

## GENERAL TECHNICAL SPECIFICATIONS

### 1.0 General :

All Measurements shall be made in metric system. Different items of work shall be measured in accordance with the procedures set forth in relevant sections read in conjunction with General Conditions of contract. The same shall not however apply in the case of lump-sum items. All measurements and computations ; unless other wise indicated, shall be carried nearest to be following limits :

- (i) Length and breadth..... 10mm
- (ii) Height, depth or thickness of earthwork,  
Sub-base, bases surfacing, and structural members ..... 5mm
- (iii) areas ..... 0.01 Sq.Metre.
- (iii) Cubic contents ..... 0.01 Cubic Metre.

In recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

### 2.0. Measurement of lead for Materials :

Where lead is specified in the contract for construction materials, the same shall be measured as described hereunder.

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regards shall be taken as final. Distance up to and including 100 Metres shall be measured in units of 50 Metres, exceeding 100 metres but exceeding 1 Km. in units of 100 Metres, and exceeding 1 Km. in units of 500 Metres. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the materials shall be divided into suitable blocks and for each block the distance from the centre of the block to the centre of placing pertaining to that block shall be taken as the lead distance.

### 3.0 Surface Regularity of sub grade and Pavement courses :

The surface regularity of completed sub-base courses and wearing surface in the longitudinal and transverse direction shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 Metre long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set for three camber boards at intervals of 10 Metres.

PERMITTED TOLERANCES OF SUB REGULARITY FOR PAVEMENT COURSE.

Sr.	Type of construction	Longitudinal Profile with 3 Metre straight edge.					Cross Profile
		Maximum permissible undulation in mm	Maximum number of undulation permitted in any 300 m. length exceeding in				Maximum permissible variation from specified profile camber themplate mm
1	2	3	4	5	6	7	8
1	Earth sub grade	36	30	-	-	-	15
2	Granular/lime Cement stabilized sub base.	23	-	30	-	-	12
3	Water Bound Macadam with nominal size metal (20-50)mm	18	-	-	30	-	8
4	Semi Dense carpet @ @	15	-	-	-	20	6

**Notes:**

1. These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance up to 50 percent above these values in the columns may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 in the table.

2. Surface evenness requirements in respect of both the longitudinal and profiles should be simultaneously satisfied.

3. **Rectification** : Where the surface irregularity of sub grade and the various pavement courses fall out side the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer- in-Charge at this own cost.

(I) **Sub grade**; Where the surface in high, it shall be trimmed and suitably compacted. Where the same in low, the deficiency shall be corrected by adding fresh material. The degree of compaction and the type of material to be used shall conform to the specified requirements.

(ii) **Granular/Sub Base**: Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

(iii) **Lime/Cement stabilized soil sub-Base**: For lime/ cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However where the surface is low, the same shall be corrected as described here in below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material, is less than 2 hours, the surface shall be scarified to a depth of 50mm, supplemented with freshly mixed material as necessary and recomposed to the relevant specification. When this time is more than 2 hour, the full depth of the layer shall be removed from the pavement and replaced with fresh material, to specification. In either case, the area treated shall not be less than 5 Metres wide. This also applies to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

(iv) **Water Bound Macadam Base** : Where the surface is high or low, that top 75mm shall be scarified, reshaped with added material as necessary and re compacted. The area treated at a place shall not be less than 5 Metres long and 2 Metres wide.

(v) **Bituminous Construction** : For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and re compaction to specifications, Where this surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 Metre long and not less than 1 lane wide.

**4.0 Quality Control Test during Construction. :**

The materials supplied and the works carried out by the Contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control test as described hereinafter, by the Engineer-in-charge. The testing frequencies set forth are the desirable minimum and the Engineer-in-charge shall have the full authority to carry out test as frequently as he may deem necessary to satisfy that the materials at work comply with the appropriated specification. Test procedures for the various quality control tests are indicated in the respective sections of the specification or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per prevalent accepted engineering practice to the directions of the Engineer-in-charge.

**5.0 Tests of Earthwork for Embankment Construction :****5.1 Borrow Materials:**

- (a) Sand content (IS: 2720 Part IV)  
Two test per 8000 Cubic Metres of soil.
- (b) Plasticity Test (IS: 2720 Part-V)  
Each type to be tested. Two tests per 8000 Cubic Metres of soil.
- (c) Density test (IS: 2720 part-VII)  
Each soil type to be tested. Two test per 8000 Cubic Metres of Soil.
- (d) Moisture Content Test (IS: 2720 Part-II)  
One test for every 250 Cubic Metres of soil.

## 5.2 Compaction Control :

Control shall be exercised by taking at least one measurement of density for each 1000 square Metres of compacted area, or closer as required to yield the maximum number of test results for evaluating day's work on statistical basis. The determination of density shall be accordance with IS: 2720 (Part XXVIII). Test locations shall be chosen only through random sampling techniques. Control shall be not being based on the result of any one test but on the mean value of set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increase to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of result is below 0.08 gm/cc. However for earthwork in shoulders and in top 500 mm portion of the embankment below the sub grade, at least one density measurement shall be taken for every 500 square Metres of the compacted area provided further that the number of the test in each set of measurement shall be at least 10. In other respects, the control shall be similar to that described earlier.

