

Approval & Reception Procedure

DG – Geotechnical Department	
High-Tenacity Bituminous Wearing Course	Document no: ARP/DG/23
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1. Reference standard

ASTM: American Society for Testing and Materials, for detailing as in the following.

JTG: China's highway industry construction, for detailing as in the following.

2. Approval procedures

2.1 Definition

- ① Each batch (bituminous mixture) refers to the same type of bituminous mixture for the same pavement layer.
- ② Each batch (raw materials of bituminous mixture) refers to the raw materials used in the same pavement layer, the same type bituminous mixture, such as bitumen, mineral aggregate, tack coat (interlayer bonding material), and the material has the same shape and size and from the same source of origin.

2.2 Quality Assurance Information

Before the production and paving construction of high-tenacity bituminous mixture for wearing course, the following quality assurance information must be submitted:

- ① Method statement for the mixing, transportation and paving construction for bituminous mixture.
- ② Test report for mix design for bituminous mixture (no more than 6 months for each batch).
- ③ Test report for bitumen (no more than 6 months for each batch).
- ④ Test report for mineral aggregate (including coarse aggregate, fine aggregate, and filler) (no more than 6 months for each batch).
- ⑤ Test report for tack coat (interlayer bonding material (bitumen emulsion)) (no more than 6 months for each batch).
- ⑥ Test report for performance of bituminous mixture (no more than 6 months for each batch).

3. Reception procedures and Acceptance criteria

The high-tenacity bituminous mixture for wearing course apply high-performance polymer modified bitumen as the cementing material of the hot-mix bituminous mixture. High bitumen content is adopted in dense gradation of special aggregate skeleton, then the compacted bituminous pavement would provide excellent crack resistance, anti-rutting and impermeability, to ensure that the pavement will not be loose, potholes, shoving and other early disease. However, to ensure the interlayer connection, a non-sticky high-viscosity modified bitumen emulsion is sprayed between the wearing course and underlie layer.

3.1 Mix design for bituminous mixture

Mix design for high-tenacity bituminous mixture for wearing course shall be performed before the production and paving construction, as for the basis for controlling the bituminous mixture production plant. The performance of the bituminous mixture must be verified to comply with project requirement during mix design process. Test report for mix design for bituminous mixture contain the information as in the table below.

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Test	Unit	Acceptance Criterial	Test Method
Air Void (VV)	%	3-6	T0705 · ASTM D2726 · ASTM D2172 · ASTM D6307
Voids in the coarse aggregate fraction of the compacted mix (VCA _{mix})	%	≤VCA _{DRC}	T0705
Marshall Stability	kN	≥6	T0709 · ASTM D1559
Wheel Tracking, DS (60°C · 0.7MPa)	time/mm	≥6000	T0719
Cantabro scattering loss	%	≤8	T0733
Residual(Marshall Stability)	%	≥85	T0709 · ASTM D1559
Residual of splitting tensile strength on bituminous mixture	%	≥80	T0729
Permeability	ml/min	≤120	T0730
Remarks: Each batch (bituminous mixture) before project production work.			

3.2 Reception test for bitumen

The bitumen apply for high-tenacity bituminous wearing course would be PG100 high-viscosity high-elasticity polymer modified bitumen (no modified resin), the reception and acceptance criteria as in the table below.

Test	Unit	Acceptance Criterial	Test Method
Penetration (25 °C, 5s, 100g)	0.1mm	30 ~ 60	T0604 · ASTM D5
Softening Point T _{R&B}	°C	≥95	T0606 · ASTM D36
Flash Point	°C	≥230	T0611 · ASTM D92
Solubility (in Trichloroethylene)	%	≥99	T0607
Elastic Recovery (25°C)	%	≥98	T0662 · ASTM D6084
DSR at 60 °C (G*)	kPa	≥12	T0628
Viscosity at 60 °C	Pa·s	>580000	T0620
TFOT(or RTFOT) Residual			
Change in Mass	%	±1.0	T0610 (or T0609) · ASTM D1754 · ASTM D6 (or ASTM D2872)
Penetration Index (25°C)	%	≥70	T0604 · ASTM D5
Temperature at G*/sinδ ≥2.2kPa	°C	≥100	T0628
Remarks: In each batch (raw materials of bituminous mixture), shall include the origin, batch number and quality certificate in delivery notes.			

