2 washers
0 GA	2" x 72" & 2 washers

[6] Mast Arm Length

<u>Constructed Extension for arm length</u>	<u>Indicate</u>
50'	50'
60'	60'-70'
70'	70'

[7] Flange Bolt Size²

<u>Pole Gauge Size</u>	<u>Indicate</u>
7 GA	1-1/4" x 4" & washer
3 GA	1-1/2" x 5" & washer

¹For twin mast arm poles with identical size flange plates, indicate **L & R** preceding the 50' mast arm size; for twin mast arm poles with different size flange plates, indicate either 50' or 60'-70' mast arm sizes in the corresponding Left Arm Size or Right Arm Size as oriented by the line bisecting the acute angle formed by the two mast arm pole flange plates. For triple mast arm poles with different size flange plates, indicate either 50', 60'-70' or 38' mast arm sizes in the corresponding Left Arm Size, Center Arm Size or Right Arm Size as oriented by the centerline of the mast arm pole center flange plate.

²For twin mast arm poles with identical size flange plates, indicate **L & R** preceding the 1-1/2" x 5" & washer Flange Bolt Size; for twin mast arm poles with different size flange plates, indicate either 1-1/2" x 5" & washer or 1-1/4" x 6-1/2" & 2 flat washers & lock washer flange bolt sizes in the corresponding Left Flange Bolt Size or Right Flange Bolt Size as oriented by the line bisecting the acute angle formed by the two mast arm pole flange plates. For triple mast arm poles with different size flange plates, indicate either 1-1/2" x 5" & washer, 1-1/4" x 6-1/2" & 2 flat washers & lock washer or 1-1/4" x 4" & washer flange bolt sizes in the corresponding Left Flange Bolt Size, Center Flange Bolt Size or Right Flange Bolt size as oriented by the centerline of the mast arm pole center flange plate.

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MAST ARMS AND MAST ARM POLES

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0 GA 1-1/4" x 6-1/2" & 2 flat washers & lock washer

[8] Bolt Circle

<u>Pole Gauge Size</u>	<u>Indicate</u>
7 GA	16" Dia.
3 GA	18" Dia.
0 GA	22" Dia.

[9] Connection Bolt Size

<u>Two or three Piece Arm Size</u>	<u>Indicate³</u>
50'	5/8" x Var.
60'	5/8" x Var.
70'	5/8" x Var.

[10] Standard or Alternate Twin.

³Length to be determined by the successful bidder.

SPECIAL PROVISIONS

CONTRACT NO. T-1164-0140

800 SIGNAL EQUIPMENT TURN ON, PICK UP, REMOVAL AND MAINTENANCE

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**CATEGORY 800
TRAFFIC**

**SIGNAL EQUIPMENT TURN ON, PICK UP,
REMOVAL AND MAINTENANCE**

DESCRIPTION. Pick up of Administration furnished materials, remove existing equipment, and maintain existing equipment as specified in the Contract Documents or as directed by the Engineer.

MATERIALS. Not applicable

CONSTRUCTION.

Equipment Turn On. Notify the Engineer and Traffic Operations Division representatives within 10 working days prior to completion of the project to allow the Administration to install any additional traffic control device.

Notify the Engineer and Traffic Operations Division representative five working days prior to the completion of the project to schedule a final inspection and turn-on.

Stakeout, with the Engineer present, the proposed construction as indicated on the plan.

Pick-Up of Administration Furnished Materials. Notify the appropriate OOTS warehouse a minimum of 72 hours in advance of the anticipated pick up or delivery of materials. The OOTS signal and sign warehouses are located at:

7491 Connelley Drive
Hanover, Maryland 21076
Signal Phone 410-787-7667
Sign Phone 410-787-7670

The Contractor shall be responsible for the transportation, labor, equipment, tools and incidentals necessary to obtain and load any Administration furnished materials.

Materials not furnished by the Administration shall be furnished by the Contractor.

Removal and Disposal of Existing Material and Equipment. Remove concrete foundations specified in 207.03.01. All holes caused by this removal shall be backfilled, compacted and restored to surrounding conditions.

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800 SIGNAL EQUIPMENT TURN ON, PICK UP, REMOVAL AND MAINTENANCE

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Remove all existing hard rubber detectors and handholes not shown on the Plans. The holes shall be backfilled, compacted and restored to surrounding conditions. The sidewalk where handholes are removed shall be reconstructed to the nearest tooled joint or expansion joint. The roadway where hard rubber detectors are removed shall be reconstructed in conformance with Administration utility patch repair standards.

Disconnect existing inductive loop detectors and magnetic detectors not shown on the plans.

Disposal of all material not salvaged. Non-galvanized green painted structures may contain lead and the contractor will be responsible for proper disposal of such material.

Storage of Materials. Materials shall be bundled, stored, and protected in conformance with the manufacturer's recommendations or as approved by the Engineer.

Maintenance of Materials and Equipment. The maintaining agency will continue maintenance of any existing signals until the Contractor places new equipment into operation.

When the work requires adjustments to the traffic control devices to maintain the minimum Administration standards, the adjustments to the traffic control devices shall be made within 4 hours of verbal notification by the Engineer. Failure to comply with this time period will result in the Administration performing adjustment and deducting the cost of the adjustment from the Contractor's payment.

Existing signals shall remain in their original condition until the new signals have been completed, satisfactorily tested and its operation accepted by the Engineer.

Maintain the continuous operation of all vehicular and pedestrian detectors. If any detector is damaged by the Contractor, it shall be repaired within 72 hours after notification by the Engineer.

All traffic signals and existing interconnect cable shall be operational and actuated as specified in the Contract Documents.

Plan the work to minimize interference with any existing traffic control device.

MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work for one or more of the items specified in the Contract Documents.

Equipment Turn On. Equipment Turn On will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

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800 SIGNAL EQUIPMENT TURN ON, PICK UP, REMOVAL AND MAINTENANCE

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Pick-Up of Administration Furnished Materials. Pick-up of Administration furnished materials will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

Removal and Disposal of Existing Signal Material and Equipment. Removal and disposal of existing signal material and equipment will be measured and paid for at the Contract unit lump sum price.

Maintenance of Existing Signal Equipment. Materials storage, cable sealing and handling, adjustments to maintain minimum Administration standards on existing signals made necessary by new signal or geometric modifications and Contractor repair of any damaged detector caused as a result of Contractor's error will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

CATEGORY 800**TRAFFIC****IP-BASED VIDEO TRAFFIC DETECTION CAMERAS**

DESCRIPTION. Furnish and install self-contained detection cameras that monitor vehicles on a roadway via the machine vision processing of color video images, and provide outputs to a traffic controller or similar device, as well as streaming MPEG-4 video over a common Ethernet connection, as specified in the Contract Documents or as directed by the Engineer.

MATERIALS. Video traffic detection cameras, cabinets, and all component parts shall meet the latest edition of the National Electrical Manufacturers Association (NEMA) Standards and Underwriters Laboratory (UL), as applicable. All camera components shall be ISO 9002 and CE certified. The advertising date of this Contract shall be used to determine the date of the applicable standards.

Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware. The serial number and model number shall be etched, stamped, or molded. The use of adhesive backed labels is not acceptable.

CONSTRUCTION. Video detection cameras shall consist of an IP-based video camera and a 3-conductor power cable that carries both power to the camera, and video and data signals back to Administration-installed video processing equipment in the controller cabinet. The cabinet equipment permits direct connection to the signal controller via an 10/100 Ethernet connection and the industry-standard TCP/IP communications protocol, or to contact-closure hardwired devices.

Features.

- (a) Built-in IP-based addressing with a unique Ethernet MAC address. No plug-in devices or cards shall be necessary.
- (b) Web-server interface and network connection via standard CAT-5 cable
- (c) Easy locking connector that allows technicians/installers to pull power cable either up or down a pole without splicing.
- (d) Zoom configuration is conducted at the cabinet.
- (e) MPEG-4 streaming video via any standard digital video player, with viewing rates of 5 fps to 30 fps, depending on bandwidth.
- (f) An access point in the cabinet that provides standard NTSC or PAL full-motion video output to an analog video monitor.
- (g) Internet browser interface with common Internet browsers for password-protected access over the internet. The embedded web server capability shall enable access to streaming video, configuration editing, and camera monitoring via the Internet.

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800 - IP-BASED VIDEO TRAFFIC DETECTION CAMERAS

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- (h) Dual core processor with DSP image processing and ARM general-purpose processing.
- (i) Direct real-time iris and shutter speed control.
- (j) Non-volatile memory data storage

Camera Hardware. Hardware supplied shall consist of a color video image processing camera, and a 3-wire control & data transfer cable for signal control and streaming MPEG-4 video image transfer.

Machine Vision Processor (MVP). The MVP camera shall be an integrated imaging color CCD array with zoom lens optics, high speed, dual-core image processing hardware bundled into a sealed enclosure.

- (a) The CCD array shall be directly controlled by a dual-core processor, thus providing high-quality video for detection that has virtually no noise to degrade detection performance.
- (b) It shall be possible to zoom the lens as required for setup and operation.
- (c) The MVP shall provide JPEG video compression as well as standard MPEG-4 digital streaming video with flashing detector overlay.
- (d) The MVP shall provide direct real-time iris and shutter speed control.
- (e) The MVP camera shall be equipped with an integrated 22x zoom lens that can be changed using either configuration computer software.
- (f) The digital streaming video output and all data communications shall be transmitted over the three-wire power cable.
- (g) The MVP camera shall operate on 120/220 VAC, 50/60 Hz, with a maximum wattage of 25 watts.
 - (1) The camera and processor electronics shall consume 10 watts.
 - (2) The enclosure heater shall consume 15 watts.

MVP Lens.

- (a) Low-power thermostatically-controlled ITO faceplate
- (b) Built-in heater
- (c) Hydrophilic faceplate coating to shed water
- (d) Weatherproof rear connector (IDC rapid termination industrial connector)
- (e) The lens shall be available in a standard configuration or wide-angle.
- (f) The focal length shall be 4.1mm to 87.8mm.

Detection Zone Programming. Placement of detection zones shall be by means of a portable or desktop computer using the Windows XP, or Vista operating system, a keyboard, and a mouse.

- (a) The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.
- (b) The mouse and keyboard shall be used to draw detection zones on the PC monitor. It shall be possible to:
 - (1) Download detector configurations from the PC to the MVP camera and cabinet

interface module.

- (2) Retrieve the detector configuration that is currently running in the MVP camera.
 - (3) Back up detector configurations by saving them to the PC fixed disks or other removable media storage.
- (c) The supervisor's mouse and keyboard shall be able to:
- (1) Edit previously defined detector configurations.
 - (2) Adjust the detection zone size and placement.
 - (3) Add detectors for additional traffic applications.
 - (4) Reprogram the camera for different traffic applications, changes in installation site geometry, or traffic rerouting.
 - (5) Perform the above upload, store, and retrieve functions for video snapshots of the MVP cameras' view.