## 6. Following materials shall conform to the Indian Standards shown against them;

- |     |                                   |          |
|-----|-----------------------------------|----------|
| (1) | Cement                            | IS: 269  |
| (2) | Sand for masonry                  | IS: 2116 |
| (3) | Sand for concrete                 | IS: 383  |
| (4) | Course aggregate.                 | IS: 383  |
| (5) | Mild Steel.                       | IS: 432  |
| (6) | High yield strength deformed bars |          |
|     | (a) Hot Rolled.                   | IS: 1139 |
|     | (b) Cold Twisted.                 | IS: 1786 |

## 7. Barrel thickness of pipes of different class shall be under:

Sir No	Internal DiaMetre of pipes in MM	Barrel thickness (in mm)		
		NP1	NP2	NP3
1	80	25	25	-
2	100	25	25	-
3	150	25	25	-
4	250	25	25	-
5	300	30	30	-
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	-	35	75
10	600	-	40	80
11	700	-	40	80
12	800	-	45	90
13	900	-	50	100
14	1000	-	55	100
15	1100	-	60	115
16	1200	-	65	115

### Special conditions for Bituminous surface work with use of Drum mix plant, paver finisher.

1. The hot mix plant and accessories to be used for the work shall be in conformity with the specification prescribed vide Govt of India. Ministry of Transport Circular No. RQ/RMP/ 1613784 Dt. 1-1- 87 The plant shall be equipped with all units and accessories as per latest IS 3066 / 1965, as amended from time to time. The contractor will have to modify their plants suitably within a period of six months from the date of issue of latest I.S. Specification of codes.
  2. The work of laying aggregate mixed with bitumen shall start on site of work only after 8.00 hours in the morning and continue up to 17.00 hours in winter season and up to 18.30 hours in summer No work shall be done except during the period mentioned above and also on Sundays and National holidays viz. 26th January, 15th August & 2nd October.
  3. Quantity of bituminous aggregate mix to be laid shall be restricted to 250 tones per day for 30/40 capacity plant and may be more or less depending upon the rated capacity of the plant.
  4. The work of laying asphalt mix shall start latest within 60 days from the date of issue for work order except when work is closed for few days due to breakdown of machinery and during such period the contractor has not shifted paver plant to any other paver work not carried out by the same plant and will be completed as per time limit. Reasons for delay in starting of work after 60 days shall result into sufficient cause for laying compensation for disproportionate progress. However, the period from 15th June to 15th October monsoon shall not be counted for the purpose of disproportionate progress and consequent cause for levy of compensation. The contractors shall commence the work of laying payment on or before the last date of the period. The contractors shall commence the work of laying pavement on or before the last date of the period mentioned above falling which he shall pay for every day that he shall delay the commencement of the work as above in accordance with clause 2 of the contract.
- SF[g8=FS8Z &\_ INJ;GL V\NZ SFD X~ SIF" 5KL UF[0]S SFD SZLG[ GLR[ NXF"J[, ;\HFUFPP I;JFI SFD VW[ZF D[ SX[ TF[ H[ INJ;YL SFD VW]~ D]S[ T[ INJ;YL SFD X~ SZ[ tIF ;]WL ~FP 5\_\_qv ,[B[ J/TZ J;], SZJFDF VFJX[P
- s!f DXLGZL A|[SOFpG YI[, CF[I VG[ T[8,F H H]H ;DI 5]ZT] SFD A\W ZC[, CF[IP
- sZf DXLGZL A|[SOFpG ;DI NZdIFG 5[JZ %,Fg8 56 tIFYL B;[OJFDF VFJ[, G CF[I VYJF TP H %,Fg8 5PJZ YL VgI HuIFVP SFDULZL SZJFDF VFJL G CF[IP
5. The contractor shall invariably get the job mix formula for the mix approved by the Engineer in charge before starting the work.
  6. These special conditions shall be applicable to the specifications of all the items included in this contract where work is to be carried out with Hot mix plant and paver finisher.

### SCHEDULE OF WORK TO BE EXECUTED SHALL BE AS UNDER

#### Time Limit:

#### Sir No Period

#### Description of items to be executed

- |    |                               |   |
|----|-------------------------------|---|
| 1. | Month ..... Month             | 1. Collection of Materials on site  |
| 2  | From month 2 to 4 month       | 2.Erection of Plant machinery as required   |
| 3  | From Month..... to .....month | 3.Laying of asphalt work carpet & seal coat & flushing of sand over surface, side with filling with earth as required and directed. |

## ANNEXURE - 1

### TECHNICAL REQUIREMENTS OF HOT MIX PLANT

Composition of plant : The hot mix plant shall conform generally to IS Specification No. IS 3066 / 1965 as amended from time to time and shall be equipped with the following arrangements :

1. **Cold Aggregate Feeder :** The cold aggregate feeder shall have minimum three independent bins or compartment, each provided with accurate mechanical pre determined rate to the cold elevator or to some intermediate conveyor or directly into the dryer. The feeder shall provide for the adjustment of total and proportional feed and shall be capable of being locked in any setting.
2. **Dryer :** The dryer shall be capable of continuously agitating the aggregates while heating to the desired temperature. At the discharge end of the dryer or any other suitable location, means shall be provided for ascertaining the temperature of the heated aggregate.
3. **Screening Unit and Gradation Control :** The dried aggregate shall be screened into not less than three size. The plant shall include means for accurately proportioning each bin size of aggregate either by weight or volumetric measurement. When the gradation control is by volume, the unit shall include a feeder mounted under the compartment bins. Each bin shall have an accurately controlled, individual gate to form an orifice for proportioning the material drawn from each respective bin compartment. The orifice shall have mechanical adjustment and provided with a lock indicators shall be provided on each gate to show the opening in centiMetres.
4. **Mixer Unit :** The plant shall include a mixer of an approved twin shaft pug mill type capable of producing a uniform mix. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of fines.
5. **Mineral filler supply Unit :** There shall be a independent arrangement to feed mineral filler directly into the pugmill. The hopper to bin for mineral filler shall provide for the adjustment to proportion the feed with the aggregate and bitumen feed and shall be capable of being locked in any setting.
6. **Bitumen Heating:** A heating system for bitumen always with effective and positive control of temperature shall be provided, to maintain proper temperature and for allowing continuous circulation between storage tanks and proportioning units during the entire opening period. Suitable arrangements shall be provided for recording the temperature at the tank and in the circulation system.
7. **Synchronization:** For synchronization of Aggregate. Bitumen and filler feeds satisfactory means shall be provided to afford positive inter- locking control between the flow of aggregates from the bins or compartment, flow of bitumen from the tank and flow the tank and flow of mineral filer.

