



ENGINEERING POLICY BALLOT

Effective:

Level 2

Level two revisions require the approval of the **Assistant Chief Engineer** and the **Federal Highway Administration** only. The **Senior Management Team** is encouraged to review the content and provide comment to the appropriate director. For all other parties, these revisions are posted for information only.

ENGINEERING POLICY BALLOT

Effective: July 1, 2023

Issue 1: Asphalt Binder Grade Revision

Approval: Level 2 – Assistant Chief Engineer

Sponsor: Jason Blomberg – CM

Summary: This revision provides clarification of the temperature requirements for PG graded bituminous and surface level asphalt mixes. It further defines the expectation of the recycled limits for the mix temperatures. This revision will also improve thermal cracking and rut resistance with the Surface Level (Sec 402) and BP (Sec 401) asphalt mix types.

Publication: Missouri Standard Specification: Sec 401.2.2

Issue 2: Modified BP mix density testing

Approval: Level 2 – Assistant Chief Engineer

Sponsor: John Donahue - CM

Summary: Sec 401.8.4 is being revised to match the coring frequency of Sec 403 mix requirements. This will decrease the QC coring for BP density measurements from one per 500 tons to one per 1000 tons. The corresponding guidance in the EPG will also be updated to reflect the proposed coring guidance.

Publications: Missouri Standard Specification: Sec 401.8.4
Engineering Policy Guide: 401.2.7 Quality Control (Sec 401.8)

Issue 3: New aggregate and deleterious material testing requirement

Approval: **Level 2 – Assistant Chief Engineer**

Sponsors: John Donahue - CM

Summary: Sec 409.2 will be revised to include defined QC/QA testing frequencies for aggregate gradation and deleterious materials, rather than a per activity frequency. QC samples will be taken every 2500 tons, while QA samples will be every 10,000 tons.

Publication: Missouri Standard Specification: Sec 409.2

Issue 4: EPG 450 Revisions - Minimum Lift Thicknesses

Approval: **Level 2 – Assistant Chief Engineer**

Sponsors: Jason Blomberg - CM, John Donahue - CM, Willie Johnson - CM

Summary: The EPG is being updated to reflect a change in policy to increase minimum lift thicknesses for Superpave and Bituminous Pavement mixes. This will reflect NCHRP's recommendations for using four times the nominal maximum aggregate size, as a basis for the pavement lift thickness. Additional language was added to explain MSCR Graded binders.

Publication: Engineering Policy Guide: 450 Bituminous Pavement Design

SECTION 401

PLANT MIX BITUMINOUS BASE AND PAVEMENT

401.2.2 Reclaimed Asphalt. Reclaimed Asphalt may be obtained from Reclaimed Asphalt Pavement (RAP) and Reclaimed Asphalt Shingles (RAS). The asphalt binder content of recycled asphalt materials shall be determined in accordance with AASHTO T 164, ASTM D 2172 or other approved method of solvent extraction. A correction factor for use during production may be determined for binder ignition by burning a sample in accordance with AASHTO T 308 and subtracting from the binder content determined by extraction.

The use of reclaimed asphalt shall be limited to one of the following options with the exception of bituminous base. For bituminous base the limits specified may be increased according to the recycled materials used as follows; 10 % for RAP only, 5 % for RAS only and 10 % for the appropriate RAP and RAS combination.

Binder	Percent Effective Virgin Binder Replacement		
	RAP	RAS	RAP and RAS combination
Contract Grade Virgin Binder shall be used	0 – 20	0 -10	$RAP + (2 \cdot RAS) \leq 20$
PG xx-22 Virgin Binder shall be Softened One Grade; <u>Contract Grades requiring PG xx-28 are not required to be softened^a</u>	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		

^a ~~The virgin binder shall have a low temperature grade 6 degrees lower than the binder grade specified in the contract. Lowering the high temperature of the virgin binder is not required; however, if lowered, the virgin binder shall have a high temperature grade no lower than 6 degrees below the binder grade specified in the contract.~~ The virgin binder shall have a high temperature grade no lower than 6 degrees below the binder grade specified in the contract. However, in no case shall the virgin binder high temperature grade be lower than PG 58. Contract Grades specifying PG xx-22 shall be lowered to PG xx-28 within the recycling limits specified in the table. Contract Grades specifying PG xx-28 shall be considered softened and may be used up to the recycled limits as specified in the table. (Ex. Contract grade PG 64-22; virgin binder could be either PG 58-28 or PG 64-28. Contract grade PG 58-28H; virgin binder remains at PG 58-28H or PG 58-28).