Optimal Detection. The video detection camera shall provide optimal detection of vehicle passage and presence when the:

- (a) The MVP camera is mounted 10 m (30 ft) or higher above the roadway.
- (b) The image camera is adjacent to the desired coverage area.
- (c) The distance to the farthest detection zone locations is not greater than 10 times the mounting height of the MVP camera.
- (d) The deployment geometry provides an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the MVP camera is mounted directly above the traveled lanes, the MVP camera shall not be required to be directly over the roadway.
- (e) The MVP camera is able to view either approaching or receding traffic or both in the same field of view. The preferred image camera orientation for optimal detection shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear.
- (g) The MVP camera, when placed at a mounting height that minimizes vehicle image occlusion and equipped with a lens to match the width of the road, is able to monitor a maximum of 7 traffic lanes when mounted at the roadside, or up to 8 lanes when mounted in the center with four lanes on each side.

18-Gauge Camera-to-Cabinet Cable. The cable between the MVP and the cabinet interface shall consist of three conductors 18 AWG, with an overall UV-resistant Low Density Polyethylene jacket.

(a) Conductors.

- (1) Three, 18 AWG, 19 strands of 30 gauge tin-plated copper conductor diameter .046"/.052"
- (2) Extruded polyethylene 200 conductor insulation, with nominal .030" wall Thickness.
- (3) Black, green, and white colors

(b) Construction

- (1) Extruded black polyethylene jacket .040"/.050" wall thickness, UV-resistant.
- (2) 0 .330" - .354" maximum outside diameter.
- (3) 600 volt (rms) rated.
- (4) The cable shall be imprinted with the manufacturer's part number, number of conductors, conductor size, voltage rating, jacket material, and an indication that it is conduit rated.

Count Detection Performance. Using a MVP camera installed within the optimal viewing specifications described above for count station traffic applications; the camera shall be able to accurately count vehicles with:

- (a) At least 98 Percent accuracy under normal operating conditions (day and night).
- (b) At least 93% accuracy under artifact conditions. Artifact conditions are combinations of weather and lighting conditions that result from shadows, fog, rain, snow, etc. The volume count shall be:
 - (1) Accumulated for the entire roadway (all traveled lanes).
 - (2) Accumulated over time intervals that contain a minimum of one hundred (100) vehicles to ensure statistical significance.

Demand Presence Detection Performance. Using a MVP camera installed within the optimal viewing specifications described above for intersection control traffic applications; the camera shall be able to accurately provide demand presence detection.

- (a) The demand presence accuracy shall be based on the ability to enable a protected turning movement on an intersection stop line, when a demand exists.
- (b) The probability of not detecting a vehicle for demand presence shall be less than 1- Percent error under all operating conditions.
- (c) In the presence of artifact conditions, the MVP camera shall minimize extraneous (false) protected movement calls to less than 7 %.

- (d) To ensure statistical significance, the demand presence accuracy and error shall be calculated over time intervals that contain a minimum of one 100 protected turning movements performance specifications shall be achieved with a minimum of 2 presence detectors coupled with a single detector function (Type-9) to provide adequate road coverage to sample the random arrival patterns of vehicles at the stop line.
- (e) The calculation of the demand presence error shall not include turning movements where vehicles do not pass through the presence detectors, or where they stop short or stop beyond the combined detection zones.

Speed Detection Performance. The MVP shall accurately measure average (arithmetic mean) speed of multiple vehicles with more than 97% accuracy under all operating conditions for approaching and receding traffic.

- (a) The average speed measurement will include a minimum of 100 vehicles in the sample to ensure statistical significance.
- (b) Optimal speed detection performance requires that camera location conform to the specifications described above for count station traffic applications with the exception that the camera must be higher than 13 m (40) feet.
- (c) The MVP will accurately measure individual vehicle speeds with more than 94% accuracy under all operating conditions for vehicles approaching the camera (viewing the front end of vehicles), and more than 90% accuracy for vehicles receding from the camera (viewing the rear end of vehicles).
- (d) These specifications will apply to vehicles that travel through both the count and Speed Detector pair and will not include partial detection situations created by lane-changing maneuvers.
- (e) To ensure statistical significance, the average speed accuracy and error will be calculated over time intervals that contain a minimum of one hundred vehicles.

Modular Cabinet Interface Unit (Access Point). The modular cabinet interface unit shall be furnished and installed by the ADMINISTRATION. This section is for reference only.

The modular cabinet interface unit shall communicate directly with up to eight (8) MVP cameras and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C or D detector rack providing up to thirty-two (32) inputs and sixty-four (64) outputs or a 170 input file rack providing up to sixteen (16) contact closure inputs and twenty-four (24) contact closure outputs to a traffic signal controller.

- (a) Additional Features.
 - (1) Easy IP-addressable Ethernet connectivity using RJ-45 connectors.
 - (2) USB 2.0 connector for a USB mouse.

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- (3) Provides PAL or NTSC analog video output for MPEG-4 streaming digital video.
- (4) Detector rack or shelf mount installation
- (5) 1500 volts RMS isolation between rack logic ground and street wiring.
- (6) Emulates the function of up to 4 TS2 Bus Interface Units (BIU)
- (7) Self diagnostics on power-up
- (8) High-energy transient protection
- (b) Power: 12 to 24 VDC, 11W maximum
- (c) Environmental
 - (1) Temperature: -34° C to +74° C (-29° F to +165° F)
 - (2) Relative Humidity: 0 to 95 Percent
- (d) Dimensions and Weight
 - (1) 114 mm H x 59 mm W x 175 mm L
(4.5 in H x 2.34 in W x 6.9 in L)
 - (2) Weight: 0.5 lb.
- (e) Complies with: CE EN 55022, EN 61000-6-1
FCC Part 15, Class A

Communications Interface Panel. The communications interface panel shall be furnished and installed by the ADMINISTRATION. This section is for reference only. The communications interface panel shall have the following features:

- (a) Four (4) sets of three (3) electrical terminations for three-wire cables for powering up to eight (8) MVP cameras.
- (b) High-energy transient protection to electrically protect the modular cabinet Interface unit and connected MVP cameras.
- (c) Single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the MVP cameras.
- (d) Predefined wire termination blocks for MVP power connections.
- (e) A Broadband-Over-Power-Line (BPL) transceiver that supports up to 10 MB/s inter-device communications.
- (f) An Interface connector to cable directly to the modular cabinet interface unit.
- (g) The option of using either 110/220 VAC 50/60 Hz power.
- (h) Fuse protection using SLO-BLO, ½ amp fuses.

Installation and Training. The supplier of the video detection camera shall supervise the installation and testing of the video detection camera and any optional computer equipment.

Warranty, Maintenance and Support . The video detection camera shall be warranted by its supplier for a minimum of two (2) years.

Documentation. The equipment supplier shall deliver a CD containing operating manuals, service manuals, and maintenance instructions for the video traffic detection camera being

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supplied to the Administration's Office of Traffic & Safety, Signal Operations Division, located at 7491 Connelley Drive, Hanover, Maryland 21076. The phone number is 410-787-7650.

MEASUREMENT AND PAYMENT. Video traffic detection cameras will be measured and paid for at the contract unit price per each. The payment will be full compensation for furnishing and installing the video traffic detection camera, equipment specified, all mounting hardware, including camera support to structure, 3-conductor cable from the camera to the controller cabinet, labor, and all incidentals necessary to complete this work.

NOTE: The Communications Interface Panel, Modular Cabinet Interface Unit, and all other cabinet equipment will be furnished and installed by the ADMINISTRATION.

**CATEGORY 800
TRAFFIC**

UTILITY CONNECTIONS, AND UTILITY STAKEOUT

DESCRIPTION. This work shall consist of utility connections, and utility stakeout, as specified in the Contract Documents or as directed by the Engineer.

MATERIALS.

Disconnect Switches and Utility Connections

950.13.10

CONSTRUCTION. Arrange a meeting with the utility company representatives, Traffic Operations Division representatives, the Engineer and the District Utility Engineer as specified in the Contract Documents to establish a schedule for utility connections before any equipment or material is installed.

Do not disconnect, de-energize, reconnect, tamper with, or otherwise handle any of a utility company's facilities. The Contractor shall be responsible for the utility service connections to the utility company's supplied point of service.

Make the necessary arrangements with the utility companies to insure having needed utilities available at the time of turn on. Any utility energization, connection or disconnection delays will not be considered a valid reason for any work time extension claim. Difficulties in securing utility company services are to be reported to the Engineer at the earliest possible time.

Utility Stakeout. Notify the appropriate agencies listed in the Contract Documents, and those listed below a minimum of 72 hours (excluding weekends and holidays) prior to the Contractor's anticipated beginning of any underground work.

- a) In Montgomery County, request Montgomery County (240-777-2100) to stakeout their ITS and signal facilities.
- b) Request the Statewide Operations Center (800-543-2515) to stake out SHA fibreoptic and communication cables.
- c) Request the Communications Division (410-747-8590) to stake out ITS devices.
- d) Request appropriate RME to stake out lighting.
- e) Notify the Hanover Complex Signal Shop (410-787-7652) of all requests for signal and ITS stakeouts.

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UTILITY CONNECTIONS

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Plan the work to minimize interference with any existing traffic control devices.

Existing equipment shall remain in it's original condition until the new equipment has been completed, satisfactorily tested and its operation accepted by the Engineer.

MEASUREMENT AND PAYMENT. Utility Connection. Utility Service Equipment connections will be measured and paid for as specified in 807.04.01.

All utility company energization, connection or disconnection costs will be the responsibility of the Administration.

Utility Stakeout. Utility Stakeout will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

CATEGORY 800
TRAFFIC

SECTION 814—SIGNAL HEADS

814.01 DESCRIPTION.

641 **ADD:** The following after the first paragraph.

Furnish and install Aluminum and Polycarbonate 8-in. and 12-in. vehicle traffic control signal heads and hardware with LED Green, Yellow, and Red indications, as specified in the Contract Documents or as directed by the Engineer. All signal housing shall have a black face and yellow housing.

814.02 MATERIALS.

ADD: The following to the end of the list of materials.

LED Traffic Signal Modules	“Section 800 LED TRAFFIC SIGNAL MODULES”
ALL Red and Green Traffic Signals	COMAR 14.26.03
(LED or Incandescent)	(Certification of compliance with Maryland Energy Efficiency Standards)

814.04 MEASUREMENT AND PAYMENT.

ADD: The following after the first paragraph.

Aluminum and Polycarbonate LED Signal heads will be measured and paid for at the Contract unit price per each section of signal head type and size as specified in the Contract Documents. The LED signal heads will have the LED module fitted into the housing assembly. The payment will be full compensation for the housing, LED signal module, and, mounting hardware, assembly, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SPECIAL PROVISIONS

816-TRAFFIC CONTROL DEVICE CABINETS AND EQUIPMENT

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**CATEGORY 800
TRAFFIC**

**SECTION 816 TRAFFIC CONTROL DEVICES
CABINETS AND EQUIPMENT**

643 816.04 MEASUREMENT AND PAYMENT.

DELETE: 816.04.02 in its entirety.

INSERT: The following:

816.04.02 Concrete foundations for Traffic Control Devices and Equipment will not be measured and paid for, but will be incidental the to pertinent traffic control cabinet.



**CATEGORY 900
MATERIALS**

665 **DELETE:** SECTION 902 — PORTLAND CEMENT CONCRETE AND RELATED PRODUCTS in its entirety.

INSERT: The following.