# VISCOSITY GRADE BITUMEN

## **Brief Back Ground :**

Bitumen is a thermoplastic material and its stiffness is dependent on temperature. The temperature versus stiffness relationship of Bitumen is dependent on source of Crude and method of refining. Bureau of Indian Standards (BIS) first time introduced paving grade Bitumen specifications IS:79-1950 in the year 1950 based on penetration. Based on this classification, the Bitumen were classified into five grades : S35, S435, S65, S90 & S-200.

BIS first revised the IS : 73-1950 specifications in the year 1962 based on penetration. In IS : 73-1961 specifications only eight parameters were considered for specifications.

BIS revised IS : 73-1961 specification in year 1992 for waxy and non waxy crude based on penetration. In this revision, BIS introduced four additional qualification tests like penetration ratio, paraffin wax content, viscosity at 60 & 135 Degree C and retained penetration after thin film oven test. In case of non-waxy crude an additional grade S55 (50/60 penetration) was also introduced. However, in case of non-waxy crude only four grades A35, A55, A65 & A90 were specified.

To improve the quality of the Bitumen, BIS revised IS : 73-1992 specifications based on Viscosity grading (Viscosity at 60 Degree C) in July 2006. As per this specifications there are four grades VG-10, VG-20, VG-30 & VG-40. Few qualification tests like specific gravity, water content, ductility, loss on heating & Farass breaking point were removed from IS : 73-1992 specifications as these tests do not have any relationship either with the quality or performance of the Bitumen.

## **Introduction of Viscosity Grade Bitumen :**

India has embarked upon massive and unprecedented road construction & improvement programme involving huge investments. It has also to maintain a vast road network of over 33 lakh KM. The durability of the road surfaces depends largely on the type and quality of Bitumen used and quality control exercised in the production, transportation, mixing, laying and compaction.

Traditionally, we have been using Penetration Grade Bitumen in Bituminous mixes. The Bituminous surfacing was showing rutting at higher temperatures, cracking at lower temperatures and raveling due to fatigue. The life of Bituminous surfacing on National Highways varied from 3-4 years requiring frequent repairs and renewals. To achieve durable pavements, use of Modified Bitumen was introduced in late nineties. The cost of Modified Bitumen is about 30 to 40 per cent higher than the cost of Bitumen as well as the construction of pavement with Modified Bitumen requires higher level of care & quality control during the entire process right from production of Modified Bitumen to laying and compaction. The latest instruction is "**Viscosity Grade Paving Bitumen**" which is designed to take care of lowest temperature (responsible for cracking) and maximum temperature (responsible for rutting). The BIS has issued IS 73 specification for this type of Bitumen in July 2006. In view of the importance of Bitumen in road construction and maintenance, it is necessary that appropriate grade of Bitumen most suited for our environment are used and adequate quality control is exercised at each stage.

## **Viscosity Grading of Bitumen :**

Paving grade Bitumen's are categorized according to Viscosity (degree of fluidity) grading. The higher the grade, the stiffer the Bitumen. In Viscosity Grade, Viscosity tests are conducted at 60 degree C and 135 degree C, which represent the temperature of road surface during summer (hot climate, similar to northern parts of India) and mixing temperature respectively. The Penetration at 25 degree C, which is annual average pavement temperature, is also retained.

### **VG-10 BITUMEN :**

VG-10 is widely used in spraying applications such as surface dressing and paving in very cold climate in lieu of old 80/100 Penetration grade. It is also used to manufacture Bitumen Emulsion and Modified Bitumen products.

### **VG-20 BITUMEN :**

VG-20 is used for paving in cold climate & high altitude regions, for eg. Northern regions.

### **VG-30 BITUMEN :**

VG-30 is primarily used to construct extra heavy duty Bitumen pavements that need to endure substantial traffic loads. It can be used in lieu of 60/70 Penetration grade.

### **VG-40 BITUMEN :**

VG-40 is used in highly stressed areas such as intersections, near toll booths and truck parking lots in lieu of old 30/40 Penetration grade. Due to its higher Viscosity, stiffer Bitumen mixes can be produced to improve resistance to having and other problems associated with higher temperature and heavy traffic loads.