The Pressure Aging Vessel (PAV) test temperature (AASHTO M320) shall be tested at 19° C, regardless of the high temperature grade of the selected virgin binder

^b Testing in accordance with AASHTO M323 including raw data shall be included with the mix design which demonstrates that the grade of the combine mixture meets the contract requirements.

^c Testing in accordance with either AASHTO T319, or AASHTO T164 and R59 along with grading in accordance with AASHTO M320 including raw data shall be included with the mix design which demonstrates that the grade of the combine mixture and rejuvenator, if applicable, meets the contract requirements.

MISSOURI DEPARTMENT OF TRANSPORTATION

ITEM NO.	UNIT	TYPE	ITEM DESCRIPTION	LAST UPDATED 04/01/2023
3102003	SQYD	1.00	CRUSHED STONE (B)	
3103002	TONS	1.00	CHAT (C)	
3103003	SQYD	1.00	CHAT (C)	
3105002	TONS	1.00	GRAVEL (A) OR CRUSHED STONE (B)	
3105003	SQYD	1.00	GRAVEL (A) OR CRUSHED STONE (B)	
3106002	TONS	1.00	GRAVEL (A) OR CHAT (C)	
3106003	SQYD	1.00	GRAVEL (A) OR CHAT (C)	
3107002	TONS	1.00	GRAVEL (A) OR CRUSHED STONE (B) OR CHAT (C)	
3107003	SQYD	1.00	GRAVEL (A) OR CRUSHED STONE (B) OR CHAT (C)	
3108001	CUYD	1.00	SALVAGED SURFACING	
3109905	SQYD	0.10	MISC.	
3109907	CUYD	1.00	MISC.	
3109910	TONS	0.10	MISC.	
4010101	SQYD	0.10	8 INCHES, BITUMINOUS PAVEMENT	
4010102	SQYD	0.10	9 INCHES, BITUMINOUS PAVEMENT	
4010103	SQYD	0.10	10 INCHES, BITUMINOUS PAVEMENT	
4010104	SQYD	0.10	11 INCHES, BITUMINOUS PAVEMENT	
4010105	SQYD	0.10	5 3/4 INCHES, BITUMINOUS PAVEMENT	
4010106	SQYD	0.10	6 INCHES, BITUMINOUS PAVEMENT	
4010107	SQYD	0.10	7 INCHES, BITUMINOUS PAVEMENT	
4010150	SQYD	0.10	TYPE A2 SHOULDER	
4010151	SQYD	0.10	TYPE A3 SHOULDER	
4010500	EA	1.00	SAMPLE OF COMPACTED PLANT MIX BITUMINOUS BASE	
4011207	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG70-22, (BP-1)	
4011208	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG70-22, (BP-2)	
4011209	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG64-22, (BP-1)	
4011211	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG64-22, (BP-2)	
4011213	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG64-22, (BP-3)	
4011214	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG70-22, (BP-3)	
4011231	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG58-28H, (BP-1)	