SECTION 902 — PORTLAND CEMENT CONCRETE AND RELATED PRODUCTS

902.01 STORAGE. Storage of materials shall conform to the Contract Documents and as directed by the Engineer.

902.02 CERTIFICATION OF PORTLAND CEMENT AND BLENDED HYDRAULIC CEMENT. The manufacturer shall furnish certification as specified in TC-1.03. The certification shall also include:

- (a) The mill shall report its quality control procedures, and submit a new report whenever there is a procedural change.
- (b) The mill's control laboratory shall be inspected by the Cement and Concrete Reference Laboratory of the National Institute of Standards and Technology on their regularly scheduled visits. The Engineer shall be provided with copies of the reports of these inspections along with an account of the action taken to correct cited deficiencies.
- (c) Records of data accumulated by the quality control procedures shall be produced upon request.
- (d) A certified document shall accompany each shipment stating that the contents conform to all applicable requirements. Additionally, the document shall show the producer's name, mill location, carrier number, date loaded, weight contained in carrier, silo number, consignee, destination, Contract number, and type of cement. The signature and title of the signer shall be shown on the document.
- (e) The mill shall, upon request, supply certified chemical and physical test values that can be associated with any sample representing cement drawn from a particular silo on a given date.
- (f) Acceptance of cement by certification will be terminated if test results differ from mill results by more than the precision limits given in the test method. The acceptance procedure will then revert to storage testing and approval prior to shipment.

902.03 HYDRAULIC CEMENT.



SPECIAL PROVISIONS INSERT
902-PORTLAND CEMENT CONCRETE

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902.03.01 Portland Cement. M 85, with the fineness and the time of setting determined using T 153 and T 131, respectively.

902.03.02 Ground Iron Blast Furnace Slag. M 302, Grade 100 or 120. The Contractor may request to substitute a maximum of 50 percent of the weight of cement with ground iron blast furnace slag. When ground iron blast furnace slag is used, the minimum cement factor and water/cement ratio will be determined on the basis of the combined weight of the portland cement and ground iron blast furnace slag. When ground iron blast furnace slag is used to control alkali silica reactivity, see Table 902 B for percentage.

902.04 BLENDED HYDRAULIC CEMENT. M 240, Type I (PM) or a Type IP containing 15 to 25 percent pozzolan by weight of cement. Maximum loss on ignition is 3.0 percent. Do not use ground iron blast furnace slag for blending. The requirement for a manufacturer's written statement of the chemical composition is waived.

902.05 MASONRY CEMENT. C 91, except the water retention and staining tests are waived.

902.06 CONCRETE ADMIXTURES. Do not use concrete admixtures that contribute more than 200 ppm of chlorides based on the cement content when tested per MSMT 610. Use only prequalified admixtures.

Do not use pozzolan and Type I (PM) or Type IP cement in the same mix. Since the strength gains are delayed with these materials, a longer period of time may be required for curing and form removal.

902.06.01 Air Entraining Admixtures. M 154.

902.06.02 Chemical Admixtures. M 194, Type A, D, or nonchloride C.

902.06.03 High Range Water Reducing Admixtures. M 194, except that it shall be a liquid, the water content shall be a maximum of 85 percent of that of the control, and the durability factor shall be a minimum of 90. Use Type F for early strength, which shall produce a minimum compressive strength in 12 hours of 180 percent of that of the control. Use Type G when early strength is not specified. The manufacturer shall furnish certification as specified in TC-1.03. The certification shall include curves indicating the fluid ounces of admixture per 100 lb of cement as related to water reduction and strength gain for 12 hours when used with a minimum cement factor of 700 lb.

902.06.04 Pozzolans. The use of pozzolans may be requested to control alkali silica reactivity or for other reasons. When a pozzolan is used, determine the minimum cement factor and water/cement ratio on the basis of the combined weight cement and pozzolan. See Table 902 B for percentage of fly ash, and microsilica.



SPECIAL PROVISIONS INSERT
902-PORTLAND CEMENT CONCRETE

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- (a) **Fly Ash.** M 295, pozzolan Class C or F, except that the maximum permissible moisture content shall be 1.0 percent, and when used in concrete Mix Nos. 3 and 6 the maximum loss on ignition 3.0 percent.
- (b) **Microsilica.** C 1240, except that the oversize requirement is waived.

902.06.05 Corrosion Inhibitors. Corrosion inhibitors shall be calcium nitrite based and contain a minimum of 30 percent active ingredients by mass. The gallonage of corrosion inhibitor used in the concrete mixture shall be included as water when determining the water/cementitious materials ratio.

902.07 PORTLAND CEMENT CONCRETE CURING MATERIALS. Use burlap cloth, sheet materials, liquid membrane forming compounds, or cotton mats.

902.07.01 Burlap. M 182, Class 1, 2, or 3.

902.07.02 Sheet Materials. M 171 with the following exceptions:

- (a) **White Opaque Burlap Polyethylene Sheeting.** Tensile strength and elongation requirements are waived. Use sheeting having a finished product weight of not less than 10 oz/yd².
- (b) **White Opaque Polyethylene Backed Nonwoven Fabric.** 902.07.02(a), with the thickness requirement waived. Use material having a finished product weight of not less than 5 oz/yd².
- (c) **White Opaque Polyethylene Film.** Tensile strength and elongation requirements are waived.

902.07.03 Liquid Membrane. M 148. Field control testing of the white pigmented curing compounds is on the basis of weight per gallon. The samples shall not deviate more than ± 0.3 lb/gal from the original source sample.

902.07.04 Cotton Mats. Cotton mats consist of a filling material of cotton bats or bats covered with unsized cloth and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.

Use coverings of either cotton cloth, burlap or jute having the following properties:

- (a) Cotton cloth covering shall weigh not less than 6.0 oz/yd² and have an average of not less than 32 threads/in. of warp and not less than 28 threads/in. of filling. Use raw cotton, cotton comber waste, cotton card strip waste, or combinations thereof as the raw material used in the manufacture of the cotton cloth.



(b) Burlap or jute covering for cotton mats shall weigh not less than 6.4 oz/yd² and shall have not less than of 8 threads/in. of warp and not less than 8 threads/in. of filling. Use the grade known commercially as "firsts" and they shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability.

Use a cotton bat, or bats made of raw cotton, cotton waste, cotton linters, or combinations thereof, as the filling material for the mats. Mats shall weigh not less than 12 oz/yd².

902.08 FORM RELEASE COMPOUNDS. Use form release compounds that effectively prevent the bond of the concrete to the forms. Form release compounds shall not cause discoloration of the concrete or adversely affect the quality or rate of hardening at the interface of the forms.

The flash point of the form release compound shall not be less than 100 F when tested per T 73.

902.09 PARAFFIN WAX. Use clear paraffin wax for use as a bond breaker for concrete. The flash point shall not be less than 380 F when tested under D 92.

902.10 PORTLAND CEMENT CONCRETE. Section 915 and as specified herein.

902.10.01 Proportioning. Prior to the start of construction, submit to the AME the source and proportions of materials to be used for each concrete mix. The mixture shall meet 902.10.03.

The concrete, with the exception of water and chemical admixtures, shall be proportioned by weight. Water and chemical admixtures may be proportioned by volume or weight. The mix shall be uniform and workable.

902.10.02 Materials.

Coarse Aggregate	901.01
Fine Aggregate	901.01
Cement	902.03 and 902.04
Concrete Admixtures	902.06
Synthetic Fibers	902.15
Water	921.01

902.10.03 Portland Cement Concrete Mixtures.



SPECIAL PROVISIONS INSERT
902-PORTLAND CEMENT CONCRETE

The concrete mixes shall conform to the following:

TABLE 902 A

PORTLAND CEMENT CONCRETE MIXTURES									
MIX NO.	28 DAY SPECIFIED COMPRESSIVE STRENGTH	STANDARD DEVIATION	CRITICAL VALUE	MIN CEMENT FACTOR	COARSE AGGREGATE SIZE	MAX WATER/ CEMENT RATIO	SLUMP RANGE	TOTAL AIR CONTENT	CONCRETE TEMPERATURE
	psi	psi	psi	lb/yd ³	M 43 / M 195	by wt	in.	%	F
1	2500	375	2430	455	57, 67	0.55	2-5	5-8	70 ± 20
2	3000	450	3010	530	57, 67	0.50	2-5	5-8	70 ± 20
3	3500	525	3600	580	57, 67	0.50	2-5	5-8	70 ± 20
4	3500	525	3600	615	57, 67	0.55	4-8	N/A	70 ± 20
5	3500	525	3600	580	7	0.50	2-5	5-8	70 ± 20
6	4500	675	4770	615	57, 67	0.45	2-5	5-8	65 ± 15
7	4200	630	4420	580	57	0.50	1½-3	5-8	70 ± 20
8	4000	600	4180	750	7	0.42	2-5	5-8	65 ± 15
9	3000 (a)	N/A	N/A	800	57, 67	0.45	4-8	5-8	70 ± 20
10	4500	675	4770	700	¾" - No. 4	0.45	2-5	6-9	65 ± 15
11	4200	630	4420	—	57, 67	0.45	2-5	5-8	65 ± 15
12	4200	630	4420	—	¾" - No. 4	0.45	2-5	6-9	65 ± 15

Note 1: When concrete is exposed to water exceeding 15,000 ppm sodium chloride content, Type II cement shall be used. In lieu of Type II cement, a Type I cement may be used in combined form with an amount of up to 50 percent replacement with ground iron blast furnace slag, or an amount of up to 25 percent replacement with Class F fly ash. The Contractor shall submit to the Engineer the proposed mix proportions and satisfactory test results per C 1012 showing a sulfate resistance expansion not exceeding 0.10 percent at 180 days

Note 2: The temperature of Mix No. 6 when used for other than superstructure work as defined in TC-1.03 shall be 70 ± 20 F.

Note 3: Type A or D admixture shall be added to bridge, box culvert, and retaining wall concrete.

Note 4: Nonchloride Type C admixtures may be used when approved by the Engineer.

Note 5: Other Slump Requirements:

When a high range water reducing admixture Type F or Type G is specified, the slump shall be 4 to 8 in.

When synthetic fibers are specified, the slump shall be 5 in. maximum.

When concrete is to be placed by the slip form method, the slump shall be 2-1/2 in. maximum.

When the absorption of the coarse aggregate is greater than 10 percent, the slump shall be 3 in. maximum.

Note 6: Mix 9 shall contain a Type F high range water reducing admixture.

Note 7: Mix 10 and 12 shall be proportioned as specified in 211.2 of the ACI's Recommended Practices for Selection

Proportions for Structural Lightweight Concrete. The maximum average Density of Cured Concrete shall be 118 lb/ft³.

Control testing for Density of Cured Concrete shall be two companion cylinders for each 100 yd³, or fraction thereof, as specified in M 195.

Note 8: Mix 11 and 12 shall also conform to all requirements as specified in Table 902 C.

(a) Acceptance will be based on a minimum compressive strength of 3000 psi in 24 hours. Design approval will be given based on trial batch obtaining a minimum compressive strength of 2500 psi in 12 hours. Testing shall conform to 902.10.08 except that cylinders shall remain in the molds until tests are conducted.

Coarse and fine aggregate having an expansion up to 0.10 percent when tested for alkali silica reactivity (ASR) MSMT 212 may be used without restriction. Aggregates having an expansion greater than 0.10 but less than 0.35 percent are considered reactive and may only be used when one of the options in table 902 B are employed. Those having an expansion of 0.35 percent and greater are prohibited.