**TABLE : VISCOSITY GRADE (VG) BITUMEN SPECIFICATION AS PER IS 73:2006**

Characteristics	VG-10	VG-20	VG-30	VG-40
Absolute Viscosity, 60 degree C, poises, min	800	1600	2400	3200
Kinematics, Viscosity, 135 degree C, CST, min	250	300	350	400
Flash, point, C, min	220	220	220	220
Solubility in trichloroethylene, %, min	99.0	99.0	99.0	99.0
Penetration at 25 degree C	80-100	60-80	50-70	40-60
Softening point, C, min	40	45	47	50
<b>Tests on residue from thin film over test / RTFOT :</b>				
I. Viscosity ratio at 60 degree C , max	4.0	4.0	4.0	4.0
II. Ductility at 25 degree C, cm, min, after thin film over test	75	50	40	25

### FREQUENTLY ASKED QUESTIONS

**1. What is the difference between Penetration & Viscosity Grade ?**

Penetration Grade classifications based on the Penetration value (degree of hardness) (Test conditions : 25 degree C, 100 gm, 5 sec) while VG system is based on absolute Viscosity (degree of Flow Resistance) of the Bitumen samples measured in Poise (Test conditions : @ 60 degree C, 300 mm Hg vacuum). It also includes Kinematics Viscosity measured in cst @ 135 degree C.

**2. Benefits / advantages of VG Bitumen over Penetration Grade – explain.**

- ◆ VG system is based on fundamental engineering paraMetre ( not empirical)
- ◆ Viscosity is measured at 60 degree C and 135 degree C, which takes care of both low and high temperature susceptibility of the binder, which is not possible with Penetration value @ 25 degree C. Hence, pavement engineers, contractors / consultants can have better understanding about the binder's performance in the field.
- ◆ Any two same Viscosity Grade Bitumen would give similar rutting performance in hot summer unlike Penetration Grade.
- ◆ Grater ease of handling to customers as Viscosity Value at two different temperatures (@ 60 degree C and @ 135 degree C) is available, which would enable users to measure accurate mixing and compaction temperatures.
- ◆ Minimum specified Kinematics Viscosity value @ 135 degree C helps to minimize the potential of tender mixes during construction.
- ◆ Viscosity Graded Bitumen's are suitable for a wide range of temperature; 25 degree C for raveling / fatigue cracking, 60 degree C for rutting and 135 degree C for construction (mixing and compaction).
- ◆ IS 73-2006 has only 7 tests to evaluate a sample compared to 14 tests in Penetration Grade system. This reduces time and cost of testing without sacrificing its quality.

**3. What are the limitations of Penetration Grade ?**

- ◆ This gradation is based on an empirical test and not a fundamental test; it doesn't provide any relevance with field performance of the sample.
- ◆ Two samples having same Penetration value may show different behavior at high and low temperatures.
- ◆ No Bitumen Viscosity is available near Bitumen mixing and compaction temperatures for the guidance of end users.
- ◆ Penetration grading doesn't control the temperature susceptibility of Bitumen. Highly thermal susceptible Bitumen's are not desirable because they are soft at high service temperature and very stiff at low service temperature.
- ◆ It cannot be used effectively for Polymer modified Bitumen.

**4. Is VG Bitumen is the demand / requirement of users or the statutory bodies ? Why there is a need to shift from Penetration to Viscosity Grade Paving Bitumen ?**

Penetration test was developed in an era of significantly lower pavement loading. In the past, truck weights were less than 30 tons with tyre pressure at 75 PSI. Today truck weights yields a 40% increase in the stresses applied to the pavement and is further aggravated by heavy traffic and change in weather conditions. Therefore, to cope up with the change in conditions, there is a need to shift from Penetration to Viscosity Grade Paving Bitumen. Both user agencies and statutory bodies are enforcing suppliers to supply VG Bitumen.

**5. Pavement made of VG Bitumen has longer durability than Penetration Grade Bitumen and why ?**

The pavement made from VG Bitumen will have better performance, because Viscosity value measured at 60 degree C correlated well with rutting behavior and Viscosity value at 135 degree C gives sufficient idea about the mixing and compaction temperature and as a result pavement life is improved.

**6. Can we use VG 30 Bitumen in high temperature zones where the critical highway temperature is > 60 degree C ?**

Yes, VG 30 can be used in high temperature zones as it has good thermal susceptibility.

**7. Why there is a delay in introducing Viscosity Grade Bitumen in India despite declaring the spec by BIS in 2006.**

- ◆ For decades, Indian customers have been using Penetration Grade Bitumen, customers are yet to be educated fully about the new specification and its benefits. In India, Bitumen market is driven by customers to a large extent like any other market.
- ◆ Additionally, there are other typical issues like user agencies demand for Penetration Grade Bitumen to complete the existing contracts, simultaneous, production of two grades at refineries and associated technical, logistical, administrative issues, etc.

In view of above, there is a delay in introducing Viscosity Grade Bitumen in the market.

**8. Is VG Bitumen the ultimate solution for pavement failures ?**

VG Bitumen is not the ultimate solution; it is an initial step to understand the binder performance in the field. Inline with international trend (AASHTO M320-05 specification-Super pave performance grading is being followed by USA, Europe etc.), we need to move towards performance grading system to understand the pavement failure due to binders. It is obvious that pavement design also needs due consideration.

**9. Why minimum limit to absolute Viscosity @ 60 Deg C prescribed ? Is it ok to keep Min limit ?**

The Temperature of 60 degree C is the near maximum Bituminous pavement temperature on a hot summer day, when rutting is likely to occur. It is useful to determine the stiffness (in terms of absolute Viscosity) of Bitumen at 60 degree C so that we can specify its minimum stiffness to ensure adequate resistance to rutting during hot summer. Pavement rutting is the most prevalent problem in India.

**10. What is the relevance of Ductility Test @ 25 Deg C on residue of TFOT ?**

Thin film Oven Test (TFOT) is nothing but the simulation of aging condition during mixing and compaction. If material shows good ductile characteristics after TFOT, it implies that binder can be laid nicely on the road and will not age (deteriorate) much during mixing and compaction.