4011232	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG58-28H, (BP-2)	
4011233	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG58-28H, (BP-3)	
4013000	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG58-28H, (BP-3)	
4013010	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG64-22 (BASE)	
4019901	LS	1.00	MISC.	
4019904	SQFT	1.00	BITUMINOUS PAVEMENT MIXTURE PG64-22 (BASE WIDENING)	
4019905	SQYD	0.10	MISC.	
4019910	TONS	0.10	MISC.	
4020500	EA	1.00	SAMPLE OF COMPACTED BITUMINOUS PAVEMENT	
4020520	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG64-22 (SURFACE LEVELING)	
4020521	TONS	0.10	BITUMINOUS PAVEMENT MIXTURE PG58-28H (SURFACE LEVELING)	
4029901	LS	1.00	Misc.	
4029905	SQYD	0.10	MISC.	
4029910	TONS	0.10	MISC.	
4030001	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 64-22 (SP095C MIX) ASPHALTIC	
4030002	TONS	0.10	CONCRETE MIXTURE PG 64-22 (SP095B MIX) ASPHALTIC CONCRETE	
4030003	TONS	0.10	MIXTURE PG 70-22 (SP095C MIX) ASPHALTIC CONCRETE MIXTURE	
4030004	TONS	0.10	PG 70-22 (SP095B MIX) ASPHALTIC CONCRETE MIXTURE PG 76-22	
4030005	TONS	0.10	(SP095C MIX) ASPHALTIC CONCRETE MIXTURE PG 76-22 (SP095B	
4030006	TONS	0.10	MIX) ASPHALTIC CONCRETE MIXTURE PG 70-22 (SP095BSM MIX)	
4030007	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 76-22 (SP095BSMR MIX)	
4030008	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 76-22 (SP095BSM MIX)	
4030009	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 64-22 (SP095CLP MIX)	
4030010	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 70-22 (SP095CLP MIX)	
4030011	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 76-22 (SP095CLP MIX)	
4030012	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 64-22 (SP048F MIX) ASPHALTIC	
4030015	TONS	0.10	CONCRETE MIXTURE PG 70-22 (SP048F MIX) ASPHALTIC CONCRETE	
4030016	TONS	0.10	MIXTURE PG 76-22 (SP048F MIX) ASPHALTIC CONCRETE MIXTURE	
4030017	TONS	0.10	PG 64-22 (SP048FLP MIX) ASPHALTIC CONCRETE MIXTURE PG	
4030018	TONS	0.10	70-22 (SP048FLP MIX) ASPHALTIC CONCRETE MIXTURE PG 76-22	
4030019	TONS	0.10	(SP048FLP MIX) ASPHALTIC CONCRETE MIXTURE PG 58-28 (SP095C	
4030020	TONS	0.10	MIX) ASPHALTIC CONCRETE MIXTURE PG 64-28 (SP095C MIX)	
4030021	TONS	0.10	ASPHALTIC CONCRETE MIXTURE PG 70-28 (SP095B MIX) ASPHALTIC	
4030022	TONS	0.10	CONCRETE MIXTURE PG 64-22 (SP125C MIX)	
4030023	TONS	0.10		
4030101	TONS	0.10		

