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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

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DEPARTMENT ORDER No. 13 Series of 2013 07.07.13	**SUBJECT :**	**DPWH Standard Generic Specification for Stone Mastic Asphalt (SMA), Item 734**

In line with the mandate of the Department of providing effective standards for application in the implementation of various infrastructure projects and in view of the need of setting standard specification for Stone Mastic Asphalt, the attached **DPWH Standard Generic Specification for Stone Mastic Asphalt (SMA), Item 734** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the revised edition of the DPWH Standard Specification (Volume II – Highways, Bridges and Airports)

This Order shall take effect immediately.

ROGELIO L. SINGSON
Secretary

Department of Public Works and Highways
Office of the Secretary
WIN3U00724

DPWH GENERIC SPECIFICATION FOR

ITEM 734 – STONE MASTIC ASPHALT (SMA)

734.1 Description

The Stone Mastic Asphalt (SMA) is a gap graded hot mix asphalt surface course laid on the proposed base in accordance with this specification and in conformity with the line, grades and typical cross-section shown in the plan within the tolerances specified or established by the Engineer.

734.2 Materials Requirements

734.2.1 Composition and Quality of Stone Mastic Asphalt Mixture

The Stone Mastic Asphalt shall be composed of high proportion of coarse aggregates, fine aggregates, mineral filler and a bituminous material mixed in a central plant. Cellulose fibers, either pure or bitumen coated, shall be added to the mix to absorb the excess binder and to improve the properties of the asphalt mix.

At least three weeks prior to construction, the Contractor shall submit in writing a Job- Mix Formula (JMF) for each mixture supported by laboratory test data along with samples and sources of the components and viscosity-temperature relationships information to the Engineer for testing and approval.

Each job-mix formula submitted shall propose definite single values for:

1. The percentage of aggregate passing each specified sieve size.
2. The percentage of binder material to be added
3. The temperature of the mixture delivered on the road
4. The kind and percentage of additive to be used
5. The kind and percentage of mineral filler to be used.

After the job-mix is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances:

Aggregate Fraction	Permissible Variation from JMF (%)	
	Individual Results	Average of Three Consecutive Results
Coarser than 2.36mm	±5	±3
2.36 mm – 0.075 mm	±3	±2
Binder Content	±0.5	±0.3

Should a change in source of material be proposed or should Stone Mastic Asphalt particle size distribution and asphalt content prove unsatisfactory, a new job-mix formula shall be submitted by the Contractor in writing and be approved by the Engineer prior to production.

Approval of a new job-mix formula may require laboratory testing and verification.

The mixture shall have a minimum dry compressive strength of 1.4 MPa.

The mixture shall have an index of retained strength of not less than 70% when tested by AASHTO 165. For aggregates having a maximum sizes over 25 mm AASHTO 165 will be modified to use 150 mm x 150 mm cylindrical specimens. The 150 mm cylinders will be compacted by the procedures outlined in AASHTO T 167 modified to employ 10 repetitions of a molding load of 9.6 MPa, with no appreciable holding time after each application of the full load.

734.2.2 Stone Mastic Asphalt Mixture

The kind of gap graded bituminous mixture to be used will be as called for in the Bill of Quantities while the type and grade of bituminous material will be specified in the special provisions. The grade may be changed one step by the Engineer at no change in unit price. The bituminous material shall be asphalt cement or modified bitumen and shall conform to the applicable requirements of Item 702, Bituminous Materials.

734.2.3 Coarse Aggregates

Coarse aggregates retained on the 4.75 mm (No. 4) sieve shall be crushed stone/rock, crushed slag and unless otherwise stipulated, shall conform to the quality requirements of AASHTO M 79. It shall conform to the applicable requirements of Section 703.5.1, Coarse Aggregates of Item 703.

734.2.4 Fine Aggregates

Fine aggregates passing the 4.75 mm (No. 4) sieve shall consist of natural sand, stone, stone screenings or slag screenings or a combination thereof and unless stipulated shall conform to the quality requirements of AASHTO M 29 (ASTM D 1073). It shall conform to the applicable requirements of Section 703.5.2, Fine Aggregates of Item 703.

Recommended Gradation Target Value Ranges

Maximum Aggregate Sieve Designation, mm	Grading 'A'	Grading 'B'
	19.0 mm (3/4") Passing, %	9.50 mm (3/8") Passing, %
19.00 (3/4 inch)	90 - 100	100
12.5 (1/2 inch)	55 - 85	100
9.5 (3/8 inch)	-	90 - 100
4.75 (No. 4)	-	30 - 50
2.36 (No. 8)	18 - 35	20 - 30
0.60 (No. 30)	-	-
0.30 (No. 50)	-	-
0.075 (No. 200)	3-13	8 - 13
0.02	3	-
Binder Asphalt Content % by Weight of Mix	4.5 - 6.5	5.5 7.2
% Air Voids in Mix	4.0 - 8.0	3.0 - 5.0
Cellulose fibers (pure fiber) % by Weight of Mix	0.3 - 0.40	0.3 - 0.40
Cellulose fibers (bitumen-coated) % by Weight of Mix	0.33-0.45	0.33-0.45
Layer Depth (mm)	40 – 50	30 – 50

