

PERFORMANCE GRADED BINDER

The Performance Graded Binder to be used on this project shall be PG Binder supplied by a Certified Supplier.

SECTION 1029 - PERFORMANCE GRADED BINDER (J-6-0117)

Section 503 in the Standard Specifications is amended to include Performance Graded Binders.

Subsection 1029.01 in the Standard Specifications is void and superseded by the following:

1029.01 -- Description

1. Performance Graded (PG) binder shall conform to the requirements of AASHTO M332 Table 1. PG binder shall also conform to the Department PG+ specifications (Table 1029.01) when classified as a modified binder.
 - a. The test of Direct Tension, AASHTO M332 Table 1, is omitted.
 - b. The test of J_{nriff} , AASHTO M332 Table 1, is omitted.
2. The Performance Graded Binder shall be supplied by a supplier that is certified by the Department.
 - a. A supplier may request certification by contacting the Nebraska Department of Roads, Materials and Research Division, Flexible Pavement Engineer.
 - b. A certified supplier must furnish a quality control program to the Department Bituminous Laboratory for review and approval. The program shall follow, at a minimum, the guidelines of AASHTO R26 with references to AASHTO M320 to include AASHTO M332.
 - c. A certified supplier must be a participant in one or more of the following PG Binder Groups:
 - (1) AASHTO Materials Reference Laboratory (AMRL)
 - (2) Western Cooperative Testing Group (WCTG)
 - (3) Combined States Binder Group (CSBG)
 - (4) A PG Binder round robin Group approved by the Department.
 - d. A certified supplier must maintain, meet and follow the requirements of the group or groups in which they participate, to maintain certification by the Department. In addition, active participation is required to maintain certification by the Department. Active participation will include submitting of round robin sample results.

- (1) For suppliers that desire to provide product while approved PG Binder Group membership is pending, a temporary certification may be issued for a period of up to one year. Split sample testing will be required prior to receiving a temporary certification. Split sample testing will be done on all grades of binder that the supplier intends to supply during the temporary certification period. The supplier will have up to one year to become certified by participating in and following the requirements of one or more of the approved PG Binder Groups, and to meet all other conditions for certification.
- e. A certified supplier may be asked to supply to the Department: past round robin results, laboratory inspection reports, reasons for and investigative reports on outlying results, quality control testing results, technician training and/or proficiency testing reports.
- f. A certified supplier will agree to inspection of their plant or terminal without notice anytime during production or supplying of material to the Department. The inspection may also include the supplier's laboratory.
- g. If desired, a certified supplier can voluntarily submit samples of PG binder proposed for use to the Materials and Research Bituminous Laboratory for courtesy testing prior to Asphalt production. The test results will be for Information-Only.
- h. Certification will be withdrawn from a supplier when one or more of the following conditions exist:
 - (1) Inability to consistently supply material meeting specifications as outlined herein.
 - (2) Failure to maintain an acceptable quality control program.
 - (3) The failure to meet one or more of the conditions of being a certified supplier as outlined, but not limited to only these conditions.
- i. Notification of decertification of a supplier will be submitted in writing by the Department. The notification will include the reason(s) why decertification occurred. PG Binders from a decertified source will not be accepted for use on Department projects.
- j. If a supplier has lost certification and seeks to be recertified, the following steps are required:
 - (1) Supplier shall fulfill the requirements outlined above for gaining Certified Supplier status. This may include the submittal of material samples to ensure specifications compliance before recertification approval.
 - (2) Supplier shall submit documentation to the Flexible Pavement Engineer explaining the cause(s) of decertification outlined in the notification, and the actions that are being taken to correct the problem(s) identified by the Department.

Subsection 1029.02 in the Standard Specifications is void and superseded by the following:

1029.02 -- Material Characteristics

1. Modified Performance Grade binders shall meet the following specifications:
 - a. All specified binders with a grade temperature spread of 92°C or greater, shall be defined as modified.
 - b. The PG Binder shall meet the Multiple Stress Creep Recovery (MSCR) specifications of the following Table:

**Table 1029.01
PG+ Specifications**

AASHTO T350 MSCR Average % Recovery @ 3.2 kPa for modified PG binders	
AASHTO M332 Performance Grade	Test Temperature of 58°C
58S - 34	---
58H - 34	30 Min.
58V - 34	55 Min.
58E - 34	75 Min.