**11. Number of tests for VG Bitumen is less than Penetration Grade, how this would assure / control quality of Bitumen.**

Some of the tests given in old Penetration Grade specification are the repetition of checking one parameter by different methods and some are redundant. For e.g. ductility measurement before and after TFOT. Ductility measurement after TFOT itself ensures the ductile property; there is no need to check it before TFOT. Penetration ratio, paraffin wax content and fraass breaking point tests are redundant as these properties have been taken care in new Viscosity Grade specifications.

**12. Do we have ready-made chart to use various Bitumen Grades as per the temperature zones ?**

Ideally, selection of Bitumen Grade should be based on high and low pavement. temperatures (climatic conditions). For practical consideration, selections need to be based on air temperatures, Weather data can be obtained from IMO (Indian Meteorological Organization) for the purpose of understanding region wise requirement of binder grades. Selection criteria for VG paving Bitumen based on climatic conditions is tabulated below :



S.No.	Lowest Daily Mean Air Temperature, C	< 25 Deg. C	20 to 30 Deg. C	> 30 Deg. C
1.	More than -10 Deg. C	VG-10	VG-20	VG-30
2.	- 10 Deg. C or lower	VG-10	VG-10	VG-20

**13. What is the effect of using VG-10 Bitumen in hot climate areas ? What is the right grade to be used in this area ?**

Due to high temperature in hot climatic areas, use of VG-10 would not provide good rutting resistance. Based on the highest daily mean air temperature which good rutting resistance. Based on the highest daily mean air temperature which generally ranges from 30 to 44 Deg. C, VG-30 Bitumen can be used in this area.

**14. Is there any difference in process for manufacturing VG Bitumen over Penetration Grade ?**

Yes, process parameters needs to be modified to produce VG Bitumen. It is produced by blowing Bitumen with air.

**15. How to measure Viscosity at 60 Deg. C ? What type of equipments and which manufactures do you recommend ?**

A vacuum capillary tube viscometre is used to perform the Viscosity test at 60 Deg. C. Viscosity test equipment consists of i.e Calibrated cannon-Manning Viscosity tube, ii. Oil bath maintained at 60 Deg. C, iii. Vacuum pump and iv. Vacuum gauge, controller, thermometer, stop watch. Viscosity tube to be imported through Indian distributor and remaining items are easily available in India. Generally Cannon Manning vacuum capillary viscometre, Cannon fenske viscometre and brook field viscometre are used to measure the Viscosity.

Ref :

- (1) Ministry of Shipping, Road Transport & Highway, Govt. of India letter No. RW/NH-33041/3/2001 S & R (R) Vol. III Dt.4/8/08.
- (2) Ministry of Shipping, Road Transport & Highway, Govt. of India letter No. RW/NH-33041/3/2001 S & R (R) Vol. III Dt.4/2/09.
- (3) Indian Oil Corporation Ltd. letter dated 27/7/09.

## Item No.1

**Providing and laying Compacted W.B.M. 150mm thick of Grading-II, using B.T.M.C. metal of size 45mm to 63mm including using 13% Stone Screening 13.2mm size and 7% stone dust as filler including spreading, watering and consolidation by vibratory roller etc. complete**

### **405. WATER BOUND MACADAM SUB-BASE/BASE/SURFACING**

#### **405.1. Scope**

**405.1.1.** This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary, and water laid on a properly prepared subgrade-sub-base/base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

#### **405.2. Materials**

**405.2.1. Coarse aggregates:** Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates, such as, kankar and laterite of suitable quality. Materials obtained from rocks, such as, Phyllites, Shales or Slates, etc. shall not be permitted in WBM construction. Materials other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400.7. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the Soundness test shall be carried out on the material delivered to site as per IS:2386 (Part 5).

**TABLE 400.7: PHYSICAL REQUIREMENTS OF COURSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE/BASE/SURFACING COURSES**

Test	Sub-base	Base	Surfacing
Aggregate Impact Test (IS:2386 Part 4 or IS:5640)	Less than 50	Less than 40	Less than 30
Flakiness Index Test (IS:2386 Part 1)	Less than 30	Less than 25	Less than 20
Soundness Test (IS:2386 Part 1)			
- Loss with Sodium Sulphate	Less than 12%	Less than 12%	Less than 12%
- Loss with Magnesium Sulphate	Less than 18%	Less than 18%	Less than 18%

**405.2.2.** Aggregates, like, brick bats, kankar, laterite, etc. which get softened in presence of water shall be tested for Aggregate Impact Value under wet conditions in accordance with IS:5640.

**405.2.3.** The requirement of flakiness Index shall be enforced only in the case of crushed or broken stone and crushed slag.

**405.2.4. Crushed or broken stone:** The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

**405.2.5. Crushed slag:** Crushed slag shall be made from air-cooled blast furnace slag. It shall be angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials.

**405.2.6 Overburnt (Jhama) brick aggregates:** Jhama brick aggregates shall be made from over burnt bricks or brick ballast and be free from dust and other objectionable and deleterious materials.

**405.2.7. Grading requirement of coarse aggregates:** The coarse aggregates shall conform to one of the Gradings given in Table 400.8 as specified, provided, however, the use of Grading No.1 shall be restricted to sub-base courses only.

**TABLE 400.8 : GRADING REQUIREMENTS OF COARSE AGGREGATES**

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
(1)	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
(2)	63 mm to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
(3)	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

Note: The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Gradings, i.e., 2 & 3, it shall be 75 mm.

