



MoDOT Specification Review

2023 Black to the Basics

February 2023

@ Holiday Inn Executive Center, Columbia MO

MAPA/MoDOT Specification Topics

- Ground Tire Rubber
- High RAP/RAS Mix Performance
- Cold Weather Paving
- VRAM and Longitudinal Joint Update
- Future Specification Changes
 - 403 BMD Spec
 - IC/PMTP
- Safety Items
 - Red/Blue Warning Lights
 - PPE
 - Work Zone Traffic Management JSP
- Where to Find Specifications

MoDOT History with GTR



- MoDOT accustomed to using ground tire rubber
 - Allow the GTR blended into asphalt binder (wet process) for about 20 years
- GTR added as an aggregate (dry process)
 - 2006 and 2014 had two pilot projects using GTR (dry process)
 - 2020 trial project on I-44 Franklin County
- MO 740 ECR (Engineered Crumb Rubber) Trial
 - 1.14 miles (2.28 lane miles)
 - 10 percent GTR by weight of asphalt binder
 - Used Elasticko crumb rubber additive
- I-155 ECR Dense Graded and SMA Trial



MoDOT (Dry Process) GTR Specification

1.0 Description. This work shall consist of the dry process of adding ground tire rubber (GTR) to modify bituminous material to be used in highway construction. Existing GTR requirements in Section 1015 pertain to the wet process method of GTR modification that blends GTR with the asphalt binder (terminal blending or blending at HMA plant). The following requirements shall govern for dry process GTR modification. The dry process method adds GTR as a fine aggregate or mineral filler during mix production. All GTR modified asphalt mixtures shall be in accordance with Secs 401, 402, or 403 as specified in the contract; except as revised by this specification.



MoDOT (Dry Process) GTR Specification

2.1 Product Approval. The GTR product shall contain a Trans-Polyoctenamer (TOR) added at 4.5 % of the weight of the crumb rubber or an engineered crumb rubber (ECR) workability additive that has proven performance in Missouri. Other GTR additives shall be demonstrated and proven prior to use such as a five-year field performance history in other states or performance on a federal or state-sanctioned accelerated loading facility.

- TOR is a polymer/compatibilizer that makes GTR workable
- Engineer Crumb Rubber (ECR) workability additive – Elastiko™
- Other Sources – NOT BEEN PROVEN IN MISSOURI YET

MoDOT (Dry Process) GTR Specification





MoDOT (Dry Process) GTR Specification

5.0 Testing During Mixture Production. Testing of asphalt mixes containing GTR shall not begin until at least 30 minutes after production or per additive supplier's recommendation.

7.0 Mix Design Test Method Modification. A formal mixing procedure from the additive supplier shall be provided to the contractor and engineer that details the proper sample preparation, including blending GTR with the binder or other additives. Samples shall be prepared and fabricated in accordance with this procedure by the engineer and contractor throughout the duration of the project.

8.0 Mix design Volumetrics. Mix design volumetric equations shall be modified as follows:

MoDOT (Dry Process) GTR Specification

9.0 Minimum GTR Amount. The minimum dosage rate for GTR shall be 5 % by weight of total binder for an acceptable one bump grade or 10 % by weight of total binder for an acceptable two bump grade as detailed in the following table. Varying percentage blends of

Contract Binder Grade	Percent Effective Virgin Binder Replacement Limits	Required Virgin Binder Grade	Minimum GTR Dosage Rate
PG 76-22	0 - 20	PG 70-22	5 %
		PG 64-22	10 %
PG 70-22	0 - 30	PG 64-22	5 %
		PG 58-28	10 %
PG 64-22	0 – 40*	PG 58-28	5 %
		PG 52-34	10 %
PG 58-28	0 – 40*	PG 52-34	5 %
		PG 46-34	10 %

MoDOT (Dry Process) GTR Specification

403.2.5.2 Fibers. A fiber additive shall be used as a stabilizer in SMA Mixtures. Fibers shall be uniformly distributed by the end of the plant mixing process. The dosage rate for fibers shall be no less than 0.3 percent by weight of the total mixture for cellulose and no less than 0.4 percent by weight for mineral fibers.

403.4.9 Draindown. AASHTO T 305, Draindown Test, shall be performed on all SMA mixtures prior to job mix approval. The mixture shall be stabilized in such a way that the draindown of the asphalt binder shall not exceed 0.3 percent by weight of mixture.