- c. The binder shall incorporate a blend of base asphalt and the use of the elastomer modifiers styrene-butadiene (SB), styrene-butadiene-styrene (SBS), or styrene-butadiene-rubber (SBR).
 - (1) Polyphosphoric Acid (PPA) may be used as an additional modifier to elastomer modifiers and shall not exceed 0.50% maximum PPA addition (by weight of binder). The total phosphorous content of the PPA-modified PG Binder shall not exceed 1900 ppm. The total phosphorous content shall be determined as per ASTM D1091, ASTM D6443, or ASTM D6481.
 - (i) To determine specifications compliance, the Department requires a sample of the base asphalt binder, a sample of the PPA, and supplier-prepared varying PPA percentage modified binder samples. These samples shall be sent to the NDR Bituminous Laboratory prior to project Asphalt production.
 - (2) Crumb rubber may be used as an additional modifier to elastomer modifiers. If crumb rubber is used:
 - (i) Paragraph 5.4 (solubility) of AASHTO M332 is then void.

- (ii) Paragraph 5.5 (micron requirement) of AASHTO M332 is then void.
- d. The composite material shall be thoroughly mixed at the asphalt refinery or terminal prior to (for tank storage) or as (in-line blending) being loaded into the transport vehicle.
 - (1) The modified binder shall be heat and storage stable and shall not separate when handled and stored as per the supplier's recommendations.
 - (2) The composite material shall be homogenous, and shall not demonstrate evidence of localized gelation or over-crosslinking of polymers. The composite material shall not otherwise contain any other non-homogenous conglomerations.
- 2. Unmodified Performance Grade Binders are defined as specified binders with a grade temperature spread of less than 92°C.

Subsection 1029.03 in the Standard Specifications is void and superseded by the following:

1029.03 -- Procedures

- 1. A Material Certification shall be submitted to the Engineer prior to construction or when switching suppliers, stating the type of any modifier(s) being used. The Material Certification must also state that the material has not been air blown or oxidized.
 - a. If the PG Grade modification process of the PG Binder includes the use of PPA (Polyphosphoric Acid) and/or crumb rubber, then the Material Certification must also state the type of all modifiers used in the formulation. If PPA is used, the Material Certification must state the % PPA in the binder, and also state and confirm the total phosphorous content of the PPA modified binder.
- 2. The Contractor shall receive from the supplier, instructions on the proper storage and handling of each grade and shipment of PG Binder.
- 3. Substitution of a PG Binder, which exceeds the upper and/or lower grade designations from what is specified, requires advance notification to, and approval by, the Engineer. The substitution of the PG Binder shall also be identified in the sample identification submittals.
- 4. PG Binder Lots and their respective samples are defined as follows:
 - a. Each 200 tons of liquid PG Binder grade incorporated into the production of Asphalt, or final portion thereof, will be a binder lot.
 - b. A binder lot will include only one PG Binder grade, or will include a blend of grades as defined in paragraph 5.

- c. A binder lot will include only one supplier of the PG Binder.
 - (1) If a Contractor needs to switch binder suppliers during the production of a binder lot, it is the Contractor's responsibility to ensure both the compatibility and the specifications compliance of the mixture of the respective binder products. The supplier designation of the lot will be listed as "mixed suppliers" if the binder lot sample was taken after this occurs.
 - d. The Engineer must be notified and approve of the intent to blend binder grades, or to switch binder suppliers, prior to either occurrence.
 - e. All binders shall be sampled at the rate of at least one sample per binder lot.
 - (1) The sample shall consist of a two-quart (half gallon) can and shall be taken by the Contractor's Certified Sampling Technician, with confirmation by Department personnel. The sample shall be taken at the plant from the line between the storage tank and the mixer, or from the tank supplying material to the line, at a location from which material sampled is representative of the material in the line to the mixer. The sampling process shall follow procedures of the NDR Materials Sampling Guide.
 - (2) When the tested PG Binder is in compliance, the binder lot will be accepted and the sample will be discarded. If the tested PG Binder does not comply, then the pay factor of the PG Binder lot represented by the sample shall be adjusted according to Table 1029.02, and Table 1029.03 (if modified).
 - (3) When a total PG Binder grade type on a project is less than 200 tons, a minimum of one PG Binder lot sample is required. If the PG Binder does not comply with test specifications, then the pay factor of the PG Binder lot shall be adjusted according to Table 1029.02, and Table 1029.03 (if modified).
5. Blending of differing PG Binder grades at the hot mix plant site will be allowed only with prior approval, and with the following restrictions:
- a. The resultant blend of grades will meet PG+ (if modified binder), and/or AASHTO M332 specifications when tested as $\pm 3^{\circ}$ C of the specified PG Binder grade.
 - b. The sample of the blended material will be considered as a lot sample, and it will be taken during initial production following the blending of the binders.
 - c. The lot sample of the blended material shall have a pay factor applied as per Table 1029.02, and Table 1029.03 (if modified), when not meeting specifications.
 - d. The blended sample's identification form shall note the blending conditions and provide a statement that the sample is a blend of grades.