TABLE 902 B

OPTION	ALKALI CONTENT OF CEMENT % max	REPLACE CEMENT WITH		SPECIFICATION
		MATERIAL	% BY WEIGHT	
1	1.50	Class F Fly Ash	15 – 25	M 295
2	1.50	Ground Iron Blast Furnace Slag	25 – 50	M 302 Grade 100 or 120
3	1.50	Microsilica	5 – 7	C 1240
4	—	Blended Cement (a)	100	M 240
5	0.60 (b)	Low Alkali Cement	100	M 85

(a) Pozzolan content of 15 – 25 percent by weight of cement

(b) For mix 9 used for Portland cement concrete pavement repairs; the maximum allowable percentage of alkalis in Portland cement shall be 0.70.

When reactive aggregate is used, designate which option will be used to control the formation of the ASR gel. If an option other than option 5 in Table 902 B above is chosen, conduct tests per MSMT 212 using the reactive aggregate and the proposed cementitious material. The expansion test results shall not be greater than 0.10 percent. When more than one reactive aggregate is used in a concrete mix, each shall be tested individually and the maximum amount of pozzolan required to reduce the expansion of all the aggregates to 0.10 percent or less shall be used. Submit the aggregate source, test results, and the percent and type of replacement cement to the Engineer. The Engineer may withhold source approval pending verification testing.



TABLE 902 C

MIX PHYSICAL PROPERTIES		
TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Minimum Cementitious Materials Factor, lb/yd ³	—	580
Maximum Content of Portland Cement, lb/yd ³	—	550
Water/Cementitious Materials Ratio by Wt.	—	0.45
Corrosion Inhibitor, gal/yd ³	902.06.05	2.0
Synthetic Fibers, lb/yd ³	902.15	1.5
Permeability of Field Concrete, moving average of three tests, coulombs max	T 277 Modified	2500
Permeability of Field Concrete, individual test, coulombs max	T 277 Modified	3000
Shrinkage at 28 days, microstrains	C 157	400

Note 1: Only Type I or II Portland cement shall be used.

Note 2: Mixes shall contain ground iron blast furnace slag, fly ash or microsilica.

Note 3: The water to cement ratio shall be based upon the total water to cementitious materials ratio. The gallonage of the corrosion inhibitor shall be included in the water/cementitious materials ratio.

Note 4: The permeability test value of field concrete shall be the average of two test specimens representing production concrete. Test specimens shall be molded on the project site in 4 x 8 in. molds conforming to M 205. Test specimens shall be handled under same conditions as compressive strength test specimens in conformance with C 31 for the first seven days. When seven days old, they shall be cured in a 100 F water bath for the remainder of the 28 day curing. The 28 day rapid chloride permeability of the specimens will be determined in conformance with T 277. Test for the geometry of test specimens will be waived.

Note 5: Shrinkage tests will be performed on trial mixes only.

Note 6: High range water reducing admixture may be used except the water reducing requirements will be waived.

Note 7: A sealer conforming to 902.12 shall be used on the finished surface.

902.10.04 Trial Batch. A trial batch shall be prepared to certify that each mix meets 902.10.05 and 902.10.06. Approval will be given when the test results meets the minimum required average strength.

Make arrangements with the AME at least two weeks in advance, to have an authorized representative present during the batching and testing. Each trial batch shall consist of at least 3 yd³ of concrete. Supply all equipment, and labor required to produce the trial batches and conduct the required tests at no additional cost to the Administration.

The AME may waive the requirement for a trial batch when past performance records show that the required average strength requirement has been met.



902.10.05 Design Required Average Strength.

Specified compressive strength, f_c' , psi	Required average compressive strength, f_{cr}' , psi
$f_c' \leq 5000$	Use the larger value computed from Eq. (A-1) and (A-2) $f_{cr}' = f_c' + 1.34s$ (A-1) $f_{cr}' = f_c' + 2.33s - 500$ (A-2)
Over 5000	Use the larger value computed from Eq. (A-1) and (A-3) $f_{cr}' = f_c' + 1.34s$ (A-1) $f_{cr}' = 0.90 f_c' + 2.33s$ (A-3)

where:

f_c' = the 28 day specified compressive strength.
 s = the standard deviation as specified in 902.10.06.

A test is defined as the average strength of two companion cylinders.

902.10.06 Standard Deviation.

- (a) When past performance records are available, a standard deviation will be established from documented performance records of the producer consisting of a minimum of 15 consecutive 28 day compressive strength tests obtained within the last 12 months.

The standard deviation will be established as the product of the calculated standard deviation and multiplier.

NUMBER OF TESTS	MULTIPLIER FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

Interpolate for intermediate number of tests.



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(b) When past performance records are not available, the required average strength shall meet to the following:

Specified compressive strength, f_c' , psi	Required average compressive strength, f_{cr}' , psi
$f_c' < 3000$	$f_{cr}' = f_c' + 1000$
$3000 \leq f_c' \leq 5000$	$f_{cr}' = f_c' + 1200$
$f_c' > 5000$	$f_{cr}' = 1.10 f_c' + 700$

902.10.07 Standard of Control. The average of all sets of three consecutive strength tests shall equal or exceed the critical value as specified in 902.10.03 which shall be computed using the following formula:

$$\text{Critical Value} = f_c' + (1.14 \times S) - 500$$

Failure to conform to this criteria shall be cause for immediate investigation and remedial action up to and including suspension of production. A design standard deviation equal to 15 percent of the specified strength shall be used for calculation until a minimum of 15 test results are obtained.

The actual average strength and standard deviation shall be computed upon the availability of 28 day strength data comprising a minimum of 15 tests. Should this determination indicate an excessive margin of safety, the concrete mix may be modified to produce lower average strength as approved by the Engineer. If these calculations indicate a coefficient of variation greater than 15, the quality of the concrete and testing will be evaluated.



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902.10.08 Testing. Sampling per T 141. Testing as follows:

TEST	METHOD	MINIMUM TEST FREQUENCY	RESPONSIBILITY
Temperature (e)	T 309	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Slump (a)(e)	T 119	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Air Content (a)(e)	T 152 T 196	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Compression (b)(c)(d)	T 23	1 per 50 yd ³ (or fraction thereof)	Project Engineer
Compression (b)(c)(d) Mix No. 7 Only	T 23	3 per Day	Project Engineer

- (a) A second test will be made when the first slump or air content test fails. Acceptance or rejection will be based on the results of the second test.
- (b) Compressive strength tests are defined as the average of two companion cylinders.
- (c) The Contractor shall be responsible for the making of all early break cylinders and furnishing the molds, stripping, curing/delivery of all cylinders, including 28 day cylinders, to the testing laboratory.
- (d) The Project Engineer will be responsible for making, numbering and signing the 28 day cylinders.
- (e) When constructing plain and reinforced concrete pavements, the testing frequency for slump, air content, and temperature shall be 1 per 100 yd³ or fraction thereof.

902.10.09 Acceptance. Concrete will be acceptable if both of the following requirements are met:

- (a) The average of all sets of three consecutive strength tests equal or exceed the specified design strength.
- (b) No individual strength test (average of two companion cylinders) falls below the specified design strength by more than 500 psi.

902.10.10 Price Adjustment. A price adjustment will be based on the Contract unit price per cubic yard of concrete. If the unit is a lump sum item, the price per cubic yard for the concrete will be determined by dividing the cubic yards into the Contract lump sum price.

- (a) **Test Results More Than 500 psi Below the Specified Design Strength.** Failing strength tests will be considered individually with a price adjustment being applied on the percentage basis as shown below.

(Price per yd³) X (quantity of yd³ represented by the failing concrete strength) X (percent of failure).

Example:

$$\$400.00 \text{ per yd}^3 \times 50 \text{ yd}^3 \times [1 - (3600 / 4500 \text{ psi})] = \$4,000.00$$



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No payment will be allowed when the test results fall below 50 percent of the specified design strength for structural concrete or 40 percent for incidental concrete.

The Engineer will determine when the strength of the concrete represented by the failing tests is sufficient to remain in place or whether it must be removed and replaced with Specification concrete.

- (b) **Test Results 500 psi or Less than the Specified Design Strength.** Strength failures 500 psi or less than the specified design strength will be averaged with the next two consecutive tests. If those two tests include a failure greater than 500 psi, those tests will be evaluated as in 902.10.10(a) and replaced with the next consecutive test. If the resulting average falls below the specified design strength, a price adjustment will be applied as specified in the table below. Any failure will only be included in one grouping.

STRENGTH BELOW THE SPECIFIED (avg of 3 tests) DESIGN LEVEL, psi	ADJUSTMENT FACTOR
MIX NO. 1 THRU MIX NO. 7	
1 – 100	0.005
101 – 200	0.01
201 – 300	0.02
301 – 400	0.04
401 – 500	0.08

Adjustment price equals (price per yd³) X (quantity of yd³ represented by the failing cylinders) X (the adjustment factor).

Example:

$$\$400.00 \text{ per yd}^3 \times 50 \text{ yd}^3 \times 0.01 = \$200.00$$

902.11 MORTAR FOR GROUT. Mortar used for grouting anchor bolts, pipe, handrail posts, and miscellaneous items shall be composed in accordance with one of the following:

- (a) One part Portland cement or blended hydraulic cement and one part mortar sand by dry loose volume.
- (b) Prepared bag mixes consisting of Portland cement or blended hydraulic cement and mortar sand. The prepared mixes shall produce a mortar meeting the strength requirements specified in the Contract Documents.
- (c) Use nonshrink grout when specified. The grout shall have a minimum compressive strength of 5000 psi in seven days when tested as specified per T 106, except that the cube molds shall remain intact with a top firmly attached throughout the curing period. The



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nonshrink grout shall have a minimum expansion of 0.0 percent after seven days when tested as specified per T 160.

- (d) Epoxy grout shall consist of sand and epoxy mixed by volume in per the manufacturer's recommendations. The grout shall be capable of developing a minimum compressive strength of 6500 psi in 72 hours when tested per MSMT 501. Sand for epoxy grout as specified in 901.01.
- (e) An epoxy or polyester anchoring system may be used when approved by the Engineer in accordance with the manufacturer's recommendations. Strength values shall be as specified in the Contract Documents.

902.12 LINSEED OIL. Shall consist of a 50-50 mixture (by volume) of boiled linseed oil meeting Federal Specification TT-L-190 and kerosene per D 3699.

902.13 LATEX MODIFIED CONCRETE. Portland cement concrete containing prequalified Laboratory approved styrene butadiene latex emulsion is defined as Latex Modified Concrete (LMC).

Latex emulsion shall have a minimum of 90 percent of the nonvolatiles as styrene butadiene polymers. The latex emulsion as specified in Table 902.13 A. The material shall be stored in suitable containers and be protected from freezing and exposure to temperatures in excess of 85 F.

LMC shall be proportioned using volumetric mixing and designed as follows:

LATEX MODIFIED CONCRETE	
MATERIAL	SPECIFICATION LIMITS
Portland Cement, CWT/yd ³ , min	6.6
Latex Emulsion/Cement Ratio	0.31 – 0.34
Water/Cement Ratio, max	0.22
Entrained Air, %	6.0 ± 3
Slump, in.	5 ± 1

The physical properties of LMC shall conform to Table 902.13 B. The Contractor shall furnish the necessary 3 X 6 in. molds per M 205 to be used for the fabrication of compressive strength cylinders.

Control and Acceptance Sampling.