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3.3 Reception test for mineral aggregate (including coarse aggregate, fine aggregate, and filler)

3.3.1 Coarse aggregate

Basalt and diabase is applied for coarse aggregates, of which with good wear resistance and good adhesion to the bitumen. The reception and acceptance criteria of coarse aggregate as in the table below.

Test	Unit	Acceptance Criterial	Test Method
Polished Stone Value (PSV)	BPN	≥ 42	T0321
Los Angeles Wearing Loss	%	≤ 20	T0317 · ASTM C131 · ASTM C535
Crushed Stone Value	%	≤ 18	T0316
Apparent Specific Gravity	—	≥ 2.6	T0304 · ASTM C127
Water Absorption	%	≤ 1.0	
Slender and Flat Particles Content (3:1)	%	≤ 8	T0312
Adhesion to Bitumen	Level	≥ 5	T0616
Robustness	%	≤ 8	T0314
Particle Size <0.075mm	%	≤ 1	T0310
Soft Stone Content	%	≤ 1	T0320
Sieve Analysis	—	Tender / Regulation	ASTM C136
Remarks: In each batch (raw materials of bituminous mixture), shall include the origin, batch number and quality certificate in delivery notes.			

3.3.2 Fine Aggregate

Crushed sand (machine-made sand) is applied for fine aggregate, of which must be 100% crushed, cleaned and free of impurities, and within the size of 0-3mm. The fine aggregate must be made of neutral and alkaline crushed sand. The reception and acceptance criteria of fine aggregate as in the table below.

Test	Unit	Acceptance Criterial	Test Method
Sand Equivalent	%	≥ 65	T0334
Robustness (>3mm)	%	≤ 12	T0340
Apparent Specific Gravity	—	≥ 2.5	T0349 · ASTM C128
Sieve Analysis	—	Tender / Regulation	ASTM C136
Remarks: In each batch (raw materials of bituminous mixture), shall include the origin, batch number and quality certificate in delivery notes.			

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3.3.3 Filler

Powder formed limestone or ultramafic magmatic rock with hydrophobic alkaline behavior should be applied for filler. The filler should be dry, clean and able to be free flow from the bin. Any measures should be taken such that the filler should be free of moisture to prevent agglomeration. The reception and acceptance criteria of filler as in the table below.

Test		Unit	Acceptance Criterial	Test Method
Apparent density		t/m ³	≥2.50	T0352 · ASTM C128
Water content		%	≤1.0	T0103 · ASTM D2216
Passing	< 0.6mm	%	100	T0351 · ASTM C136
	< 0.15mm		90-100	
	< 0.075mm		75-100	
Appearance		—	No pellets, no agglomeration	---
Hydrophilic coefficient		—	≤1.0	T0353
Plasticity index		%	≤4.0	T0354 · ASTM D4318
Remarks: In each batch (raw materials of bituminous mixture), shall include the origin, batch number and quality certificate in delivery notes.				

3.4 Reception test for tack coat (bitumen emulsion)

The high-tenacity bituminous wearing course should be sprayed with non-stick polymer modified high-viscosity emulsified bitumen (non-SBR modified), and the spraying amount should be 0.8~1.0kg/m² and fully demulsification. The reception and acceptance criteria of tack coat as in the table below.

Test		Unit	Acceptance Criterial	Test Method
Residues (in sieve 1.18mm)		%	≤0.1	T0652
Particle charge		—	Cation(+)	T0653
Viscosity (Asphalt Standard Viscometer C25,3)		s	12 ~ 60	T0621
Evaporation Residue	Residual content	%	≥55	T0651
	Penetration (25°C)	0.1mm	40 ~ 60	T0604
	Softening point	°C	≥80	T0606
	Ductility (5°C)	cm	≥20	T0605
	Solubility	%	≥97.5	T0607
	Elastic recovery(25°C)	%	≥92	T0662
Remarks: In each batch (raw materials of bituminous mixture), shall include the origin, batch number and quality certificate in delivery notes.				