- One Trial Project indicated that GTR can improve skid resistance in SMA mixtures without the use of Fiber Additives.
- Trial SMA mixture passed drain-down test, no visible bleeding, and increased skid resistance approximately 14% from Control.

High RAP/RAS Mix Performance

- 2015 Specification change for Section 401 mixes
- 2021 Specification change for Section 402 mixes to match

Binder	Percent Effective Virgin Binder Replacement		
	RAP	RAS	RAP and RAS combination
Contract Grade Virgin Binder shall be used	0 - 20	0 -10	$RAP + (2 \cdot RAS) \leq 20$
Virgin Binder shall be Softened One Grade ^a	21 - 40	11 - 20	$20 < RAP + (2 \cdot RAS) \leq 40$
Blend Chart ^b	0 - 100	N/A	N/A
Extraction and Grading of Binder from final Mixture ^c	0 - 100		

$$RAP G_{sb} = RAP G_{se} \times 0.98$$

Project Summary, RAP/RAS replacement

Rte	County	Year	Total %ABR	RAP %ABR	RAS %ABR	Virgin Binder Grade	Replacement
59	Atchison J1L0600K	2006 (2011 Chip)	0	0	0	PG64-22	Virgin Mix
79	Lincoln J3P0789	2008 (2014 Chip)	0	0	0	PG64-22	Virgin Mix
6	Adair J2P0782C	2015 (2020 Scrub)	27%	27%	0	PG58-28	21-40% RAP
KK	Lincoln J3L1500C	2015	37%	37%	0	PG58-28	21-40% RAP
24	Randolph J2P3051	2017	34%	30%	4%	PG58-28	21-40% RAP + 2RAS
24	Chariton J1P3005	2017	34%	30%	4%	PG58-28	21-40% RAP + 2RAS
136	Scotland/Clark J2L1700B	2015 (2020 Chip)	18%	10%	8%	PG58-28	21-40% RAP + 2RAS
U	Lincoln J2S3001	2015	50%	24%	26%	PG46-34	Extraction & Grading of Mixture
6	Grundy/Sullivan J2P0782	2015 (2018 Micro)	45%	15%	30%	PG46-34	Extraction & Grading of Mixture
6	Sullivan J2P0782B	2015	45%	14%	31%	PG46-34	Extraction & Grading of Mixture



Virgin Mixes – 5 Years After Construction

Rte. 59 J1L0600K

Rte. 79 J3P0789



27% & 37% RAP Mixes – 5 Years After Construction

Rte. 6 J2P0782C



Rte. KK J3L1500C





30% RAP & 4% RAS Mixes – 5 Years After Construction

Rte 24_Randolph_J2P3051 (2022)



Rte 24_Chariton_J1P3005 (2022)





10% RAP & 8% RAS Mixes – 5 & 7 Years After Const.

US 136_Scotland/Clark J2L1700B





45% - 50% RAP/RAS Mixes – 5 Yrs After Construction

Rte. 6_Grundy_J2P0782

Rte U_Lincoln_J1P2208

Rte. 6_Sullivan_J2P0782B



7 years after construction 14% RAP, 31% RAS



Fixing High RAP/RAS Issues – Eff. July 2023

- NW and NE Districts to specify PG 58H-28
 - H – Heavy Traffic ~ PG 64
 - -28 C ~ -18.4 F provides resistance to thermal cracking
- 2024 Specification change for Section 401 & 402 Mixes

Binder	Percent Effective Virgin Binder Replacement		
	RAP	RAS	RAP and RAS combination
Contract Grade Virgin Binder shall be used	0 – 20	0 -10	$\text{RAP} + (2*\text{RAS}) \leq 20$
PG xx-22 Virgin Binder shall be Softened One Grade; Contract Grades requiring PG xx-28 are not required to be softened ^a	21 – 40	11 – 20	$20 < \text{RAP} + (2*\text{RAS}) \leq 40$
Blend Chart ^b	0 – 100	N/A	N/A
Extraction and Grading of Binder from final Mixture ^c	-28 BINDER GRADE 0 - 100		

Surface Level (Sec 402) Cold Weather Specification Changes



< 50 ° F

402.10 Construction Requirements.

402.10.1 Weather Limitations. Bituminous mixtures shall not be placed (1) when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 50 F or (2) on any wet surface or frozen pavement. Temperatures shall be obtained in accordance with MoDOT Test Method TM 20.