- e. The next lot sample, following the sample representing the blend, will be tested as the specified binder grade for the asphalt mixture being produced and shall meet AASHTO M332 and PG+ (if modified), specifications.
 - f. For modified PG Binders, only blending of the same type of elastomer modifiers listed in 1029.02 Paragraph 1.c. will be allowed.
6. The Nebraska Department of Roads, Materials and Research Bituminous Laboratory, will do selective testing on each Binder Lot. When any test result shows a lot sample not meeting specifications, that lot sample and any adjacent previous, and any adjacent following lot sample received will be tested for complete specifications compliance. Adjacent lot sample testing will then continue in this manner until tested samples meet all specifications, or there are no more lot samples remaining to be tested.
7. All lot samples as tested are subject to the Pay Factors listed in Table 1029.02, and also Table 1029.03 if modified, below:

Table 1029.02
Tests of AASHTO M332 Pay Factor Table ¹

Test and Specification	Test Results	Pay Factor
Original Binder Dynamic Shear, $G^*/\sin \delta$, kPa Min. 1.00	> 0.99	1.00
	0.97 - 0.99	0.95
	0.94 - 0.96	0.90
	0.91 - 0.93	0.85
	< 0.91	0.70 or Reject
Rolling Thin Film Oven Residue, Standard Traffic "S", MSCR $J_{nr3.2}$ Max. 4.5 kPa ⁻¹	<4.6	1.00
	4.6	.95
	4.7	.90
	4.8	.85
	>4.8	.70 or Reject
Rolling Thin Film Oven Residue, Heavy Traffic "H", MSCR $J_{nr3.2}$ Max. 2.0 kPa ⁻¹	<2.1	1.00
	2.1	.95
	2.2	.90
	2.3	.85
	>2.3	.70 or Reject
Rolling Thin Film Oven Residue, Very Heavy Traffic "V", MSCR $J_{nr3.2}$ Max. 1.0 kPa ⁻¹	<1.1	1.00
	1.1	.95
	1.2	.90
	1.3	.85
	>1.3	.70 or Reject
Rolling Thin Film Oven Residue, Very Heavy Traffic "E", MSCR $J_{nr3.2}$ Max. 0.5 kPa ⁻¹	<0.6	1.00
	0.6	.95
	0.7	.90
	0.8	.85
	>0.8	.70 or Reject
Pressure Aging Vessel Residue Dynamic Shear, "S", $G^* \sin \delta$, kPa Max. 5000	< 5001	1.00
	5001 - 5200	0.95
	5201 - 5400	0.90
	5401 - 5600	0.85
	> 5600	0.70 or Reject
Pressure Aging Vessel Residue Dynamic Shear, "H", "V", "E", $G^* \sin \delta$, kPa Max. 6000	< 6001	1.00
	6001 – 6050	.95
	6051 – 6100	.90
	6101 – 6150	.85
	>6150	.70 or Reject

Test and Specification (cont'd)	Test Results	Pay Factor
Pressure Aging Vessel Residue BBR m-Value Min. 0.300	>0.350	1.05
	0.300 – 0.350	1.00
	0.295 – 0.299	0.95
	0.290 – 0.294	0.90
	0.285 – 0.289	0.85
	<0.285	0.70 or Reject
Pressure Aging Vessel Residue BBR Creep Stiffness, mPa Max. 300	< 200	1.05
	200 - 300	1.00
	301 - 310	0.95
	311 - 320	0.90
	321 - 330	0.85
	> 330	0.70 or Reject

