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

DPWH 13-01-2017
04-11-2017

DEPARTMENT ORDER)
No. 55)
Series of 2017)
SUBJECT : Standard Specification on the Use of
KT - Hyper Durability Epoxy Asphalt
Pavement Technology on Bituminous
Concrete Surface Course, Hot - Laid

In line with the continuing efforts to upgrade the construction technology thru adoption of successful research studies, this Department has approved the use of **KT - Hyper Durability Epoxy Asphalt Pavement Technology** on Bituminous Concrete Surface Course, Hot - Laid, subject to the specifications hereto attached.

A Certificate of Conditional Approval had been issued by this Department accrediting the use of KT - HDP in DPWH road projects from March 9, 2017 until March 8, 2022.

This order takes effect immediately.


ROMEO S. MOMO, CESO I

Undersecretary
Officer-In-Charge

Department of Public Works and Highways
Office of the Secretary



WIN7U01456

14.1.2 FET/RPF

**STANDARD SPECIFICATION ON THE USE OF KT - HYPER DURABILITY EPOXY
ASPHALT PAVEMENT TECHNOLOGY ON BITUMINOUS CONCRETE SURFACE
COURSE, HOT - LAID**

1. Description

This Item shall consist of constructing a Bituminous Concrete Surface Course, composed of aggregates, mineral filler and bituminous material with the addition of KT - Hyper Durability Epoxy Binder mixed in a central plant, constructed and laid hot on the prepared base in accordance with this Specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans.

Epoxy asphalt pavement technology - is a kind of epoxy admixture that is added to asphalt/bituminous mixture to improve its inherent characteristics (high fluid resistance, dynamic stability and durability) and the resistance to rutting of the resulting asphalt pavement.

2. Material Requirements

2.1 Composition and Quality of Bituminous Mixture (Job-Mix Formula)

The epoxy asphalt mixture shall be composed of aggregate, mineral filler, hydrated lime, and Epoxy asphalt as binder.

At least three weeks prior to production, the Contractor shall submit in writing a job-mix formula 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 Epoxy asphalt to be added.
3. The temperature of the mixture delivered on the road.
4. The kind and percentage of additive and mineral filler to be used.

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

Passing No. 4 and larger sieves	+ 7 percent
Passing No. 8 to No. 100 sieves (inclusive)	+ 4 percent
Passing No. 200 sieve	+ 2 percent
Bituminous Material	+ 0.4 percent
Temperature of Mixture	+ 10 ⁰ C

Should a change in source of material be proposed or should a job-mix formula 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 compressive strength of 1.4 MPa.

The mixture shall have a mass percent air voids with the range of 3 to 5.

The mixture shall also have an index of retained strength of not less than 70 when tested by AASHTO T 165 "*Effect of Water on Compressive Strength of Compacted Bituminous Mixtures*". For aggregates having maximum sizes over 25 mm, AASHTO T 165 will be modified to use 150 mm cylindrical specimens. The 150 mm (cylinders will be compacted by the procedures outlined in AASHTO T 167 "*Compressive Strength of Hot Mix Asphalt Mixtures*" modified to employ ten (10) repetitions of a molding load of 9.6 MPa, with no appreciable holding time after each application of the full load.

2.2 Bituminous Material

Epoxy asphalt is a two-phased chemical system in which a thermosetting amine epoxy (continuous phase) is blended with conventional asphalt (disperse phase). Epoxy resin consists of the main resin and hardener which are stored separately. Table-1 shows the standard of two (2) elements and Table-2 shows the standard of mixed epoxy resin. The epoxy asphalt, which is the combination of epoxy resin composed of the two mixed elements and asphalt with a fixed ratio of 25:75 respectively, begins with irreversible chemical reaction that increases the stiffness and strength of the mixture. After curing, epoxy resin forms a three-dimensional continuous phase in which asphalt is dispersed. Such a mixture is not only tough but also elastic at typical pavement service temperatures up to 70 degrees Celsius, providing high fatigue resistance. Epoxy asphalt is a thermoset material, does not soften as much as conventional asphalt binders at high temperatures, has good resistance to aging and chemical attack and is permeable to water and salts, in part due to its low void pavement design.