Cold Weather Specification Changes



< 40 ° F

Alternate Weather Limitations for Plant Mix Bituminous Surface Leveling

1.0 Description. Weather limitations for Plant Mix Bituminous Surface Leveling mixtures shall be as specified in Sec 402.10.1 except as otherwise allowed herein.

1.1 When all remedial actions listed in Section 2.0 have been implemented by the contractor, at no additional cost to the Commission, the alternate weather limitations in Section 1.2 shall apply in lieu of Sec 402.10.1

1.2 Alternate Weather Limitations. Bituminous mixtures shall not be placed (1) when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 40 F, or (2) on any wet surface or frozen pavement. Temperatures shall be obtained in accordance with MoDOT Test Method TM 20.

2.0 Remedial Actions.

- a) Reclaimed Asphalt Pavement (RAP) content in the mix does not exceed 20% asphalt binder replacement.
- b) No Reclaimed Asphalt Shingles (RAS) are added to the mix.
- c) A material transverse vehicle is utilized to transfer the mix from the haul trucks to the paver.
- d) Warm mix technology shall be incorporated into the mix (either by chemical additive or foaming), as approved by the engineer.



Un-tarped Truck Issues

- MAPA/MoDOT Mtg Issue – MAPA-problems with enforcing independent truck drivers.
- MAPA needs to address with truck drivers. Many of them new and do not know the specifications.
- MoDOT – PMTP tool passes problem onto contractors

Reducing Pothole Frequency with Increased Pavement Quality

- 2020 & 2021– Over 100 MoDOT TMA Crashes; Many crashed occurred fixing longitudinal joints.
- Improving Performance of Longitudinal Joints
 - Consider removal of 6" of first pass @ longitudinal joint
 - Consider use of VRAM
 - Notched wedge construction
 - BMD & Using 4 x NMAS Lift Thicknesses

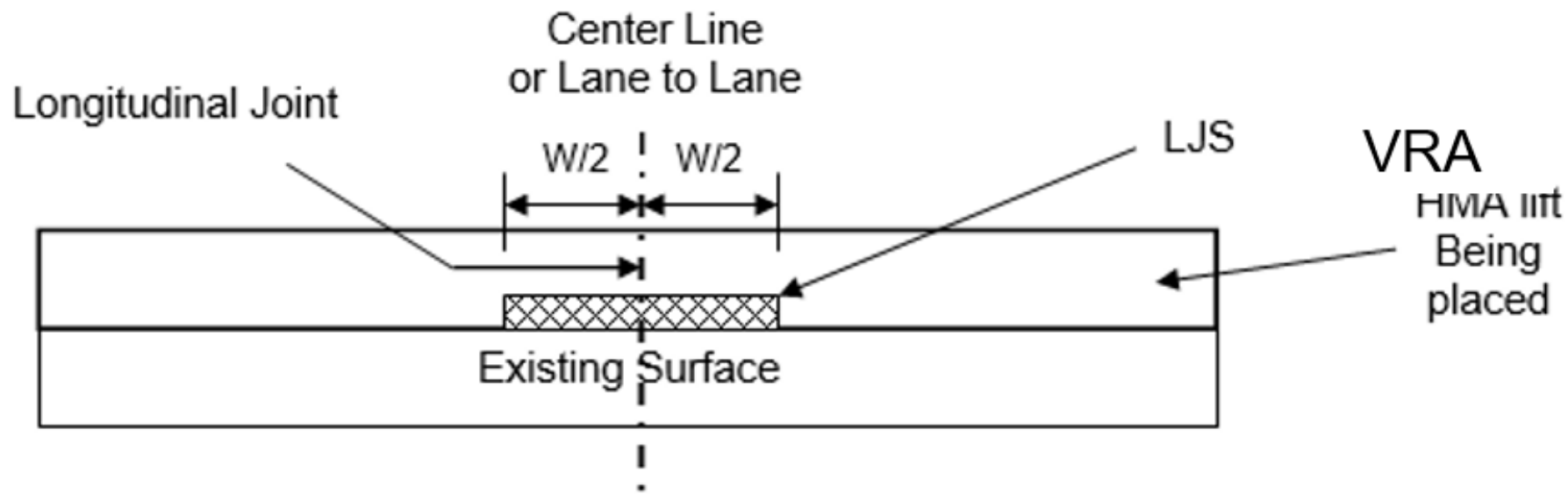




VRAM Job Special Provision

Void Reducing Asphalt Membrane for Longitudinal Joints JSP-22-03

1.0 Description. This work shall consist of applying a Void Reducing Asphalt Membrane (VRAM) at longitudinal joints at locations designated in the contract or as specified by the engineer.



