



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

207.13 DPWH  
12-12-2005

DEC 09 2005

DEPARTMENT ORDER )

NO. 97  
Series of 2005 )

SUBJECT: Use of Polymer Modified Bitumen  
(Cariphalte) as Additive to Porous  
Asphalt Mix

In line with the continuing efforts to upgrade the construction technology thru the adoption of successful research studies, this Department has approved the use of Polymer Modified Bitumen (Cariphalte) as Additive to porous asphalt mix to improve the quality of asphalt, subject to its specifications hereto attached. A Certificate of Conditional Approval had been issued by this Department, accrediting the use of Cariphalte in DPWH projects from March 2005 until March 2010.

This order takes effect immediately.

HERMOGENESE E. EMBANE, JR.  
Acting Secretary



WIN5U00049

**SPECIFICATION FOR POROUS ASPHALT PAVEMENT WITH POLYMER MODIFIED BITUMEN (CARIPHALTE)****1. Description**

This item shall consist of constructing a porous asphalt mix, a gap graded hot mix asphalt surface course laid on existing concrete or asphalt pavement as wearing course in accordance with this Specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans.

**2. Material Requirements****2.1 Composition and Quality of Porous Asphalt Mixture**

The porous asphalt mixture is a gap graded bituminous asphalt mix composed of large proportion of coarse aggregate, fine aggregate, mineral filler and Cariphalte PG76 (Polymer Modified Bitumen). The porous asphalt mixture shall allow the passage of water through it and shall have air voids within the range of 15% - 25% when tested using ASTM D 3203.

At least three weeks prior to the construction, 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 Cariphalte (Polymer Modified Bitumen) 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 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°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 porous asphalt mixture shall have a minimum compressive strength of 1.4 MPa (200 psi).

The mixture shall also have an index of retained strength of not less than 70% when tested by AASHTO T 165. For aggregates having maximum sizes over 25 mm (1 inch), AASHTO T 165 will be modified to use 150 mm x 150 mm (6 x 6 inches) cylindrical specimens. The 150 mm (6 inches) cylinders will be compacted by the procedures outlined in AASHTO T 167 modified to employ 10 repetitions of a molding load of 9.8 MPa (1400 psi), with no appreciable holding time after each application of the full load.

## 2.2 Cariphalte Properties

Polymer Modified Bitumen to be used in porous asphalt mixes shall be Cariphalte PG76, conforming to SHRP PG76 -22 when tested using AASHTO M 320.

In addition, Cariphalte PG76 shall meet the following requirements.

	Test Method	Range
Penetration @ 25 °C	ASTM D5	40 – 70
Softening Point, °C	ASTM D2398	60 minimum
Flash Point, COC, °C	ASTM D92	232 minimum
Solubility in Trichloroethylene, %	ASTM D2042	99.50 minimum
Ductility, cm	ASTM D113	150 minimum
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## 2.3 Aggregates

### 2.3.1 Coarse Aggregate

Coarse aggregate shall consist of crushed stone or crush gravel or a combination of two. The maximum size of coarse aggregates used shall not exceed 19 mm and shall conform to the applicable requirements of Item 703, Aggregates.

### 2.3.2 Fine Aggregate

Fine aggregates shall conform to the applicable requirements of Item 703, Aggregates.

## **2.4 Mineral Filler**

The mineral filler to be used shall be Portland cement and it shall conform to the requirements of Item 703 A, Mineral Filler.

## **2.5 Hydrated Lime**

It shall conform to the requirements of Item 701, Construction Lime.

## **2.6 Mixing**

Cariphalte PG76 should not be heated above 200°C. For effective aggregate coating, Cariphalte PG76 should be mixed with aggregates when the binder is at its ideal mixing viscosity of about 0.2 to 0.5 Pa.s. The ideal mixing temperature should be established prior to blending and may be determined by using a Bitumen Test Data Chart, plotting viscosity with respect to temperature. Mixing temperature must not exceed 180°C or that recommended by the Polymer Modified Bitumen supplier

## **2.7 Storage**

The storage silo shall be emptied prior to the production of asphalt concrete. The storage time should be kept to a minimum.