- (a) Submit a two qt minimum sample, of the styrene butadiene latex emulsion to the AME daily for each lot of material used in a day's production.



(b) A batch for LMC is defined as the capacity of the equipment being used on the project. Slump and air samples will be taken and tested before the placement of a batch is permitted. The slump shall be measured four to five minutes after discharge from the mixer. The test material shall be deposited off the deck and not be disturbed during this waiting period. One additional sample for slump and air will be taken randomly during the placement of each batch. For seven day compressive strength, two tests each per batch are required. A test is defined as consisting of two companion cylinders. The samples for these tests will be taken at random while the placement is in progress.

TABLE 902.13 A

REQUIREMENTS FOR CHEMICAL PROPERTIES OF LATEX EMULSION MATERIALS				
PROPERTY	SPECIFICATIONS		QUALITY ASSURANCE TESTS	
	LIMITS	TOLERANCE	PREQUALIFICATION TESTS	CONTROL AND ACCEPTANCE
Color	White	—	X	X
pH	9.0 – 11.0	—	X	X
Weight, lb/gal	8.40 – 8.47	—	X	X
Solids Content, %	46 – 53	—	X	X
*Butadiene Content, % of polymer	30 – 40	—	—	—
Viscosity @ 10 rpm-cps	Match Original	± 20	X	X
*Surface Tension, dynes/cm max	50	—	—	—
*Mean Particle Size, polymer – Å	1400 – 2500	—	—	—
Coagulum, % max	0.10	—	X	X
*Freeze-Thaw Stability, coagulum, % max	0.10	—	X	X
Infrared Spectra of Latex Film	Match Original	—	X	X
Infrared of Alcohol Soluble Portion of Latex	Match Original	—	X	X
Shelf Life, min	1 yr	—	X	—

Note 1: Quality assurance tests shall be conducted as specified in MSMT 612 except those denoted by an * shall be conducted as specified in FHWA RD – 78-35.

Note 2: The original or prequalification sample shall be accompanied by the producer's certification on all of the tests and properties noted above and as specified in TC-1.03. The certification shall contain actual test values of the product and the infrared spectrograph.

Note 3: A separate certification is required for each lot of material. The certification shall note the date of manufacture, lot size, and whether or not the material is identical to the formulation of the original sample.



TABLE 902.13 B

LATEX MODIFIED CONCRETE PHYSICAL PROPERTIES			
TEST PROPERTY	TEST VALUES	QUALITY ASSURANCE TESTS	
		PREQUALIFIED TESTS	CONTROL AND ACCEPTANCE
7 Day Compressive Strength, psi min	3000	X	X
28 Day Compressive Strength, psi min	3500	X	—
42 Day Compressive Strength, psi min	3500	X	—
7 Day Flexural Strength, psi min	550	X	—
28 Day Flexural Strength, psi min	650	X	—
42 Day Shear Bond Strength, psi min	2000	X	—
Durability Factor, 300 cycles, % min	85	X	—
Chloride Permeability, Ppm max	510	X	—
Scaling Resistance, 50 cycles, max	3	X	—

Note 1: Quality assurance tests shall be conducted as specified in MSMT 721.

Note 2: Seven Day Compressive Strength Test will be used for Control & Acceptance of the material. The minimum specified design strength is 3000 psi at seven days. The mix design approval and acceptance will be based on a coefficient of variation of 10 percent with a probability of 1 in 10 tests falling below the specified strength. Only test values 80% or greater than the specified strength will be accepted

902.14 RAPID HARDENING CEMENTITIOUS MATERIALS FOR CONCRETE PAVEMENT REPAIRS. Materials shall be a dry, packaged cementitious mortar having less than 5 percent by weight of aggregate retained on the 3/8 in. sieve and meet the following requirements:

Classification.

- Class I — For use at ambient temperatures below 50 F.
- Class II — For use at ambient temperatures of 50 to 90 F.
- Class III — For use at ambient temperatures above 90 F.

Chemical Requirements. C 928 except that no organic compounds such as epoxy resins or polyesters as the principal binder.



Physical Requirements. Meet the following when tested per MSMT 725:

COMPRESSIVE STRENGTH, psi min				
CLASSIFICATION	< 2 hr	2-6 hr	6 hr	28 days
Type I — Slow	—	—	2000	4500
Type II — Rapid	—	2000	—	4500
Type III — Very Rapid	2500	—	—	4500

TEST RESULTS	
TEST PROPERTY	LIMITS
Bond Strength, 7 days, psi min	2000
Length Change, increase after 28 days in water, based on length at 3 hr, % max	+ 0.15
Length Change, decrease after 28 days, % max	- 0.15
Freeze Thaw, loss after 25 cycles in 10% CaCl ₂ solution, % max	8
Initial Setting Time, minutes min	10

Marking. All packages delivered to the project shall be marked with the following information:

- (a) Date material was packaged.
- (b) Approximate setting time.
- (c) Recommended dosage of water or liquid component.
- (d) Mixing instructions.
- (e) Class or temperature range.

Certification. The manufacturer shall furnish certification as specified in TC-1.03 showing the actual test results for each class and type of material submitted to the Laboratory.

902.15 SYNTHETIC FIBERS. When synthetic fibers are specified in the Contract Documents, the fibers shall be 1/2 to 1-1/2 in. long and conform to C 1116, Type III. The manufacturer shall furnish certification as specified in TC-1.03. The quantity of fibers used and their point of introduction into the mix shall conform to the fiber manufacturer's recommendations.

902.16 CONTROLLED LOW STRENGTH MATERIAL.

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902.16.01 Usage. Controlled Low Strength Material (CLSM) shall consist of the types described below:

TYPE A – Used where future excavation of the CLSM may be necessary (e.g. utility trenches, pipe trenches, bridge abutments, and around box culverts).

TYPE B – Used where future excavation of the CLSM is not anticipated (e.g. filling abandoned conduits, pipes, tunnels, mines, etc. and replacing unsuitable soils below roadway and structure foundations where extra strength is required).

902.16.02 Materials.

Coarse Aggregate	901.01*
Fine Aggregate	901.01
Cement	902.03 and 902.04
Concrete Admixtures	902.06
Fly Ash	902.06.04
Water	921.01

*maximum size of 3/4 in.

Produce CLSM in conformance with the applicable portions of Section 915 and the following:

902.16.03 Proportioning. Submit the sources and proportions of materials, and test data for each CLSM mixture prior to construction. CLSM shall be proportioned, on the basis of field experience and/or laboratory trial mixtures, to produce a flowable and self-compacting mixture meeting the requirements of 902.16.04.

CLSM shall be proportioned by weight; with the exception of water and chemical admixtures. Water and chemical admixtures may be proportioned by volume or weight.

902.16.04 CLSM Mixtures. Proportion CLSM with sufficient amounts of Portland cement, fly ash, or ground granulated blast furnace slag; individually or in combination, to produce a cohesive, non-segregating mixture that conforms to the physical properties in the following table:

CLSM Mix	28 Day Compressive Strength, (psi) ASTM D4832	Flow Consistency, (in.) ASTM D6103
Type A	50 - 200	8 min.
Type B	500 min.	8 min.



**CATEGORY 900
MATERIALS**

**SECTION 904 – PERFORMANCE GRADED
ASPHALT BINDERS AND HOT MIX ASPHALT**

684 **DELETE:** 904.04.02 Mix Design in its entirety.

INSERT: The following.

904.04.02 Mix Design. Develop Superpave mix designs in conformance with R 35, except replace “Table 1, Superpave Gyrotory Compaction” with the following:

DESIGN LEVEL	20-Year Design Traffic, ESALs	Ndesign
1	<300,000	50
2	300,000 to <3,000,000	65
3	3,000,000 to <10,000,000	80
4	10,000,000 to <30,000,000	80
5	≥30,000,000	100

Design HMA Superpave mixes to conform to the specification for Superpave Volumetric Mix Design, M 323, and design the mixes for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

Crushed, reclaimed asphalt pavement (RAP) and a maximum of 5 percent asphaltic roofing shingles from manufacturing waste may be selected for use. Determine the allowable percentage and its suitability for use in conformance with MSMT 412 and M 323. Binder grade adjustments are not required when using less than 20 percent RAP or RAP/shingle combination.

Test and evaluate surface mixes consisting of 20 percent or more RAP, and base mixes consisting of more than 25 percent RAP in accordance with TP 62 to determine plant mixing capabilities. Demonstration strips or mix verifications may be required before placement.

RAP (not exceeding 15 percent) may be considered for applications where higher polish value aggregates are required or in mixes requiring elastomer type polymer binder. OMT will grant approval for use on an individual project basis and will designate placement areas within the project limits. RAP (between 11 and not exceeding 15 percent) used for these applications shall be from an identified single source and



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904 — PERFORMANCE GRADED ASPHALT BINDERS & HMA

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stored in isolated stockpiles. Submit documentation of stockpile management, quality, and traceability for approval prior to use.

Do not use crushed glass in surface mixes. Do not use roofing shingles in gap-graded mixes or mixes requiring elastomer type polymer binder.



SPECIAL PROVISIONS INSERT
925 — DETECTABLE WARNING SURFACES

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CATEGORY 900
MATERIALS

789 **DELETE:** SECTION 925 — DETECTABLE WARNING SURFACES in its entirety.

INSERT: The following.

SECTION 925 — DETECTABLE WARNING SURFACES

925.01 GENERAL. Detectable warning surfaces shall conform to the current accessibility guidelines of the Americans with Disabilities Act (ADA). The Office of Materials Technology (OMT) maintains a Qualified Products List (QPL). Manufacturers seeking inclusion of their product on the QPL shall submit certified test results showing conformance to the properties in 925.07, as well as installation instructions and the types of adhesives and sealants required.

925.02 COMPOSITION. Warning surfaces shall be either flexible or rigid. If there is a change in the composition of a qualified product, the manufacturer shall notify OMT and submit new test results showing conformance with 925.07.

925.02.01 Pavers. Type III Brick Pavers shall conform to the requirements of C 902, Class SX, Type 1, and Application PX. The pavers shall be 2-1/4 x 4 x 8 in. with square edges and a surface meeting 925.03.

925.03 CONFIGURATION AND DIMENSIONS. The warning surface shall consist of a system of truncated domes having a base diameter of 0.9 in. to 1.4 in., a top diameter 50 to 65 percent of the base diameter, and a height of 0.2 in. The domes shall be arranged in a square grid with center-to-center spacing of 1.66 to 2.35 in.

925.04 COLOR. The color shall be homogeneous across the surface of the material and contrast with adjoining surfaces.

925.05 IDENTIFICATION. The top surface shall have an identifier that uniquely distinguishes the manufacturer. Brick pavers are excluded.



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925 — DETECTABLE WARNING SURFACES

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925.06 REQUIREMENTS.