**405.2.8 Screenings:** Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where economic considerations so warrant, predominantly non-plastic material (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent. The Screenings shall not contain any of the undesirable constituents listed in Clause 301.2.3 which would render it unsuitable as a fill material.

Screenings shall conform to the grading set forth in Table 400.9. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 400.10. The Table also gives the quantities of materials (loose) required for 10 m<sup>2</sup> for sub-base compacted thickness of 100/75 mm.

**TABLE : 400.9 : GRADING FOR SCREENING**

Grading Classification	Size of Screenings	IS Sieve Designation	Percent by Weight Passing the IS Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35

		180 micron	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 micron	15-35

The use of screenings shall be omitted in the case of soft aggregates, such as, brick metal, kankar, laterite, etc. as they are likely to get crushed to a certain extent under rollers.

**405.2.9 Binding material:** Binding material to be used for water bound macadam as a filler material meant for preventing raveling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 for sub-base/base course and 4 to 10 for surfacing course as determined in accordance with IS:2720 (Part 5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be  $0.06-0.09 \text{ m}^3/10\text{m}^2$  and  $0.08-0.10 \text{ m}^3/10 \text{ m}^2$  for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction, etc.

Application of binding materials may not be necessary when the screenings used are of crushable type.

**TABLE 400.10: APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 mm COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/ BASE/ SURFACING COURSE FOR 10 M<sup>2</sup> AREA.**

Classification	Size Range	Compacted thickness	Loose Quantity	Stone Screenings		Crushable Screenings such as moorum or	
				Grading Classification & Size	For WBM Sub-base/ Base Course (Loose Quantity) m <sup>3</sup>	Properties	Loose Quantity
Grading 1	90 to 45	100	1.21 to 1.43	Type A 13.2	0.27 to 0.30	LL<20, PI<6 percent passing 0.075 mm 10	0.30 to 0.32
Grading 2	63 to 45	75	0.91 to 1.07	Type A 13.2	0.12 to 0.15	-do-	0.22 to 0.24
Grading 2	63 to 45	75	0.91 to 1.07	Type B 11.2	0.20 to 0.22	-do-	-do-
Grading 3	53 to 22.4	75	0.91 to 1.07	Type B 11.2	0.18 to 0.21	-do-	-do-

### 405.3. Construction Operations

**405.3.1. Preparation of base:** The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course).

Laying water bound macadam course over an existing bituminous layer shall be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it.

**405.3.2. Inverted choke:** Where the WBM layer is to be laid over the subgrade and the subgrade soil is fine-grained, it is advisable to lay 100 mm intervening layer of screening or coarse sand on top of the fine-grained soil.

**405.3.3. Provision of lateral confinement of aggregates:** While constructing water bound macadam, arrangement shall be made for the lateral confinement of the aggregate. This shall be done by laying materials in adjoining shoulders along with that of water bound macadam layer and following the sequence of operations described in Clause 407.4.1.

**405.3.4. Spreading coarse aggregates:** The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base to proper profile by using templates placed across the road about 6 mm apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in Clause 405.2.5. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

**405.3.5. Rolling:** Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates, like, brick metal, laterite and kanker, compaction shall be continued until the aggregates are thoroughly keyed. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses, in accordance with the procedure given in Clause 407.4.1.

**405.3.6. Application of screenings:** After the coarse aggregate has been rolled to Clause 405.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

**405.3.7. Sprinkling of water and grouting:** After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

**405.3.8. Application of binding material:** After the application of screenings in accordance with Clauses 405.3.5 and 405.3.6 the binding material where it is required to be used (Clause 405.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of

the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

**405.3.9. Setting and drying:** After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

#### **405.4. Surface Finish and Quality Control of Work**

**405.4.1.** The surface finish of construction shall conform to the requirements of Clause 1802.

**405.4.2.** Control on the quality of material and works shall be exercised by the Engineer in accordance with Section 1800.

**405.4.3.** The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0° C in the shade.

**405.4.4. Reconstruction of defective macadam:** The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Clause 1802. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

#### **405.5. Arrangement for Traffic**

During the period of construction, the arrangement of traffic shall be done as per Clause 111.

#### **405.6. Measurements for Payment**

Water bound macadam shall be measured as finished work in position in cubic metres.

#### **405.7. Rate**

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in Clause 401.9 (i) to (v) including arrangements of water used in the work as approved by the Engineer.

## Item No.2

**Providing and Laying of 37.50mm thick Compacted Built up Spray Grout with B.T. Aggregates as per required gradation & using bitumen Grade VG-30 of Mixing with aggregates @ 1.99% i.e. 19.90 Kg./M.T. of total mix including & Bitumen for Tack Coat Emulsion (RS1) @ 2.50 Kg./10-Sq.mt. for B.T. Surface including heating & mixing in Drum Mix Plant, transporting spreading the same with paver finisher & consolidation with vibratory roller including necessary fire wood oil, lubricant, labour charges etc. using contractor own drum mix plant & equipment tools etc. complete in accordance with the requirement of specification.**

### Scope :

The work shall consist of construction, in a single course, of compacted crushed aggregates premixed with a bituminous binder, to serve as base / binder course, laid immediately after mixing on a base prepared previously in accordance with the requirement of these specifications and in conformity with the lines, grades and cross-sections shown on the drawing or as directed by the Engineer.

Built-up grout shall be used in a single course in a pavement structure.

### Materials :

**Bitumen :** The Bitumen shall be paving bitumen of suitable penetration grade **VG-30 as per IS 73**. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions Guidelines on selection of the grade of bitumen are given in Appendix-4.