## **2.8 Proportioning of Porous Asphalt Mixture.**

The proportion of the Cariphalte (Polymer Modified Bitumen) shall be 4.5 to 6.5 percent. The exact percentage to be used shall be fixed by the Engineer in accordance with the job-mix formula and other quality control requirements.

Samples shall be taken from the hot bins in the asphalt plant. Sieve analysis shall be carried out on the samples and the proportioning of the mixture will be based on the results obtained.

## **2.9 Recommended Mix Design of Porous Asphalt.**

The percent void content of porous asphalt mixture shall be designed by adjusting the ratio of fine and coarse aggregates. The following gradation was recommended to yield a higher percentage of voids, high stability and requirements necessary in the design of the mix:

Sieve Sizes (mm)		Passing, %
¾	( 19 )	100
½	( 12.5 )	88 – 98
3/8	( 9.5 )	34 – 48
No. 4	( 4.75 )	17 – 24

No. 8	( 2.36 )	12 – 20
No. 30	( 0.63 )	6 – 12
No. 50	( 0.30 )	3 – 9
No. 200	( 0.075 )	2 – 7

Residual Asphalt Content, % by weight	5.0 – 6.0
Air Voids, %	15 – 25
Stability, lbs	1500 minimum

## 2.10 Mix Design

Test specimens shall be made using methods described in ASTM D 1559 or equivalent. The specimens shall be compacted using 75 compaction blows on each side of the specimen sample.

Using the selected design gradation, prepare three (3) samples with binder contents at 0.50% increments.

Perform draindown test on the specimen samples at 15°C higher than the ideal mixing temperature. Draindown results should not exceed 0.30% by total mass of mix.

Test air voids of the porous asphalt mix. Results should fall between 15% to 25%.

Test stability, flow, specific gravity and durability.

## 2.11 Evaluation Procedure on the Design of Bitumen Content

To determine the optimum asphalt content, the Cantabro test using the Los Angeles abrasion machine (ASTM C 131) on the samples must be conducted. The specimen samples shall be stored for at least 2 days at a temperature of not more than 25° and tested within 7 days from manufacture of the sample. In this method, subject the specimen samples to 300 rotations in Los Angeles abrasion machine without the steel spheres at a rate of 30 to 33 revolutions per minute and a temperature of 25°C ± 1°C. The abrasion, expressed as a loss mass, is charted with respect to the binder content. The wear loss decreases when the binder content increases with the curve sloped downward and becomes flat when a certain percentage of bitumen is reached, which corresponds to the minimum binder content needed to ensure adequate adhesion. The abrasion loss from the Cantabro test should not exceed 20% on the unaged specimens. The inflection point is the minimum asphalt content at which the sample mixture can retain its shape under the condition after compaction. The optimum asphalt content is determined as the average of the two asphalt contents. Abrasion tests on aged (7 days @ 60°C) samples must also be conducted with abrasion loss not exceeding 30% on the aged specimens

### **3. Construction Requirements**

The construction requirements shall be in accordance whenever applicable, with Item 307 Bituminous Plant – Mix Surface Course (Général) subsection 307.3 Construction Requirements.

#### **3.1 Weather Limitations**

Asphalt paving mix shall not be placed on any wet surface or when weather conditions will otherwise prevent its proper handling or finishing. It shall only be placed when the mix can be compacted to the specified density. No work shall commence when rain is imminent and all works should be suspended when it is raining and asphalt concrete delivered to the site shall be returned to the Contractor without compensation.

#### **3.2 Construction Equipment**

The Contractor shall provide a minimum of 2 (two) paving gangs for each Contract where necessary.

The Contractor shall have a minimum of two pavers, each with a capacity of not less than 40 tonnes per hour and are either pneumatic tyred or crawler mounted.

For the smooth operation of the works, the Contractor shall have an asphalt plant with a manufacturer quoted capacity of not less than 120 tonnes/hour for the purpose of this Contract. The Asphalt Concrete plant shall be equipped with a separate bitumen tank with capacity of not less than 20 tons for the purpose of storing the approved polymer modified bitumen.

Rolling should be carried out using a tandem, non-vibrating steel roller weighing not less than 6 tons. Pneumatic tired rollers should not be used at any time when compacting porous asphalt mixes.