VRAM Job Special Provision

5.0 QC/QA Changes

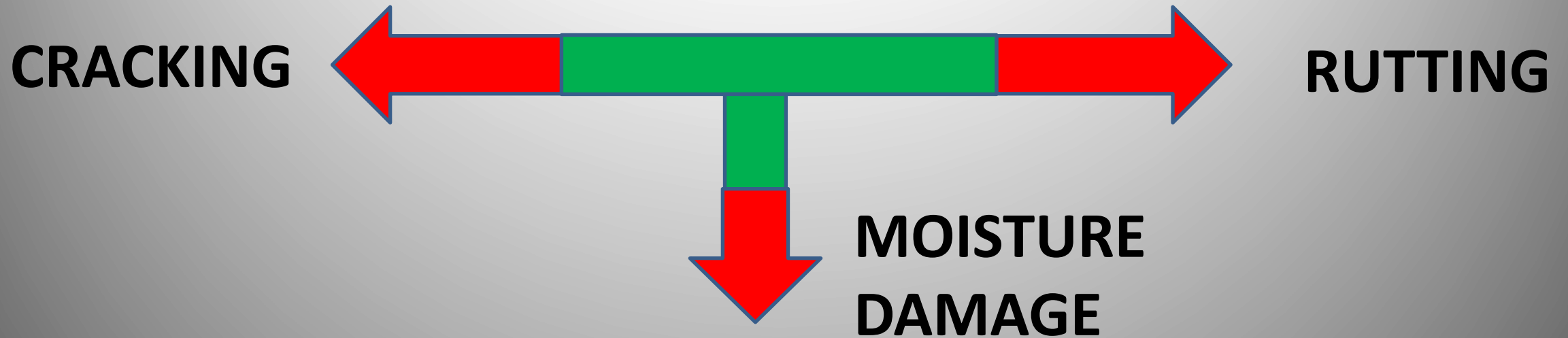
Delete Section 403.16.1 and substitute the following:

403.16.1 Joint Composition. Longitudinal joints shall be formed by the use of an edging plate fixed on both sides of the finishing machine. When the VRAM material is satisfactorily placed, the unconfined longitudinal joint density in the table within **Sec 403.19.3** for Test and Pay Factor Items will not be required and the pay adjustments will not apply. There will be no density requirement within 6-inches of the confined or unconfined longitudinal joint; however, a minimum of two passes with a roller is required within the longitudinal joint area to activate the VRAM material.

Delete Section 403.23.6 Density Adjustment in its entirety.



FUTURE - BALANCED MIX DESIGN for Low Volume Routes



New BMD Performance Specification

Current Performance Tests

IDEAL-CT (CT_{Index})

- Cracking Potential

Hamburg Wheel Track

- Rutting Potential

Tensile Strength Ratio

- Stripping/Mix Durability





“DRAFT” BMD Specification Review in Progress

403.23.5 Performance Adjustment. Incentive/disincentive payment will be calculated based upon the mixture cost for the tonnage represented by each sample, generally 10,000 tons or fraction thereof. The contract unit price of all mixtures shall be adjusted based on performance and/or TSR according to the following if the CT_{Index} results are within the incentive range and HWT results are below 0.50 inch.