SPEC:

401.8.4 Pavement Testing. During construction, the engineer will designate as many tests as necessary to ensure that the course is being constructed of proper thickness, composition and density. Density of the roadway shall be determined by one core obtained by the contractor at a random location selected by the engineer for every ~~500~~ 1000 tons of production. ~~The cores from each day's production~~ Every four roadway cores will be averaged to determine acceptance. A joint density core shall be taken from the same transverse cross section as the mat core and alternate sides. The maximum theoretical density shown on the job mix formula shall be used for this determination. Minimum 4- inch diameter cores, shall be taken the full depth of the layer to be tested. Cores tested by AASHTO T 166 shall be in accordance with Sec 403.19.3.1.3. The contractor shall restore the surface from which samples have been taken immediately with the mixture under production or with a cold patch mixture acceptable to the engineer.

EPG:**401.2.7 Quality Control (Sec 401.8)****Pavement Testing (Sec 401.8.4)**

See Density Samples in Paving Operations.

A random number can be selected for each mat core or a random number can be selected for the first joint core and the remaining cores in the sample can be located by moving down the mat some distance. The distance between the joint cores should be equal. A mat core should be taken for each ~~500~~ 1000 tons of production in order to determine acceptance of the in-place material. A joint core should be taken along with the mat core, particularly during the first quarter of the production. If no deficient joint cores are found, meaning all joint densities are found to be above 90%, in the first 25 percent of production the established rolling procedure may be used at the direction of the Resident Engineer in lieu of joint density tests provided no changes in the material, typical location or temperatures are made. The joint core shall be centered at an offset of 6 inches from the longitudinal joint on the center line side and shall be centered at an offset of 12 inches from the longitudinal joint on the shoulder side. Also, the joint core shall ~~and~~ be taken from the same station or logmile transverse cross section, ~~generally meaning the same station or logmile~~, as the mat core. QA will determine the locations of all cores. QC will perform the testing on all cores. The specific gravity of the joint cores can be determined as a whole, or the specific gravity of each joint core can be determined and the results averaged. If there is any reason to suspect that density is not being achieved, the inspector should have more cores taken within these guidelines.

409.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Aggregate for Seal Coats ^a	1003

^a The grade of aggregate will be specified in the contract

409.2.1 Seal coat aggregate shall be tested for gradation and deleterious material by the contractor for every 2500 tons of production, and shall be tested for gradation and deleterious material by the engineer for every 10,000 tons of production.

409.2.1.2 All limestone and dolomite shall be either pre-coated as specified herein or fog sealed in accordance with Sec 413.

409.2.2.3 Emulsified asphalt or polymer modified emulsions shall be in accordance with Sec 1015, with the following exceptions:

Asphalt Emulsion Requirements			
Tests on Asphalt Binder ^a	Test Method	Minimum	Maximum
Penetration @ 77°F	ASTM D 5	60	150
Elastic Recovery @ 50°F, %	AASHTO T 301	65	---

^a These tests shall be done on the asphalt residue for emulsions and cutbacks.

409.2.3.4 Pre-coating binder shall be in accordance with Sec 1015 for PG binder or emulsions.

Category:450 Bituminous Pavement Design

450.1 Asphalt Binder

Performance grade (PG) asphalt binders are identified by their desired "high temperature" (e.g. "64", "70", "76", etc.) and "low temperature" (e.g. "-22", "-28", "-34", etc.) characteristics. The temperature numbers represent Celsius degrees and are used in 6 degree increments. The high temperature value is associated with controlling rutting, while the low temperature value is associated with resisting cold weather cracking. The following table should be used as a guide to select asphalt binder grades for bituminous mixtures. Occasionally, asphalt grading will be noted with MSCR Grading notations, as per AASHTO M 332. For instance, PG64-22H is a MSCR graded asphalt that is an allowed replacement for PG70-22. Equivalent grading is specified in Sec. 1015.10.3.1.

Asphalt Binder Selection Criteria			
Type of Corridor	Traffic Level	Type of Mix	Asphalt Binder
Interstates and Other Freeways	All Levels	Surface Mixture (SP125 or SMA) and First Underlying Lift	PG 76-22
		Remaining Underlying Lifts	PG 64-22
Other Remaining Major Routes	Heavy Volume	Surface Mixture (SP125) and First Underlying Lift	PG 70-22
		Remaining Underlying Lifts	PG 64-22
	Medium or Low Volume	Surface Mixture (SP125 or BP)*	PG 64-22
		Underlying Lifts	PG 64-22
Minor Routes	All Levels	All Mixtures (Generally BP-1 as Surface Mix)	PG 64-22
*Note: Requires JSP to include appropriate smoothness requirements.			

The low temperature number is to remain as indicated in the above table unless specifying a Surface Level or BP-4 surface mix in one of the northern districts. To improve thermal crack resistance, a PG58H-28 should be specified on minor routes in the Northwest and Northeast Districts.

The high temperature numbers have been set for the traffic loads and operation speeds normally associated with these corridors. The high temperature numbers are recommended minimums and are not to be reduced; however, may be raised to a PG 70-22 or PG 76-22, when deemed necessary, to accommodate actual or anticipated traffic conditions. Typically, the high temperature number should be raised one increment (6 degrees) when traffic speeds are expected to be in the range of 12 to 45 mph and raised two increments (12 degrees) for extremely slow traffic of < 12 mph. Typical candidates for these high temperature number raises are roadways with AADT greater than 3500 that are in a highly congested, urbanized area, have frequent stop and go traffic, or have steep grades with significantly slow traffic speeds. Use of any other PG asphalt binder must be approved by the State Construction and Materials Engineer.