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3.5 Reception test for bituminous mixtures

3.5.1 Production and construction temperature of bituminous mixture

The heating temperature of high-viscosity and high-elastic polymer-modified asphalt (non-resin modified) and aggregate during the production of high-tenacity bituminous wearing course and the production and construction temperature of bituminous mixture are shown in the following table.

Bitumen temperature	180 ~ 190°C
Aggregate temperature	190 ~ 220°C
Temperature of mixture after production	170 ~ 210°C, discard when > 220°C
Delivery temperature	not less than 170°C
Paving temperature	Not less than 160, discarded when > 140°C
Compacting temperature	not less than 110°C
Curing and open traffic	After compaction, surface temperature < 50°C

3.5.2 Quality of bituminous mixture during production and construction

The high-tenacity bituminous wearing course shall be sampled in-situ and then tested. The reception and acceptance criteria of high-tenacity bituminous wearing course as in the table below.

Test		Unit	Acceptance Criterial	Test Method
Marshall	Density	g/cm ³	—	T0705 T0709 T0729 ASTM D2726 ASTM D1559 ASTM D2172 ASTM D6307 ASTM D5444
	Air void	%	3-6	
	Void in mineral aggregate (VMA)	%	—	
	Degree of saturation (VFA)	%	—	
	Stability	kN	≥6	
	Flow	mm	—	
	Bitumen content (to mixture)	%	Diff. from mix. Design 0, +0.2	
	Sieve analysis	%	Refer to mineral gradation range of high-tenacity bituminous wearing course	
Residual Marshall	Density	g/cm ³	—	
	Air void	%	3-6	
	Void in mineral aggregate (VMA)	%	—	

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	Degree of saturation (VFA)	%	—	
	Residual Marshall stability	%	≥85	
	Flow	mm	—	
Wheel Tracking, DS (60°C · 0.7MPa)		time/mm	≥6000	T0719

Remarks :

- ① Daily by each mixer, once in the morning and once in the afternoon for Marshall test, and submit relevant production documents, etc.
- ② Daily by each mixer, once in the morning and once in the afternoon for residual Marshall and wheel tracking test, and submit relevant production documents, etc.

Refer to mineral gradation range of high-tenacity bituminous wearing course

Bituminous mixture	Percentage by weight (%) passing through the squared sieve (mm)									
	16.0	13.2	9.5	4.75	2.36	1.18	0.6	0.3	0.15	0.075
Grading, upper limit	100	100	75	45	32	22	18	16	12	8
Grading, Lower limit	100	90	50	22	15	13	11	8	6	4
To comply with design requirement										
Diff. from mix. Design (%)	±4				±3					±1

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3.5.3 Quality of bituminous mixture after compaction

After compaction, the appearance should be uniform, without segregation and scratches. There should be no bleeding, loose, non-completed mixing etc. The reception and acceptance criteria of compacted bituminous mixture as in the table below.

Test		Frequency	Acceptance Criterial	Test Method
Thickness	Representative value	Once per 2000m ²	≥ -10% design	T0912 ASTM D3549
	Extremum		≥ -20% design	
Field density and Degree of compaction	Representative value	Once per 2000m ²	≥ 98% standard density in lab. ≥ 94% theoretical max. density ≥ 99% density in trial area	T0924 ASTM D2041 ASTM D2726
	Extremum		1% more in representative value	
Flatness		10 location for each 10km, 3m Straight Edge for each location	≤5mm	3m Straight Edge
Skid resistance		5 test location for each 1km	≥55BPN	T0965 · ASTM E303
Texture depth		5 test location for each 1km	≥0.6mm	T0961
Permeability coefficient		5 location for each 1km	≤120ml/min	T0971