<u>Performance Tests</u>			
<u>CT_{Index}</u>		<u>Hamburg</u>	<u>Percent of Contract Price</u>
<u>Non-SMA</u>	<u>SMA</u>		
<u>Greater than 100</u>	<u>Greater than 240</u>	<u>Less than 0.50 in</u>	<u>103</u>
<u>75 - 100</u>	<u>180 - 240</u>	<u>Less than 0.50 in</u>	<u>101</u>
<u>50 - 74</u>	<u>135 - 179</u>	<u>Less than 0.50 in</u>	<u>100</u>
<u>30 - 49</u>	<u>80 - 134</u>	<u>0.51 in – 0.55 in</u>	<u>95</u>
<u>Less than 30</u>	<u>Less than 80</u>	<u>Greater than 0.55 in</u>	<u>Cease production and reverify mix</u>

The final percent of contract price will follow the poorest performing test.
(e.g. If CT_{Index} is greater than 100 and Hamburg is 0.51 in; payment is 95% of contract price)

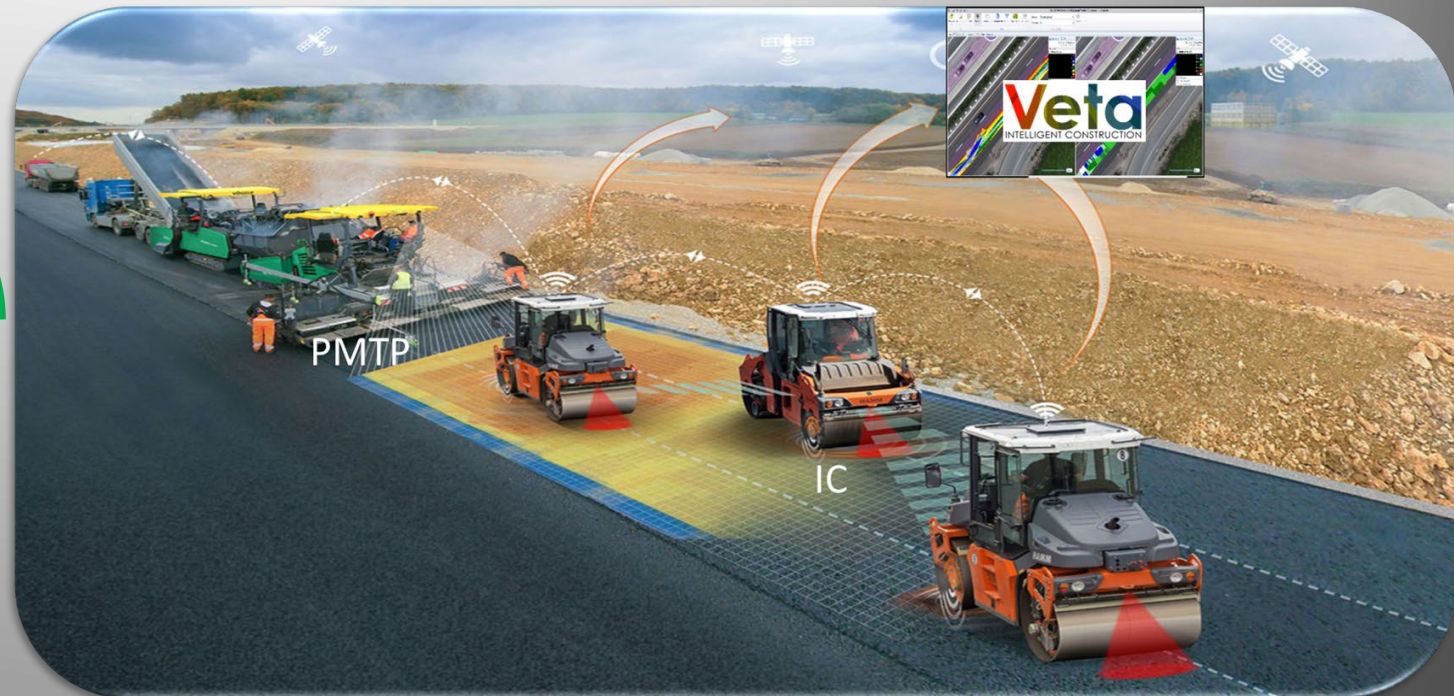
:

<u>TSR</u>	<u>Percent of Contract Price</u>
<u>90% and above</u>	<u>102</u>
<u>75-89%</u>	<u>100</u>
<u>70-74%</u>	<u>98</u>
<u>65-69%</u>	<u>97</u>
<u><65%</u>	<u>Remove</u>

New BMD Performance Specification

403.23.7.2 Pay Factors. The total pay factor (PF_T) for each lot will be equal to the weighted sum of the pay factors (PF) for each pay factor item for each lot, and is determined as follows:

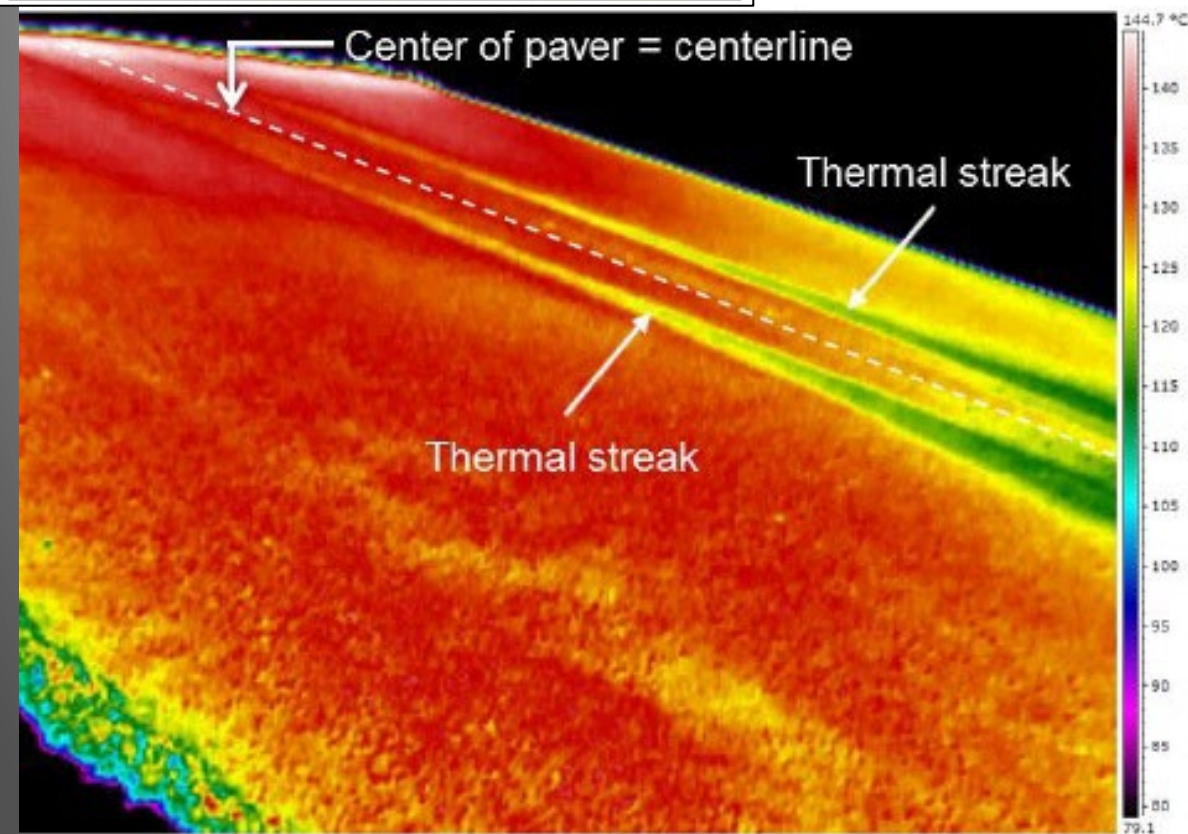
$$PF_T = + (0.75) PF_{\text{density}} + (0.25) PF_{AC}$$



Paver Mounted Thermal Profiler Specification Changes – July 2023



- Change To RTK Accuracy
 - +/- 2 inches Accuracy
- Required Boundary Control Points Automated
 - Require LiDAR or automated methods of getting edge of roadway
 - Hand-Held Rover Units Not Allowed



A photograph of a multi-lane highway with several cars driving in both directions. The image is partially obscured by a yellow and grey curved graphic element that frames the title below.