734.2.5 Stabilizing Additives

Cellulose fibers, either pure or bitumen coated should be used as additives to Stone Mastic Asphalt to inhibit the loss of bituminous binder by drainage from the aggregate. Both cellulose fibers, in pellets form, shall conform to the following data sheet:

a. Appearance	Grey cylindrical fiber pellets
b. Residue on Ignition (%)	15 (approx.)
c. Moisture Content (%)	6 (approx.)
d. Ph Value (%)	7 (approx.)
e. Bulk Density (g/l)	25 (approx.)
f. Bitumen/Polymer Content (%)	0 – if pure cellulose fiber 0.1 – 0.34 – if bitumen coated cellulose fiber
g. Cellulose Fiber (% by Weight)	0.3-0.4 (3-4 kgs/m.t.) – if pure cellulose fiber 0.33-0.45 (3.3-4.5 kgs/m.t.) – if bitumen coated cellulose fiber
h. Sieve Analysis (Alpine Air Draught Sieve)	
< 800 um (%)	85 (approx.)
< 200 um (%)	50 (approx.)
< 32 um (%)	15 (approx.)

734.2.6 Mineral Filler

Mineral filler shall be the fraction of fine aggregates that predominantly passes the 0.075 mm (No. 200) sieve. It may consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash or other suitable mineral matter. It shall be free from organic impurities and at the time of use, shall be sufficiently dry to flow freely and shall be essentially free from agglomerations. It shall conform to the applicable requirements of Item 703-A, Mineral Filler.

734.2.7 Proportioning of Mixture

The proportion of bituminous materials, on the basis of total weight of mix, shall be from 5.5 to 7.2 mass percent for Grading "B" while 4.5 to 6.5 mass percent for Grading "A". The exact percentage to be used shall be fixed by the Engineer in accordance with job-mix formula and other quality control requirements.

Cellulose fibers, in pellets or loose fiber form, are usually added to the bituminous mixtures in the amount of 0.3 to 0.4 percent by weight (3 to 4 kgs. per metric tonnes) if pure, while 0.33 to 0.45 percent by weight (3.3 to 4.5 kgs. per metric tonnes) is added if bitumen coated. Mineral filler shall be added to the mixture during the mixing operation in the amount of one-half to one (0.5 to 1.0) mass percent dry aggregate basis. The lower percentage limit is applicable to aggregates which are predominantly calcareous.

734.3 Construction Requirements

The construction requirements shall be in conformance, whenever applicable, with section 307.3 of Item 307.

734.3.1 Weather Limitations

Bituminous stone mastic plant mix shall not be placed on any wet surface or when weather conditions would prevent the proper handling or finishing of the bituminous mixtures.

734.3.2 Mixing Procedure with Cellulose Fiber Additives

a. Heat the aggregate between 160°C - 180°C.

b. Add the cellulose fibers, in pellets form, on the dry mix aggregates and allow approximately 5-15 seconds mixing time. It shall be added through a separate inlet directly into the weigh hopper above the pug-mill or through an opening in the pug-mill.

c. Add/spray bitumen/asphalt cement on the dry mix for 5-15 seconds.

d. The standard wet mixing time shall be observed to ensure adequate blending with asphalt cement.

734.3.3 Laying

The mixture shall be placed at a temperature of not less than 135°C and a maximum of 180°C measured in the truck before dumping into the spreader.

The mixture shall be spread and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

734.3.4 Compaction

Rolling shall be continued until roller marks are eliminated and a minimum of at least 97% of the theoretical density has been obtained. After the in-placed density have been achieved, rolling operations should stop to avoid migration of asphalt cement and filler to the compacted pavement.

Vibratory compaction (8-10 tonnes tandem roller) shall only be used after the static rollers have been applied and when the temperature of the mixture is sufficiently high. Vibratory rolling shall be limited to a maximum of 3 passes at a mixture temperature of not less than 100°C.

The newly paved section shall be closed to vehicular traffic until such time that the temperature lowers to 60-70°C.

Marshall Mix Design Criteria

Mix Criteria	Heavy Traffic Surface and Base
Compaction	50 blows
Marshall Stability	8006 N
Flow, 0.25 mm	8 Min. | 14 Max
Air Voids, % Grading "B"	3 – 5
Grading "A"	4 – 8
Voids in Mineral Aggregates, %	-
Voids Filled with Asphalt, %	65 Min. | 78 Max.
Immersion Compression Test	For Item 310
Stability, KPa	
Dry	1400
Wet	-
Index of Retained Strength (IRS), %	70 min.
Dynamic Stability, pass/mm	-
Rate of Deformation, mm/minute	-
Draindown Test, %	0.3% max.

734.4 Method of Measurement

The bituminous mixture (Stone Mastic Asphalt) will be measured by square meter (sq.m.). The quantity to be paid for shall be the number of square meters of the mixture placed and compacted in the accepted pavement. No deduction will be made for the weight of bituminous material in the mixture.

Batch weights will not be permitted as a method of measurement.

734.5 Basis of Payment

The accepted quantity shall be paid at the contract unit price for Stone Mastic Asphalt Surface Course, Hot-Laid which price shall be full compensation for furnishing of materials, handling, mixing, hauling, placing, rolling, compacting, labor, equipment, tools and incidentals necessary to complete this item of work.

Payment will be made under:

Payment Item Number	Description	Unit of Measurement
734	Stone Mastic Asphalt with Cellulose Fiber Surface Course, Hot-Laid	Square Meter