TYPE	DESCRIPTION	PHYSICAL TEST REQUIREMENTS
Type I	Cast in Place	A, B, C, D, E, G
Type IIa	Surface Mount, Rigid	A, B, C, D, E, G
Type IIb	Surface Mount, Flexible	A, B, C, D, F, G
Type III	Brick Pavers	925.02.01
Type IV	Prefilled Pavers	A, B, C, D, G

925.07 PHYSICAL PROPERTIES.

	PROPERTY	TEST METHOD	SPECIFICATION LIMIT
A	Slip Resistance Coefficient	C 1028 (dry method)	0.80 minimum
B	Abrasive Wear, index	C 501	150 minimum
C	Fade (UV) Resistance/Color Retention	D 4587	Fade or Change in color after 2000 hours less than $\Delta E = 5^*$
D	Freeze/Thaw Resistance	C 1026	No disintegration
E	Adhesion/Bond Strength, pull off	C 482/C 882(as appropriate)	No adhesion failure
F	Adhesion/Bond Strength, peel	D 903/D 429 (modified as appropriate)	No adhesion failure
G	Contrast	Contrast percentage formula** using E 1349 to determine cap Y brightness/light reflectance values (LRV)	Current ADA requirement***

* Chromaticity coordinates ($L^*a^*b^*$ system) checked in conformance with D 2244, before and after test.

** Contrast % = $[(B_1 - B_2)/B_1] \times 100$,

where B_1 = (LRV) of the lighter area, and B_2 = (LRV) of the darker area.

*** For the purpose of determining whether a material meets acceptable contrast criteria, use actual cap Y brightness of detectable warning surface, and assume a value of 15 for the cap Y brightness of cured concrete, or a value of 3 for asphalt wearing surfaces to determine percentage difference. Detectable warning surfaces to be installed on other materials are required to undergo additional testing.



**CATEGORY 900
MATERIALS**

SECTION 950 — TRAFFIC MATERIALS

792 **DELETE:** 950.03 REFLECTORIZATION OF SIGNS AND CHANNELIZING DEVICES in its entirety.

INSERT: The following.

950.03 REFLECTORIZATION OF SIGNS AND CHANNELIZING DEVICES.

Provide retroreflective sheeting that meets the requirements of the latest version of ASTM D 4956 and is selected from the Administration's QPL. The type of sheeting to be used for different classifications of signs shall be as specified in the QPL and as described below.

Provide fluorescent colors, when yellow, orange or pink sheeting is specified. Color coordinates and values shall be as described in the MDMUTCD and 23 CFR Part 655, Subpart F, Appendix.

Provide non-reflective sheeting, when black sheeting is specified.

All sheeting for legend and backgrounds shall be from the same manufacturer and be a matched component system intended to be used together.

Use ASTM Type IV or VIII construction sheeting with a Class 1 backing for drums for maintenance of traffic. The sheeting must be reboundable as defined in the supplementary requirements of ASTM D 4956, latest version.

Use ASTM Type IV, V or VIII for delineators, and lane separator systems. Use ASTM Type IV, VI or VIII sheeting for cones for maintenance of traffic. The sheeting must be reboundable as defined in the supplementary requirements of ASTM D 4956, latest version.

Use ASTM Type VI sheeting with a Class 5 backing for Roll up signs for Maintenance of Traffic.

Use ASTM Type VIII, IX or XI sheeting for rigid temporary traffic signs.

Use ASTM Type IX or XI sheeting for Guide Signs, Exit Gore Signs, General Information Signs, School Signs, Warning Signs and Red Regulatory Signs.

Use ASTM Type IV, VIII, IX or XI sheeting for all other Regulatory Signs and for Route



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SPECIAL PROVISIONS INSERT

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950.03— REFLECTORIZATION OF SIGNS AND CHANNELIZING DEVICES

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Markers.

Use ASTM Type I or higher sheeting for No Trespassing Signs, signs directed at Pedestrian Traffic, signs directed at Bicycle Traffic, R7 series Parking signs, R8 series Parking signs and supplemental panels for R7 and R8 series signs.

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950.06-ELECTRICAL CABLE AND WIRE

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CATEGORY 950
TRAFFIC MATERIALS

SECTION 950.06-ELECTRICAL CABLE AND WIRE

794 950.06.03 Cable Duct.

DELETE: Delete the last sentence of 950.06.03.

INSERT: The following.

Cable shall be type XHHW, rated for 600 volts.

CATEGORY 950
TRAFFIC MATERIALS

SECTION 950.15 TRAFFIC SIGNAL HEADS

804 **DELETE** the table and section titled Hardware in its entirety

INSERT The following:

ITEM	DESCRIPTION	A	B	C	D
1	Aluminum Alloy - Casting	A 319	A 380	A 713	6063 T6
2	Yield Strength, ksi	18	23	25	25
3	Tensile Strength, ksi	27	47	35	30
4	Brinell Hardness	70	80	75	73
5	Elongation (% in 2 in.)	1.5	4	3	12
6	Stainless Steel	A 316	-	-	-
7	Galvanized Steel	A 157	A 153	G 60	-
8	Steel-Flat Sheet	16 gauge	-	-	-
9	Coating	*	Anodized Finish	-	-
10	Brass	CZ120	-	-	-

* The signal head housing shall be yellow in conformance with Federal Standards 595, Color Chip No. 13538. The signal head door and visor shall be optical flat (dull) black Federal Standards 595, Color Chip No. 37038. Aluminum signal heads shall be painted using fusion bonded polyester coating method.

Hardware.

- (a) Hub plate shall conform to A, 1 thru 5 and 9B.
- (b) Span wire hanger clamp shall conform to C, 1 thru 5.
- (c) Balance adjuster body shall conform to 10A.
- (d) Balance adjuster eyebolt and hardware shall conform to 6A, 7A, and 7B.

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- (e) 2-way lower arm shall conform to 7C and 8A.
- (f) 2-way tri-stud arm shall conform to A, 1 thru 5.
- (g) Span wire entrance fitting shall conform to C, 1 thru 5.
- (h) Mast arm mount signal bracket (1-way, 2-way, and 5-section) shall conform to 1A and 1D.
- (i) Side pole upper and lower arm assembly shall conform to 1B thru 5B or 1D thru 5D.

The maximum allowable play or space between the sides of the eyebolt and span wire clamp shall be 0.062 in.

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- (f) Terminal blocks screws shall be of the captive type secured by fasteners on the reverse side of the terminal block. Terminal block screws shall be a # 10 size.
- (g) Male spade terminal ends shall be furnished for each position on the terminal block angled at 45 degrees and perpendicular to the terminal block face.

**CATEGORY 900
MATERIALS****SECTION 951 — PAVEMENT MARKING MATERIALS****951.01 NONTOXIC LEAD FREE WATERBORNE PAVEMENT MARKINGS**

All nontoxic lead free waterborne pavement marking materials shall be ready-mixed, pigmented binder, emulsified in water, and capable of anchoring reflective beads that are applied separately.

The pavement marking material shall not contain any hazardous material listed in the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1.

951.01.01 Waterborne Physical Requirements. The nontoxic lead free waterborne pavement marking material shall conform to the manufacturer's formulations as initially approved for use by the Administration and shall be controlled from batch to batch. All paint shall be evaluated in conformance to the requirements listed below.

Production batch samples will be subject to random tests, such as but not limited to, X-ray spectroscopy, infrared spectroscopy, ultraviolet spectral analysis, and atomic absorption spectroscopy.

The combined total of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 ppm, when tested by X-ray fluorescence spectroscopy, or other method capable of detection at this level.

For each production batch, the Contractor shall provide the Administration with the manufacturer's certified analysis conforming to TC-1.03 of the Standard Specifications.

- (a) **Viscosity.** The viscosity shall be 85 ± 10 KU when tested in conformance with D 562.
- (b) **Pigment For Yellow Pavement Marking Material.** The colorants used to attain the color of the yellow product shall be one or more of the following, along with titanium dioxide: Pigment Yellow 65, Pigment Yellow 75, and opaque Pigment Yellow 74.
- (c) **Color and Appearance.** Color and appearance shall be evaluated using the following: CIE 1976 $L^*a^*b^*$, illuminant D 65, and standard observer angle 1931 CIE 2 degrees. The geometry shall be 45/0 or 0/45, or d/8, excluding specular gloss. Measurements shall be taken from samples applied to an opacity chart, e.g., Leneta Form 2A, at a wet film thickness of 15 mils \pm 1 mil. The applied sample shall have been allowed to dry for at least 12 hours before measurements are taken. The evaluation shall be as follows:
 - (1) **Production:** The color of the dry paint film of the production sample shall match the $L^*a^*b^*$ values provided, under the specified conditions. For white material the values are: $L^* = 94.80$, $a^* = -2.35$, $b^* = 3.20$. For yellow material the values are: $L^* = 80.70$, $a^* = 19.40$, $b^* = 88.65$. The colors shall match when compared instrumentally.

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- (2) **Control.** The maximum permissible variation from the specified $L^*a^*b^*$ values shall be $2.0 \Delta E_{cmc}$. The measurements shall be taken from a sample applied over the black portion of an opacity chart.

The Administration will approve or disapprove any batch based on a laboratory visual evaluation for blemishes and irregularities in the test specimen (i.e. cracks, flaking, surface depressions, pooling, etc.) that would interfere with the measurement of color and appearance on the opacity chart. The Administration will make the final decision.

- (3) **Reflectance.** The reflectance, without beads, and using CIE XYZ Y_{xy} , shall be a minimum Y of 80 percent for white production batches; and a minimum of 50 percent for yellow production batches with a maximum of 60 percent. The measurement shall be taken from a sample applied over the black portion of an opacity chart.
- (4) **Color Difference over Black and White.** For any production batch the measured color difference between readings taken over the black portion of the opacity chart from those taken over the white portion shall be a maximum value of $1.0 \Delta E_{cmc}$ for white products and $1.3 \Delta E_{cmc}$ for yellow products.
- (5) **Yellowness Index.** The yellowness index of the white material, when determined according to E 313, Using Equation 1 and the coefficients for CIE D 65 illumination, 1931 from Table 1 in that standard, shall not exceed 8.0.

- (d) **Flexibility.** The pigmented binder shall not display cracking or flaking when subjected to the flexibility test of Federal Test Method TT-P 1952D, with the exception that the panels shall be 35 to 31 gauge (0.0078 to 0.0112 in.) tin plate approximately 3 x 6 in. The tin plates shall be lightly buffed with steel wool and thoroughly cleaned with solvent and dried before being used for the test.

- (e) **Weight per Gallon.** The weight per gallon for a production batch, when determined according to D 1475, shall be within ± 0.3 lb/gal of the value obtained by The National Transportation Product Evaluation Program (NTPEP), and reported on a NTPEP deck designated "north". When the Administration waives the NTPEP requirements, another target value will be stipulated.

951.01.03 Glass Bead Physical Requirements. Each lot of glass beads shall be sampled in conformance with the Administration's Frequency Guide and shall be submitted to the Administration's Office of Materials and Technology for testing and approval prior to use.

Glass beads shall be colorless, clean, transparent, and free of milkiness and excessive air bubbles.

Reflective glass beads shall conform to M 247, except that the gradation shall conform to the following:

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PERCENT PASSING			
SIEVE SIZE	Standard Beads	Large Beads	Maryland Blend
12 (1.70 mm)	—	100	100
14 (1.40 mm)	—	95 – 100	98 – 100
16 (1.18 mm)	—	80 – 95	88 – 97
18 (1.00 mm)	—	10 – 40	48 – 70
20 (0.85 mm)	100	0 – 5	28 – 50
30 (0.60 mm)	75 – 95	—	—
50 (0.30 mm)	15 – 35	—	5 – 25
80 (0.18 mm)	—	—	0 – 5
100 (0.15 mm)	0 – 5	—	—

Moisture resistance and flotation test are not required.