Table - 1 Standard of Epoxy Resin

	Tests	Standard Value	Test Method
Main Resin	Viscosity@25°C (mPa . s)	10000 - 15000	ASTM D 2393
	Epoxy equivalents weight (g/eq)	180 - 200	ASTM D 1652
	Flash Point, Cleveland open cup (°C)	≥240	ASTM D 92
	Density@25°C (g/cm³)	1.00 - 1.25	ASTM D 1475
Hardener	Viscosity@25°C (mPa . s)	5 - 80	ASTM D 2393
	Amine Value (mgKOH/g)	180 - 230	ASTM D 7237
	Flash point, Cleveland open cup (°C)	≥145	ASTM D 92
	Density@25°C (g/cm³)	0.75 - 1.00	ASTM D 1475

Table - 2 Standard of Combined EPOXY Resin

Main Resin: Hardener = 61:39 (Weight)

Tests	Standard Value	Test Method
Tensile Strength@23°C (MPa)	≥ 5.0	ASTM D 638
Elongation at break@23°C (%)	≥ 50	ASTM D 638

2.3 Aggregates

Aggregates shall conform to the requirements of Item 703, Aggregates of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

2.4 Mineral Filler

It shall conform to the requirements of Item 703 A, Mineral Filler of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

2.5 Hydrated Lime

It shall conform to the requirements of Item 701, Construction Lime of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

2.6 Mixing Temperature

The mixing temperature is made at a higher temperature of 175°C with a minimum temperature of 170°C. The compaction temperature was set to a minimum of 155°C.

2.7 Proportioning of Mixtures

The proportion of bituminous material on the basis of total dry aggregate shall be from 5.0 to 8.0 mass percent. The exact percentage to be used shall be fixed by the Engineer in accordance with the job-mix formula and the other quality control requirements.

During the mixing operation, one-half to one (0.5 to 1.0) mass percent of hydrated lime, dry aggregate basis, shall be added to the mixture. The lower percentage limit is applicable to aggregates which are predominantly calcareous.

3. Construction Requirements

The construction requirements shall be in accordance whenever applicable, with Section 307.3 of Item 307, Bituminous Plant-Mix Surface Course - General in DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

4. Method of Measurement

The area to be paid for under this Item shall be the number of square meters (m²) of asphalt pavement placed, compacted and accepted based on the thickness and density of the cores taken in accordance with Item 307, Subsection 307.3.10 (Acceptance, Sampling and Testing) of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

5. Basis of Payment

The accepted quantity, measured as prescribed in Subsection 4, shall be paid for at the contract unit price for Epoxy Asphalt Pavement, which price and payment shall be full compensation for furnishing all materials, handling, mixing, hauling, placing, rolling, compacting, labor, equipment, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
	Epoxy Asphalt Pavement	Square Meter

REFERENCES:

1. DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition
2. KINDAIKASI Website <http://www.kindai-kasei.co.jp/>
3. Technical Report of Technical Services Division (TSD) BRS
4. American Society for Testing and Materials (ASTM)
 - ASTM D 2393 – Test Method for Viscosity of Epoxy Resins and Related Components
 - ASTM D 1652 – Standard Test Method for Epoxy Content of Epoxy Resins
 - ASTM D 92 – Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
 - ASTM D 1475 - Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
 - ASTM 7237 – Standard Test Method for Free Cyanide and Aquatic Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection
 - ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
5. American Association of State Highway and Transportation Officials (AASHTO)
 - AASHTO T 165 – Standard Method of Test for Effect of Water on Compressive Strength of Compacted Bituminous Mixtures
 - AASHTO T 167 - Standard Method of Test for Compressive Strength of Hot Mix Asphalt