### Aggregates :-

The aggregates shall consist of crushed stone of type black trap only. They shall be clean, strong, durable, of fairly cubical shape and free from desegregated pieces, organic or other deleterious matter and adherent coating the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable does as Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table.

### PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS GROUT.

Sr, No.	Test	Test Method	Requirement
01	Los Angles Abrasion Value.	IS : 2386(Part – 4)	40 % Maximum
02	Aggregate Impact Value.	IS : 2386(Part – 4)	30 % Maximum
03	Flakiness and Elongation indices (Total)**	IS : 2386(Part – 1)	30 % Maximum
04	Coating and stripping of bitumen aggregate mixtures.	AASHTO T 182	Minimum retained coating 95 %.
05	Soundness (i) Loss with sodium sulphate 5 cycles.	IS : 2386(Part – 5)	12 % Maximum



	(ii) Loss with Magnesium sulphate 5 cycles.		
06	Water absorption.	IS : 2386(Part – 3)	2 % Maximum

- Aggregates may satisfy requirements for either of the two tests.
- To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by remaining(non flaky) stone metal elongation index is weight of elongated particles divided to total non flaky particles. The value of flakiness index and elongation index to found are added up.

#### **Proportioning of materials :**

The bitumen content for premixing shall be 1.99 percent by weight of the total mix except when otherwise directed by the engineer.

The maximum compacted thickness of a layer shall be 100 mm.

The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compactions.

#### **AGGREGATE GRADING FOR BITUMINOUS GROUT.**

IS Sieve Designation	Percent by weight passing the sieve.
53.0 mm.	100
26.5 mm.	75-100
22.4 mm.	50-85
13.2 mm.	20-40
5.6 mm.	5-20
2.8 mm.	0-5

**Variation in proportioning of material :** The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix A variation in binder content +0.3 % by weight of total mix shall blow ever be permissible for individual specimens taken for quality control test vide Section 900.

#### **Construction Operations :**

**Weather and seasonal limitations :** The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when atmosphere temperature in shade is 10 degree C or less.

**Preparation of base :** The work shall consist of preparation and existing granular or black topped surface bituminous course. The work shall be performed on such widths and lengths as shown in applicable drawing or as directed by the Engineer. The existing surface shall be firm ad clean, and treated with prime or tack coat as shown on the drawings as otherwise stated in the contract.

#### **Materials :**

**For scarifying and re-laying granular surface :** The materials used shall be coarse aggregate salvaged from scarification of the existing granular base course supplemented by fresh coarse aggregates and screenings so that aggregates and screening thus supplemented correspond to Clause 404 : Water macadam or Clause 406 Wet Mix Macadam, as the case may be.

**For patching potholes and scaling cracks :** Where the existing surface to be overlaid is bituminous. Any existing potholes and cracks shall be repaired and sealed in accordance with Clauses 3004.2 and 3004.3 or as directed by the Engineer.

For profile corrective course : A profile corrective course for correcting the existing pavement profile shall be laid to varying thickness as shown on the Drawings. Or as indicated in the Contract Documents. The profile corrective course shall be laid to tolerances and densities as specified for wearing course if a single layer or base course, if it is to be covered with a wearing course layer.

Profile corrective course and its application : The type of material for use as a profile corrective course shall be as shown on the drawing. If it is to be laid as part of the overlay/strengthening course, the profile corrective course material shall be of the same specification as that of the overlay/strengthening course. However, if provided as a separate layer, it may be of the same specification as the layer over which it is to be laid or intermediate between underlying layers, as shown on the Drawings.

#### **Surface Levels**

The levels of the sub grade different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross profile of the road, shown on the drawings or as directed by the engineer beyond the tolerances mentioned in Table 900-1.

Bituminous materials shall not be applied to a wet surface or during a dust storm or when the weather foggy, rainy or windy or when the temperature in the shade is less than 10°C where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

#### **Construction Equipment :**

The tack coat distributor shall be self propelled or towed bitumen pressure sprayer, quipped for spraying the material uniformly at a specified rate. Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure and sprayer, or as directed by the Engineer. 503-4.2 of MORTH Specification Preparation of base : The surface on which the tack coat is to be applied shall be clean and free from dust, dirt and extraneous materials, and be otherwise prepared in accordance with the requirements of Clauses 501.8 and 902 as appropriate immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

#### **Application of tack coat :**

The application of tack coat shall be at the rate specified in the contract, and shall be applied uniformly, if rate of application of tack coat is not specified in the contract then it shall be at the rate specified in TABLE 500-2 OF MORTH Specification. The normal range spraying.

#### **TABLE 500-2, RATE OF APPLICATION OF TACK COAT**

The **Emulsion RS1** at the rate of 2.5 kg. per 10 sq. m. on BT surface and 4.00kg/10sqm on WBM surface shall be used for tack coat temperature for a bituminous emulsion shall be 20°C to 70° C and for a cutback, 50°C to 80° C if RC-70/MC -70 is used. Where geosynthetic is proposed for use, the provisions of Clauses 703.3.2 and 703.3.4 of MORTH specification shall apply. The method of application of the tack coat will demand on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Where the material to receive an overlay is a freshly laid bituminous layer, that has not been subjected to traffic or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

Curing of tack coat : The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No person or vehicles shall be allowed on the tack coat other than those essential for the construction.