- (a) **Refractive Index.** The refractive index shall be 1.50 minimum, when tested in conformance with MSMT 211.
- (b) **Roundness.** Glass beads shall be smooth, spherical in shape, free of sharp angular scars, scratches, or pits, and shall contain a minimum of 60 percent silica. Beads shall have a minimum average roundness of 75 percent when tested in conformance with D 1155.

951.01.04 Qualification. Pavement marking material manufacturers desiring to have their material formulations approved under this Special Provision shall have their formulations evaluated on a NTPEP North Test Deck unless waived by the Administration. Only NTPEP evaluated formulations will be considered candidates for selection, unless the requirement is waived.

951.01.05 Field testing. Materials conforming to this specification shall be field evaluated for performance on a NTPEP North Test Deck. Materials performing satisfactorily throughout the test period will be placed on the Administration's Qualified Products List. All marking materials supplied under the Contract Documents shall be identical in composition to the materials submitted for initial NTPEP testing. The Office of Materials and Technology will determine conformity with these requirements.

951.01.06 Material Acceptance. Only Administration approved and stamped materials conforming to these Specifications shall be used.

Prior to the shipment of any pavement marking material batch, the manufacturer shall provide access for the Administration's representative to collect samples of the material from each production batch. The samples shall be sent to the Administration laboratory for QA testing. Each sample shall be accompanied by a certified analysis conforming to TC 1.03, showing compliance with the physical and chemical requirements of this Specification, and a statement certifying that any marking material supplied under the Contract Documents is identical in

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composition to the material submitted for initial NTPEP testing. The Administration will determine conformity with these requirements. Administration authorization shall be required before a batch or a portion of a batch is shipped.

Paints shall be compatible with cleaning solvents used in equipment cleaning.

Nontoxic waterborne pavement markings shall not skin, curdle, settle or be unusable or difficult to apply within 12 months of the date of manufacture. The supplier, at the Administration's request, shall replace containers of marking material exhibiting an unacceptable level of settling, skinning, or curdling, as determined by the Administration. Marking material from a production batch shall not be used beyond 12 months after the date of manufacture.

951.01.07 Certification. The manufacturer shall explicitly certify in writing that any marking material supplied under the Contract Documents conforms to the formulation identified by the same product code or name placed on the NTPEP test deck from which it was approved. The same code or name as used in the published report from that test deck must identify the product. Failure to certify will be considered grounds for product batch rejection.

The manufacturer shall, in accordance with TC-1.03, explicitly certify, in writing, of any paint batch supplied under the Contract Documents that it complies with all applicable specifications. Failure to so certify will be considered grounds for product batch rejection. Certification for yellow nontoxic lead free waterborne pavement markings shall include, for the purpose of showing compliance with this specification, the name or the type of colorant used to achieve the yellow color. The Administration will keep the paint composition and chemical analysis information confidential.

The Certification shall also, contain the following:

- (a) Manufacturer's name.
- (b) Place (address) of manufacture.
- (c) Color of material.
- (d) Date of manufacture (month-day-year).
- (e) Lot or batch identification.
- (f) Size of lot/batch.
- (g) The recommended paint temperature at the spray gun.
- (h) Material Safety Data Sheets for all materials submitted for testing and application.

The Contractor shall furnish a copy of this certification to the Administration's representative before applying the paint batch it represents.

951.01.08 Production Facility.

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- (a) The producer shall have a facility, presently in operation, capable of producing the traffic paint in the quantity and quality required by the Administration. This facility will be subject to the Administration's approval.
- (b) The producer shall have a laboratory, subject to the Administration's approval, that is capable of performing the required tests.

**CATEGORY 900
MATERIALS**

SECTION 951 — PAVEMENT MARKING MATERIALS

951.02 LEAD FREE REFLECTIVE THERMOPLASTIC PAVEMENT MARKINGS. All materials composing the reflective thermoplastic material shall be lead free. Reflective thermoplastic material shall be homogeneously composed of pigment, filler, resins and glass beads and shall conform to the following.

951.02.01 Reflective Thermoplastic Components.

(a) Composition.

COMPONENT	TEST METHOD	COLOR	
		WHITE	YELLOW
Binder, % min	Certified	18.0	18.0
Premixed Reflective Beads, % min	MSMT 614	30.0	30.0
Titanium Dioxide, % min	X-Ray Fluorescence	10.0	N/A
Calcium Carbonate Inert fillers, % max	D 34	42.0	*
Yellow Pigment, %	—	N/A	*

* Amount of yellow pigment, calcium carbonate and filler shall be at the option of the manufacturer, provided all other requirements are in conformance.

Restrictions. The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm when tested by X-Ray Fluorescence, ICP, or comparable method capable of this level of detection. Diarylide type pigments shall only be used when the manufacturer or pavement marking material application temperature does not exceed 392 F.

(b) Binders. The binder shall be alkyd consisting of maleic modified glycerolester of resin and other plasticisers.

(c) Titanium Dioxide. The titanium dioxide shall be rutile type.

951.02.02 Reflective Thermoplastic.

(a) Physical Properties.

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Bond Strength, psi min.	MSMT 614	180
Softening Point, F		215 ± 15
Low Temperature Stress Resistance	T 250	No Cracks

(b) Specific Gravity. The specific gravity of the white and yellow pavement marking material shall be 1.7 to 2.2 when tested in conformance with D 153, Method A at 77 F.

(c) Color. After heating for 4 ± 0.5 hours at 425 ± 3 F, the thermoplastic shall be as specified in E 1347 and the following:

(1) Production. The color of the cured thermoplastic material film of the production sample shall match the Federal Standard 595 Color chips specified when compared by instrumental measurement.

(2) Control. Control color matching determinations will be made using a Pacific Scientific Color Machine, and an observation angle of 2°, and the CIE Chromaticity Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the cured thermoplastic film sample:

	WHITE Color No. 17886		YELLOW Color No. 13538	
	X	Y	X	Y
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	± 0.020	± 0.020	± 0.030	± 0.030

(3) Reflectance.

COLOR	TEST METHOD	DAYLIGHT REFLECTANCE at Degree	PERCENT MIN
White	Fed Std 595 No. 17886	45 - 0	80
	Fed Std 595		

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Yellow	No. 13538	45 - 0	50
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(d) **Yellowing Index.** The yellowing index of the white material shall not exceed 8 prior to QUV and 15 after QUV when tested in accordance with E 313.

951.02.03 Glass Beads Physical Requirements. The glass beads shall conform to M 247 and the following:

GRADATION SIEVE SIZE	PERCENT PASSING
	STANDARD BEADS
0.85 mm (No. 20)	100
0.60 mm (No. 30)	75 - 95
0.30 mm (No. 50)	15 - 35
0.15 mm (No. 100)	0 - 5

Glass beads shall be colorless, clean, transparent, and free of milkiness, excessive air bubbles, and essentially free of sharp angular scarring or scratching. The beads shall be spherical in shape and shall contain a minimum of 60 percent silica. Roundness shall be 75 percent minimum when tested as specified in D 1155, Procedure A.

Glass beads shall have a 1.50 minimum refractive index when tested in conformance with MSMT 211.

Glass beads shall not absorb moisture in storage and shall remain free of clusters or lumps.

951.02.04 Field Testing. Materials conforming to this specification shall be field evaluated at the National Transportation Product Evaluation Program (NTPEP) Northeast test deck for performance. Materials performing satisfactorily throughout the test period will be placed on the Administration's Prequalified Materials List. All marking materials supplied during the Contract shall be identical in composition to the materials submitted for initial testing. Conformity with these requirements will be determined by the Office of Materials and Technology (OMT).

951.02.05 Sampling for Preapproval. Sources supplying thermoplastic material and glass beads shall be submitted by the Contractor to the Engineer for approval in conformance with the Contract Documents.

Each lot of thermoplastic material will be sampled at the source and tested by the Administration over two construction seasons. If 95 percent of the lots tested conform to Specifications, source samples will no longer be required and the manufacturer may ship directly to the project. All shipments shall be accompanied by a manufacturer's certification in conformance with TC-1.03 and shall include the following:

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- (a) Manufacturer's name.
- (b) Place of manufacture.
- (c) Material color.
- (d) Date of manufacture (month-year).
- (e) Lot identification.
- (f) Size/quantity of lot represented.

Random samples will be taken on the project in conformance with the MSMT Sample Frequency Guide and tested for conformance with these specifications. Nonconformance may result in the suspension from the certification program until conformance is reestablished. To reestablish conformance, the manufacturer shall achieve a 95 percent approval level from samples taken at the manufacturer's facility and tested by the Administration prior to shipment to Administration projects.

Each lot of glass beads shall be sampled in conformance with the MSMT Sample Frequency Guide and shall be submitted to the OMT for testing and approval prior to use.

Sampling will be by batch or lot which is defined as a maximum of 44 000 lbs of material.

951.02.06 Certification. The Contractor shall furnish notarized certification as specified in TC-1.03. The manufacturer shall certify that any reflective thermoplastic materials supplied during the Contract conforms to the identical formulation as the samples submitted for evaluation on the NTPEP Northeast test deck, and identify the formulas by referring to the code used on the deck. Reflective thermoplastic materials which fail to conform will be rejected.

The manufacturer shall also provide the following:

- (a) Material Safety Data Sheets for all materials submitted for testing and use.
- (b) A facility, presently in operation, capable of producing the reflective thermoplastic materials in the quantity and quality required by the Administration.
- (c) A laboratory subject to the Administration's approval which is capable of performing the required tests.

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951.04 — REMOVABLE PAVEMENT MARKING TAPE

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**CATEGORY 900
MATERIALS**

SECTION 951 — PAVEMENT MARKING MATERIALS

951.04 REMOVABLE PAVEMENT MARKING TAPE. Removable pavement marking tape shall remain in place on the pavement surface without being displaced by traffic, or affected by weather conditions. The material shall be capable of being removed without the use of heat, solvents, grinding, or sand blasting and shall not leave an objectionable residue.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

Performance Requirements. When applied in conformance with the manufacturer's recommendations, the material shall provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface or underlying markings remain stable. The material shall be weather resistant and, through normal traffic wear, shall show no lifting or shrinkage that will significantly impair the intended usage of the tape throughout its useful life, and shall show no significant tearing while in place, or other signs of poor adhesion. The material shall be capable of easy removal without tearing into small pieces.

951.04.01 White and Yellow. Removable preformed pavement marking materials shall conform to the requirements of the MdmUTCD and the following:

- (a) **Composition.** The marking material shall consist of a mixture of polymeric materials, pigment, and glass beads distributed uniformly throughout the surface.
- (b) **Color.** The color of the marking materials shall match Federal Test Standard No. 595 for the following color numbers:

White - 37925
Yellow - 38907

- (c) **Glass Beads.** Glass beads shall conform to the General Requirements of M 247 and have a minimum refractive index of 1.90 when tested as specified in MSMT 211.
- (d) **Frictional Resistance.** The British Pendulum Number shall be a minimum of 50 when tested as specified in E 303.
- (e) **Certification.** Samples submitted to the Office of Materials Technology (OMT) for testing shall be accompanied by the manufacturer's certified analysis in conformance with TC-1.03.

Any material supplied for a Contract shall be identical in composition to the material originally submitted for testing. Conformity will be determined by OMT.