If a higher type PG asphalt binder is warranted, it shall be used in the surface mixture and the first lift of the underlying mixture.

450.2 Mix Selection

The following table should be used as a guide in selecting the appropriate asphalt mix. See [Thickness Determination](#) for additional mix selection discussion regarding minor road spot improvements.

Corridor Designation	Traffic	Recommended Mix
Interstates and Other Freeways	All Traffic	Superpave
Remaining Major Routes	Total Average 24 Hour Commercial Truck Traffic - 600 or greater	Superpave
Remaining Major Routes	Total Average 24 Hour Commercial Truck Traffic - less than 600	BP-1 (Sec 401) ⁽¹⁾⁽²⁾
Minor Routes	Total Average 24 Hour Commercial Truck Traffic - 600 or greater	Superpave ⁽²⁾
Minor Routes	AADT > 3500 and Total Average 24 Hour Commercial Truck Traffic < 600	BP-1 (Sec 401)

Minor Routes	AADT < 3500 and Total Average 24 Hour Commercial Truck Traffic < 600	BP-1 or BP-2 ⁽³⁾
⁽¹⁾ Note: Requires JSP to include appropriate smoothness requirements.		
⁽²⁾ Note: Consideration should be given to alter mix type for overlays based upon existing conditions.		
⁽³⁾ Note: The selection of which mix to use is left to the district's discretion based upon past field performance.		

450.3 Layer Design

[Min. Placement Depths and Min. %AC by Volume for Asphalt Treatment Options](#)

Minimum Lift Thickness

The minimum lift thicknesses for asphalt layers should be:

SP250	SP190	SP125 ¹	SP095 ¹	SP048 ¹
3 4 in.	2 3 in.	1 3/4 2 in.	1 ½ in.	1 in.
¹ When used as the riding surface. When used as a leveling course below the top lift, the minimum lift thickness should be in accordance with EPG 450.4 Level Course .				
PMBB	BP-1 ¹	BP-2 ¹	BP-3 ¹	
3 in.	1 3/4 2 in.	1 ½ in.	1 in.	
¹ When used as the riding surface. When used as a leveling course below the top lift, the minimum lift thickness should be in accordance with EPG 450.4 Level Course .				

The above minimum lift thicknesses are recommended to ensure adequate field density can be achieved and a quality product can be provided. The minimum lift thicknesses do not account for surface irregularities in the roadway. Additional asphalt quantities should be included with single lift asphalt overlays to account for the surface irregularities. The additional asphalt quantities added should be in accordance with the average rutting depth measurements from the roadway as provided in [Table 402.1.2.1](#).

Central Office Construction and Materials may recommend thicknesses greater than the above minimums but projects should not be designed for thicknesses less than the above minimums. If using the minimum lift thickness criteria results in the project exceeding its budget, then a finer gradation asphalt mixture should be used and designed for its minimum lift thickness or greater (for example, if ~~1.75~~2 in. of BP-1 exceeds project budget, use 1.5 in. or greater of BP-2).

450.4 Level Course

Existing surfaces, both asphaltic and portland cement concrete, should be prepared either by milling or leveling course before the first full-thickness lift of asphalt is placed. Milling is the preferred method of leveling, however PMBP or SP asphaltic concrete may be used for spot wedging and for leveling course as per the standard specifications, providing the minimum thickness is not less than the following:

BP-1 and SP125	BP-2 and SP095	BP-3 and SP048
1 1/2 1 3/4 in.	1 1/4 in.	3/4 in.

The level course can be one design level lower than the lift above it. For example, an SP level C design may be used to level under an SP level B overlay. A BP mix may be used to level under an SP Level C overlay.