Safety Items

Red and Red/Blue Lights in Work Zones – Sec 616.5.1.1

- Used only at night (dusk to dawn)
- Only on stationary vehicles or equipment
- Two vehicles or equipment at a time
- Workers have to be present
- The work zone has to be designated by traffic control signage

State Statute RSMo 307.175

Safety Items

Personal Protective Equipment (PPE) – Sec 107.4.1

- **Daytime Workers:** shall wear a hard hat, safety glasses, a Class 2 or 3 top/vest and safety footwear
- **Daytime Flaggers:** shall wear a high visibility hard hat, safety glasses, a Class 2 or 3 top/vest, and safety footwear
- **Nighttime Workers:** shall wear a hard hat, safety glasses, Class 3 top/vest OR Class 2 top/vest with Class E bottoms and safety footwear
- **Nighttime Flaggers:** shall wear high visibility/reflective hard hat, safety glasses, Class 3 top/vest AND Class E bottoms, or Class 2 top/vest AND Class E bottoms, and safety footwear



A photograph of a multi-lane highway with many cars driving on it, positioned at the top of the slide. A yellow and grey wavy graphic separates the image from the text below.

Safety Items

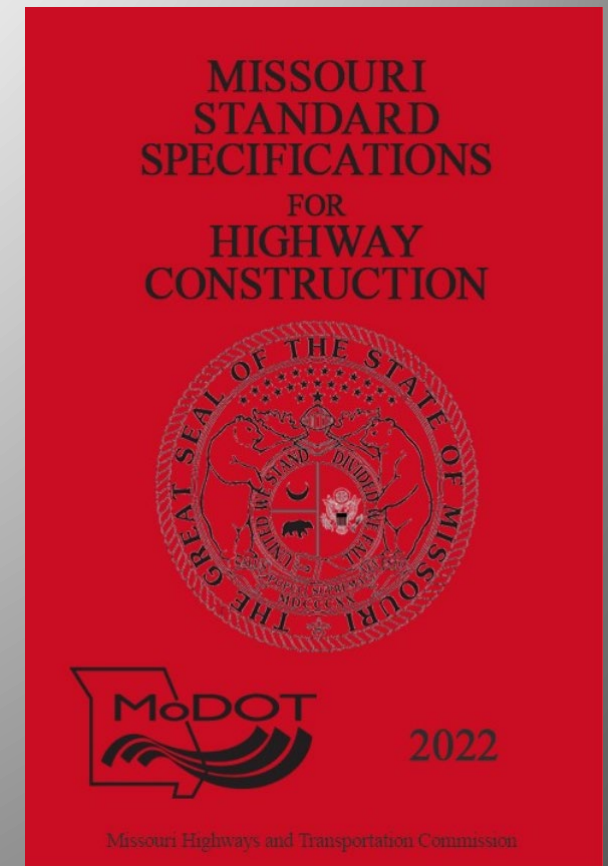
Work Zone Traffic Management JSP-02-06

- **Goes in every project**
- **Maintaining and reviewing work zones and a contractor provided work zone specialist**
- **Traffic management schedule**
- **Traffic congestion**
- **TMC Coordination**
- **Work hour restrictions and holidays**

Where to Find Contract Specifications

Missouri Standard Specifications for Highway Construction

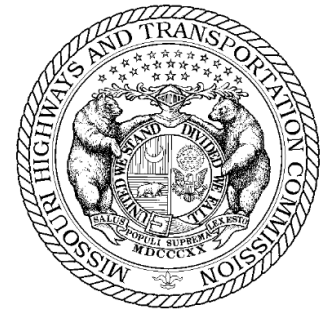
- Available online at www.modot.org/Missouri-standard-specifications-highway-construction
- New book is “published” every July; updated quarterly
- Specifications are referred to by Sections or Sec (i.e. Sec 403 is for Asphaltic Concrete Pavement)
- Standard Specifications are signed and sealed by the Chief Engineer



Where to Find Contract Specifications

Supplemental Specifications to the Standard Specifications

- Supplemental Specifications are “published” quarterly for October, January, and April
- In the same document as the General Provisions (discussing soon)
- These are interim specification changes. They are incorporated into the Spec Book every July



MISSOURI
HIGHWAYS and TRANSPORTATION
COMMISSION

JEFFERSON CITY, MISSOURI

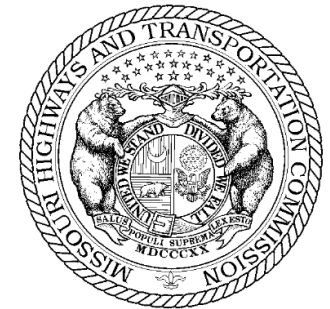
GENERAL PROVISIONS AND
SUPPLEMENTAL SPECIFICATIONS TO 2021
MISSOURI STANDARD SPECIFICATIONS FOR
HIGHWAY CONSTRUCTION