- (f) **Field Testing.** Line marking materials conforming to the Contract Documents will be field tested by The National Transportation Product Evaluation Program (NTPEP) and over 180 day period as specified in MSMT 723 for conformance with the following:

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- (1) Ease of Application - satisfactory.
- (2) Removability - a minimum rating of 2.
- (3) Residue Remaining at Time of Removal (day and night) - minimum rating of 2.
- (4) Durability, Appearance, and Night Visibility - minimum weighted rating of 4.
- (5) Loss or Movement - minimum rating of 2.

Upon satisfactory completion of the field testing, the marking materials will be placed on OMT's Qualified Products List. The material shall conform to all criteria for a minimum period of 120 days to be considered satisfactory.

951.04.02 Black. Removable preformed pavement marking materials shall conform to the requirements of the MdMUTCD and the following:

- (a) **Composition.** The non-reflective blackout tape shall not contain metallic foil and shall consist of a mixture of high quality polymeric materials, pigments, and inorganic fillers distributed throughout its cross-sectional area, with a matte black non-reflective surface. The film shall be pre-coated with a pressure sensitive adhesive. A nonmetallic medium shall be incorporated to facilitate removal.

For patterned materials, a minimum of 20 percent of the total surface area shall be raised and coated with nonskid particles. The channels between the raised areas shall be substantially free of particles.

- (b) **Color.** The color of the blackout material shall match Federal Test Standard No. 595 for the following color numbers:

Black - 37038 (or as approved by the Engineer)

- (c) **Frictional Resistance.** The British Pendulum Number shall be a minimum of 50 when tested as specified in E 303.
- (d) **Certification.** Samples submitted to OMT for testing shall be accompanied by the manufacturer's certified analysis in conformance with TC-1.03.

Any material supplied for a Contract shall be identical in composition to the material originally submitted for testing. Conformity will be determined by OMT.

- (e) **Field Testing.** Line marking materials conforming to the Contract Documents will be field tested by The National Transportation Product Evaluation Program (NTPEP) and over a 180 day period as specified in MSMT 723 for conformance with the following:

- (1) Ease of Application - satisfactory.
- (2) Removability - a minimum rating of 2. The manufacturer shall show that the blackout tape can be manually removed after its intended use, intact or in large pieces, at

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temperatures above 40 F without the use of heat, solvents, grinding, or sand or water blasting. The blackout tape shall remove cleanly from existing markings that are adequately adhered to the pavement surface.

- (3) Residue Remaining at Time of Removal (day and night) - minimum rating of 2.
- (4) Durability, Adhesion, Appearance, and Night Visibility - minimum weighted rating of 4. The manufacturer shall demonstrate that the properly applied blackout tape adheres to the roadway and existing stable roadway markings under climatic and traffic conditions normally encountered in the construction work zone.
- (5) Loss or Movement - minimum rating of 2.

Upon satisfactory completion of the field testing, the marking materials will be placed on OMT's Qualified Products List. The material shall conform to all criteria for a minimum period of 180 days to be considered satisfactory.

951.04.03 Packaging. Preformed pavement markings shipping package shall conform to the manufacturer's shipping requirements to prevent damage during delivery and unloading of all shipments. The shipping package shall be marked with the following information placed on each container:

- (a) Description of item.
- (b) Date of manufacture.
- (c) Successful Bidder's Name.
- (d) Purchase Order Number.
- (e) Lot Number.
- (f) Color.
- (g) Installation instructions.

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951.05 — SNOWPLOWABLE RAISED PAVEMENT MARKERS and
RECESSED PAVEMENT MARKERS

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**CATEGORY 900
MATERIALS**

SECTION 951 — PAVEMENT MARKING MATERIALS

**951.05 SNOWPLOWABLE RAISED PAVEMENT MARKERS (SPRPM) AND
RECESSED PAVEMENT MARKERS (RPM).**

Pavement Marker Reflector Lenses. Pavement marker reflector lenses shall conform to the requirements of D 4383 and shall be comprised of materials with adequate chemical, water and UV resistance for the intended use. The reflector lens shall contain one or two prismatic reflective faces to reflect incident light from opposite directions. The reflector lens shall be in the shape of a shallow frustum of a pyramid. The bottom of the reflector lens shall be equipped with an elastomeric pad to permit its attachment to the surface of the casting using the manufacturer's recommended adhesive. The lens faces shall provide extremely hard and durable abrasion resistant surfaces.

Pavement marker reflector lenses shall be 4.00 x 2.00 x 0.46 in. The slope of the reflecting surface shall be 30 degrees and the area of each reflecting surface shall be 1.7in.². The outer surface of the shell shall be smooth except in identification areas.

The pavement marker reflector lens shall be imprinted with the model number and the manufacturer's name.

SPRPM Casting. Both ends of the casting shall be shaped to deflect a snow plow blade. The bottom of the casting shall incorporate two parallel keels and an arcuately shaped web designed to fit into a grooved surface. Casting dimensions shall be a minimum of 9.25 x 5.86 x 1.69 in. and shall not exceed 10.5 x 7.25 x 1.69 in. The installed height shall not exceed 0.25 in. above the road surface.

The casting shall be nodular iron conforming to A 536, Grade 80-55-06, hardened to 51 to 55 Rc. The surface of the keel and web shall be free of scale, dirt, oil, grease or any other contaminant, which may reduce its bond to the epoxy adhesive.

The casting shall be imprinted with the model number and the manufacturer's name.

Recessed Pavement Marker Adhesive. The adhesive used to fasten the pavement marker lens to the pavement surface shall conform to D 4383-05 Table X1.4.2.3 M 237 Type II. Rapid Set Type adhesives shall not be used.

Casting Adhesive. The epoxy adhesive used to fasten the castings to the pavement surface shall conform to D 4383-05 Table X1.1.

Reflector Lens Adhesive in Casting. The adhesive used to fasten the reflector lens to the casting shall conform to the manufacturers' recommendations.

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RECESSED PAVEMENT MARKERS**

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951.05.01 Field Testing. Materials conforming to SPRPM Specification shall be field evaluated at the National Transportation Product Evaluation Program (NTPEP) Northeast test deck for performance. Materials conforming to recessed pavement marker specification shall be field evaluated at any (NTPEP) test deck for performance. Materials performing satisfactorily throughout the test period will be placed on the Administrations Prequalified Materials List. All marking materials supplied during the Contract shall be identical in composition to the materials submitted for initial testing. Random sampling will be performed on projects sites. Conformity with these requirements will be determined by the Office of Materials Technology (OMT).

951.05.02 Facility Sampling. Random testing of samples will be performed by the Administration as Quality Assurance and certification verification. Materials will be periodically sampled at the manufacturer's facility by the Administration. Each sample shall be accompanied by a certification showing compliance with the physical requirements of this Specification. Materials supplied during the Contract shall be identical in composition to the materials submitted for initial testing. Conformity with these requirements will be determined by OMT.

Sources supplying materials shall be submitted by the Contractor to the Engineer for approval in conformance with the Contract Documents.

The material manufacturer shall reimburse the Administration for the cost of sampling and shipment of the samples when sampled by the Administration.

Material Shipment. The components shall be shipped in containers sealed by the manufacturer. The label on each container shall include the following information:

- (a) Manufacturer's Name.
- (b) Place of Manufacture.
- (c) Color of Material and Component Type.
- (d) Date of Manufacture (month-year).
- (e) Batch and Lot Identification Number.
- (f) Size/quantity of lot represented.

951.05.03 Certification. The Contractor shall furnish notarized certification as specified in TC-1.03.

The manufacturer shall certify that any SPRPM materials supplied during the Contract conforms to the identical composition of the samples submitted for evaluation on the NTPEP

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RECESSED PAVEMENT MARKERS**

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Northeast Test Deck, and identify the SPRPM materials by referring to the code used on the deck. PRPM materials which fail to conform will be rejected.

The manufacturer shall certify that any recessed pavement marker materials supplied during the Contract conforms to the identical composition of the samples submitted for evaluation on any NTPEP Test Deck, and identify the recessed pavement marker materials by referring to the code used on the deck. Recessed pavement marker materials which fail to conform will be rejected.

The manufacturer shall also provide the following:

- (a) Material Safety Data Sheets for all materials submitted for testing and use.
- (b) A facility, in operation, capable of producing the materials in the quantity and quality required by the Administration.
- (c) A laboratory capable of performing the required tests. This laboratory will be subject to the Administration's approval.

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MATERIALS**

SECTION 951 — PAVEMENT MARKING MATERIALS

951.06 HEAT APPLIED PERMANENT PREFORMED THERMOPLASTIC PAVEMENT MARKING MATERIAL. The material shall be highly durable retroreflective polymeric materials designed for use as transverse lines, numbers, legends, symbols and arrow markings subjected to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment.

The applied material shall adhere to hot mix asphalt (HMA), open-grade friction courses (OGFC), stone matrix asphalt (SMA), portland cement concrete (PCC), and any existing pavement markings when applied using normal heat from a propane fueled heat gun in conformance with manufacturer's recommendations.

The applied material shall be capable of conforming to pavement contours, breaks and faults, shall not be affected by weather conditions, and shall remain in place on pavement surfaces without being displaced by traffic.

The material shall have a minimum shelf life of one year.

The material shall conform to the requirements of the MdMUTCD and the following:

(a) Composition. The material shall consist of polymeric materials, pigments, binders and glass beads distributed throughout the entire cross-sectional area. The thermoplastic material shall conform to M 249 with the exception of the relevant differences for the material being supplied in the preformed state.

Restrictions. The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm when tested by X-ray diffraction, ICP, or comparable method capable of this level of detection. Nonleachable lead based pigments will not be permitted. Diarylide type pigments shall only be used when the manufacture or pavement marking material application temperature does not exceed 392 F.

(b) Color. Preformed markings shall consist of film with pigments selected and blended to match Federal Standard 595 color chip Nos. 17886 and 13538 for white and yellow respectively.

(c) Frictional Resistance. The surface of the applied material shall provide a minimum average skid resistance value of 50 BPN when tested in conformance with E 303.

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- (d) **Patchability.** The material shall be capable of use for patching worn areas of the same type in conformance with manufacturer's recommendations.
- (e) **Thickness.** The minimum thickness, without adhesive, shall be 120 mils.
- (f) **Adhesion.** The material shall retain a minimum of 65 percent adhesive bond after 100 cycles of freeze-thaw when tested in conformance with C 666, Method B.
- (g) **Beads.**
 - (1) **Index of Refraction.** All beads shall meet the general requirements of M 247, Type I, and shall have a minimum index of refraction of 1.50 when tested using the liquid oil immersion method specified in MSMT 211.
 - (2) **Acid Resistance.** A maximum of 15 percent of the beads shall show a formation of a distinct opaque white layer on the entire surface after exposure to a 1 percent solution (by weight) of sulfuric acid in conformance with MSMT 211.

Field Testing. Materials conforming to this Specification shall be field tested at AASHTO regional test facilities, such as National Transportation Product Evaluation Program (NTPEP), for performance.

Materials performing satisfactorily throughout the test period, including exhibiting a minimum retained reflectance of 100 mcd/m²/lux at the completion of the testing, will be placed on the Prequalified Materials List maintained by the Office of Materials and Technology.

Certification. Any marking material supplied during the Contract shall be identical in composition to the material submitted for initial testing. Samples submitted for testing shall be accompanied by the manufacturer's certified analysis in conformance with TC-1.03.