#### **3.3 Placement**

Before commencing the paving work, it shall be the responsibility of the Contractor to check that all tools, equipment and machines necessary for the job are on the site and in proper working condition. A competent paver operator shall be operating the paving machine throughout the duration of the works. All rollers to be used must be checked to ascertain that they contain water which are not muddy or in any way contained with chemicals.

A representative from the Contractor well versed in asphalt laying work must be on site and be present throughout the duration of the works to organize and supervise the works and to handle all contingencies which may arise.

The underlaying surface shall be clean before placing the mix. The approved tack coat of bitumen emulsion shall also be spray-applied at a rate of at least 0.54 liter per sq.m. to completely cover the surface where the Porous Asphalt Pavement is to be laid.

During the placement, the mix temperature shall not deviate from the mixing temperature by more than 10°C. The temperature shall be measured at a point 100mm within the load on the truck.

The asphalt paver hopper shall not be left more than half empty unless new mix is immediately available to fill it up. In the event of break for rest or when the machine has remained idle for more than 15 minutes, the mix shall be fully discharged and joints constructed if no new mix is added.

As far as possible, the paving work shall cover the entire pavement width within one day.

### **3.4 Laying Temperature**

The temperature of Plant mixtures in the spreader hopper shall be around 140°C at the time of spreading depending on the ambient temperature.

### **3.5 Compaction Temperature**

Compacting temperatures should be determined by establishing the temperature range at which the Polymer Modified Bitumen obtains a viscosity of between 2 Pa.s and 20 Pa.s. Initial compaction should not commence at a temperature higher than this range and final compaction should stop before it reaches minimum. The surface shall be rolled when the mixture is in proper condition and when rolling does not cause undue displacement, cracking or shoving.

Firstly use a 3 – 4 metric ton static steel-wheeled rollers to compact the porous asphalt for 4 passes. Then follow by another 2 passes by using 6 – 8 metric ton steel wheeled rollers to finish the compaction.

The compacted porous asphalt concrete shall be opened to traffic movement at ambient temperature.

### **3.6 Acceptance Procedures.**

Acceptance Procedures for Cariphalte shall conform to the applicable requirements of Item 702; subsection 702.4 Acceptance Procedures for Bituminous material.

## **4 Method of Measurement**

The area to be paid for under this item shall be the number of square meters (m<sup>2</sup>) of porous asphalt pavement with Cariphalte placed, compacted and accepted.

## **5 Basis of Payment**

The accepted quantity, measured as prescribed in Section 4, shall be paid for at the contract unit price for Porous Asphalt Pavement with Polymer Modified Bitumen (Cariphalte), 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.

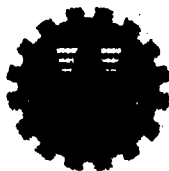
Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1	Porous Asphalt Pavement with Polymer Modified Bitumen (Cariphalte)	Square Meter

**References :**

1. Construction of Pilot Road Research Project using Porous Asphalt Pavement with Shell Cariphalte by DPWH - BRS - RDD (June 2004)
2. DPWH Standard Specification for Highways, Bridges and Airports, Volume II (1995)
3. Product Information Sheet, Shell Cariphalte (Distributed by Shell during Product Demonstration at DPWH - BRS office. August 11, 2004)





Republic of the Philippines  
Department of Public Works and Highways  
Office of the Secretary

# CERTIFICATE OF CONDITIONAL APPROVAL

## Product Accreditation

This is to certify that

**CARIPHALTE**

which is exclusively distributed  
in the Philippines by :

Pilipinas Shell Petroleum Corporation  
156 Valero St., Salcedo Village  
Makati City

is duly accredited for use in DPWH projects as polymer modified asphalt to Porous Asphalt Pavement, subject to its specifications (hereto attached) pursuant to the provisions of DPWH Department Order No. 189, series of 2002.

This Accreditation shall remain in force until expiry date printed below, subject to compliance with the requirements of the aforementioned Department Order.

Conditional Approval No. : 005  
Date Issued : March 2005  
Expiry Date : March 2010

**HERMOGENES E. ERDANE, JR.**  
Acting Secretary



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