Table 1029.03
PG + Pay Factor Table ¹

AASHTO T350 Multiple Stress Creep Recovery (MSCR) @ 58°C Test and Specifications	Test Results	Pay Factor
AASHTO M332 Performance Grade 58H-34 Average % Recovery @ 3.2 kPa Min. 30%	> 29	1.00
	29	0.95
	28	0.90
	27	0.85
	< 27	0.70 or Reject
AASHTO M332 Performance Grade 58V-34 Average % Recovery @ 3.2 kPa Min. 55%	> 54	1.00
	54	0.95
	53	0.90
	52	0.85
	< 52	0.70 or Reject
AASHTO M332 Performance Grade 58E-34 Average % Recovery @ 3.2 kPa Min. 75%	> 74	1.00
	74	0.95
	73	0.90
	72	0.85
	< 72	0.70 or Reject

¹ If a lot sample has more than one test that results in a reduced pay factor (less than 1.00) from either or both of the above Pay Factor Tables, the single largest pay factor reduction will be the one used in determining the lot pay factor. If a lot sample passes all testing (1.00 or greater), and one or more test pay factors are 1.05, the pay factor of 1.05 will be the one used in determining the lot pay factor.

8. When all lot samples have been received and tested, a final pay factor of all the PG Binder per Asphalt type will be calculated and applied as follows:

- a. The final pay factor is the average of all lot sample pay factors. The final pay factor cannot exceed 1.000.

Example Calculations:

4 Binder Lots Asphalt: $\frac{0.95 + 1.05 + 1.00 + 0.85}{4} = 0.962$ Final Pay Factor

3 Binder Lots Asphalt: $\frac{0.95 + 1.05 + 1.05}{3} = 1.017 =$ Final Pay Factor of 1.000

- b. The final pay factor will be applied to the contract unit price of asphalt binder.
- c. The Engineer will determine if lots that have a test pay factor of 0.70 or Reject will be removed. If 0.70 or Reject material is left in place, a price factor of 0.70 will be the determined lot pay factor. The final pay factor will be applied to the contract unit price of asphalt binder.
- (1) Removal and replacement will be at no additional cost to the Department.
- (2) If any lot was removed, a new lot pay factor will be determined by testing of the replacement material.

9. When the testing of a PG binder lot sample shows test results that are outside of specification limits, the initial process of resolving the sample failure will include the following actions, as appropriate:

- a. The Department Bituminous Laboratory may conduct retesting of the remaining portion of the sample as determined necessary to confirm the original test result(s).
- b. The Department Bituminous Laboratory will notify the Department project personnel, who will in turn notify the Contractor. All parties will arrange to investigate all aspects of the testing, loading, handling and delivery of the material in question. The Contractor and Department project personnel shall report their findings to the Bituminous Laboratory.
- c. The Department Bituminous Laboratory will collect and compile all information provided.
- d. The Department Bituminous Laboratory will issue a standard report of tests for all samples tested, to include any resulting final pay factor deductions or removals. A copy of the report of tests will be distributed to the District and the Construction Division. The District will then provide a copy to the Contractor. PG Binder Supplier requests for a copy of this report will be directed to the Contractor.

10. If the Contractor wishes to dispute any results after testing and investigations have been completed on any failing lot sample(s) that subjected the final pay factor from paragraph 8 to less than 1.000, the Department will select an independent laboratory for referee testing to take place on the remaining portion of the sample(s).
 - a. Only the Contractor can initiate dispute resolution, and request referee testing. The request must be made, in writing, to the Department Construction Division within 30 days of awareness of final pay factor determination. Otherwise dispute resolution is forfeited.
 - b. The identity of the independent laboratory will not be revealed until the selected laboratory has completed the referee testing, and the Department Bituminous Laboratory has submitted a final report of the results.
 - c. If the independent lab's tests indicate failing results and pay deductions equal to or greater than the Department's, the Contractor will reimburse the Department for the cost of testing. If the independent lab's tests indicate that the material meets specification, or is at a pay deduction less than the Department's, the Department will assume the cost of testing. When the independent lab's tests indicate a pay deduction, the lesser of the Department's and the independent lab's deductions will be applied.

Subsection 503.05 in the Standard Specifications is amended to include the following:

503.05 -- Method of Measurement

PG Binder shall be measured in accordance with Subsection 503.05, Paragraph 3, in the Standard Specifications. References to the term asphalt cement are superseded with the term PG Binder.

Subsection 503.06 in the Standard Specifications is amended to include the following:

503.06 -- Basis of Payment

Subsection 503.06 in the Standard Specifications is amended to provide that PG Binder, accepted by the Engineer for use in asphaltic concrete, will be paid for at the contract unit price per ton (Megagram) for the item "Performance Graded Binder _____", less any deductions as prescribed in the pay factor tables.