Effective April 1, 2022

Where to Find Contract Specifications

General Provisions

- The General Provisions and Supplemental Specifications are often referred to as the “Blue Pack”; they go into every contract
- General Provisions are specifications that are unique to the spec book
- This is where you find DBE, e-Construction, Safety Plan, and other contract requirements



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GENERAL PROVISIONS AND
SUPPLEMENTAL SPECIFICATIONS TO 2021
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Where to Find Contract Specifications

Missouri Standard Plans for Highway Construction

- Available online at www.modot.org/Missouri-standard-specifications-highway-construction
- New book is “published” every July; updated quarterly
- Standard Plans are numbered to align with the standard specification numbering system
- Standard Plans are signed and sealed by Division Engineers



A photograph of a multi-lane highway with several cars driving in both directions. The image is partially obscured by a yellow and grey decorative graphic at the bottom.

Where to Find Contract Specifications

Job Special Provisions (JSPs)

- Job Special Provisions are specific to each project/contract
- There are six required JSPs; although required, they differ because of the specific information provided in the provision

JOB SPECIAL PROVISIONS TABLE OF CONTENTS (ROADWAY)

(Job Special Provisions shall prevail over General Special Provisions whenever in conflict therewith.)

A.	General - Federal JSP-09-02G	1
B.	Contract Liquidated Damages JSP-13-01B	1
C.	Work Zone Traffic Management JSP-02-06K	2
D.	Emergency Provisions and Incident Management JSP-90-11A	7
E.	Project Contact for Contractor/Bidder Questions JSP-96-05	7
F.	Supplemental Revisions JSP-18-01S	8

The background of the slide is a photograph of a multi-lane highway with several cars driving on it. A large, curved yellow and orange graphic element is positioned over the bottom half of the image.

Where to Find Contract Specifications

JSPs (cont.)

- Because every project/contract differs, there will be differing requirements; JSPs spell out the requirements whether it is for a contract method, material requirements or changes, or a unique pay item.

Guardrail Posts in Concrete JSP-22-02A

1.0 Description. This work shall consist of the careful removal of any posts, including but not limited to: bridge anchor section and transition section posts, that are embedded in concrete (drain basin or other concrete surface), the coring of new holes to install posts that fall within the limits of the concrete surface, the repair of the holes left from removal of existing posts, and the backfilling of material in the new locations in accordance with the plans and these provisions.

2.0 Construction Requirements. The contractor shall carefully saw cut around the existing guardrail posts embedded in concrete or otherwise remove the posts with minimal damage to the surrounding concrete.

2.1 Posts for the new bridge anchor section and asymmetrical transition section shall be installed in the concrete drain basin per Standard Plan 606.50. The relief slot behind the post shall be filled with coarse Type 1 Aggregate to within two (2) inches of the surface. The top two (2) inches shall be filled with compacted hot mix asphalt or a dense cold asphalt repair mix. The purpose of the capped material is to prevent water intrusion.

2.2 All voids in the concrete left from the removal of the existing posts shall be filled with concrete or compacted hot mix asphalt to a depth that matches the existing thickness of the concrete surface. Concrete bag mix (5,000 psi or greater) or a commercial mix will be allowable for this purpose.

3.0 Method of Measurement. Measurement of Guardrail Posts in Concrete will be per each new post installation that falls within the limits of the concrete surface.

4.0 Basis of Payment. All labor, equipment, and materials necessary for compliance with this provision will be paid for at the contract unit bid price for Item 606-99.02, Misc. Guardrail Posts in Concrete, per each.

A photograph of a multi-lane highway with several cars driving in both directions. The image is partially obscured by a yellow and grey curved graphic element at the bottom.

Where to Find Specifications

Hierarchy of Contract Documents

- **Sec 105.4 Coordination of Contract Document**
- **Helps contractors prepare bids, know which materials to order, and how to construct the project**

- (a) Job Special Provisions
- (b) Project Specific Drawings
- (c) General Provisions
- (d) Supplemental Specifications
- (e) Standard Specifications
- (f) Standard Drawings
- (g) Bid Items or Quantities

A photograph of a multi-lane highway with several cars driving away from the viewer. The image is partially obscured by a large, stylized yellow and grey graphic element that curves across the top of the slide.

Questions??