#### **Quality control of work : TOLERANCES IN SURFACE LEVELS**

1. Sub grade	1.20 mm.
	25 mm.
2. Sub-base 4-10 mm.	
a) flexible pavement	-20 mm.
b) concrete pavement.	-6 mm.
(Dry lean concrete or rolled concrete)	-10mm.
3. Base-course for flexible pavement.	
a) Bituminous course.	+6 mm.
	+6 mm.
b) Other than bituminous.	+10 mm.
(i) Machine laid.	-10 mm.
(ii) Manually laid,	+15 mm.
	-15 mm.
4. Wearing course for flexible pavement.	
a) Machine laid.	+6 mm.
	-6 mm.
b) Manually laid	+10 mm.
	-10 mm.
5. Cement concrete pavement.	+5 mm.
	-6 mm.

## TACK COAT

### Scope

This work shall consist of the application of a single coat of high viscosity liquid bituminous material to an existing bituminous road surface preparatory to be superimposition of a bituminous mix when specified in the Contract or instructed by the Engineer.

### Materials

The binder used for tack coat shall be **Emulsion RS1** complying with ISS 8887 of a type and grade as specified in the Section 600 of MORTH specification contract or as directed by the Engineer. The use of cutback bitumen as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

### Weather and Seasonal Limitations

For control of the quality of materials supplied and the works carried out the relevant provisions of Section 900 shall apply.

**Specifications :** The rate shall cover the provision of tack coat at 0.25 kg. / 0.40kg per square Metre with the provision that the variation in actual quantity of bitumen used will assessed and the payment adjusted accordingly.

Preparation and transport of mix :

Bituminous grout mix shall be prepared in abet mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality, with thoroughly coated aggregates.

The plant shall be drum mix type. The plant shall have coordinated set of essential units capable of producing uniform mix within the job mix formula such as laid down in Appendix-A.

- In case of drum mix plant, the cold feed system shall have variable speed conveyors/or other suitable devices for regulating the accurate proportion/Control Cabin.
- Bitumen Control Unit : Capable of measuring/Metreing and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.
- Filter System : A fines feeder system suitable to receive bagged or bulk supply of filter materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary.
- Dust control : A suitable built in Dust control equipment for the dryer to contain the exhaust of the dust in to atmosphere for environmental control whoever so specified by the Engineer.

- (e) Suitable auxiliary Bitumen : Boiler of adequate capacity with self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instructs. The temperature of binder at the time of mixing shall be in range of 150°C to 163°C and that of the aggregate in the range of 155°C to 163°C provided that the difference in temperature between the binder and aggregate at no time exceeds 14°C.

Mixing shall be through to ensure that a homogneneous mixture is obtained in which all particles of the aggregates are coated uniformly and then discharged temperature of mix shall be between 130°C to 160°C.

The mixture shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue shall be removed from the work unit such conditions are corrected.

**Spreading :** The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grads and cross sections. The paver finisher shall have the following essential features.

- (a) Loading hoppers and suitable distributing mechanism.
- (b) All drives having hydrostatic drive/control.
- (c) The machine shall have a hydraulically extendable screed for appropriate width requirement.
- (d) The screed shall have tamping and vibrating arrangement for initial compacting to the layer as it is spread without rutting of otherwise marrying surface, it shall have adjustable amplitude and variable frequency.
- (e) The paver shall be equipment with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- (f) The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.
- (g) The screed shall have the internal heating arrangement.
- (h) The paver shall be capable of laying either 2.5 to 4.0 m. width of 4.0 to 7.0 m. width as stipulated in the Contract.
- (i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation. However, in restricted location and in narrow widths where the available plant cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range 120° C to 160°C. In multi layer construction, the longitudinal joint in one layer shall offset that the layer below by about 150 mm. However, the joint in the top-most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and surface painted with hot bitumen before placing fresh material. Longitudinal and transverse joints shall be offset by at least 250 mm. from those in the lower course and the joint on the top-most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh materials. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80°C before laying of adjacent materials.

**Compaction :** After the spreading of mix, rolling shall be done by 80 to 100 KN. Vibratory roller. Rolling shall start as soon as possible after the material has been spread deploying 3 set of rollers as the rolling is to be completed in limited time frame. The roller shall move at a speed not more than 5 km/h. Rolling shall be done with care to avoid unduly roughening of pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the center longitudinally except that on super elevated and unidirectional cambered portions, it shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial or break-down rolling shall be done with 80-100KN. Static weight static weight smooth wheel roller (3wheels or tandem) as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100 KN. Static weight of pneumatic tyred roller of 150 to 250 kn. Weight with minimum 7 wheels and minimum tyre pressure of 0.7 Mpa. As closely as possible to the paver and be done while material is still workable enough for removal of roller marks, with 60 to 80 Kn. Tandem roller. During the final rolling, vibratory system shall be switched off. The joints and edges shall be rolled with a 80 to 100 kn. Static roller.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 percent of the average laboratory density (obtained from marshal specimens compacted as defined in Table(500-10), there is not crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous materials from sticking to the wheels and being packed up. In no case shall fuel, lubricating oil be used for this purpose, nor excessive water poured on the wheels.

Rolling operations shall be completed in every respect before the temperature of the mix falls below 100°C.

Roller(s) shall not stand on newly laid materials while there is a risk that surface will be deformed thereby. The edges along and transverse of the bituminous grout laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

#### **Surface Finish and Quality Control of Work.**

The surface finish of constructing shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

The built up spray grout shall be provided with next surfacing without any delay. If there is to be any delay, the surface shall be covered by a seal coat to the requirement of Clause 613 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

#### **Arrangements for Traffic.**

During the period of construction, arrangement of traffic shall be done to Clause 112 of MORTH specification.

#### **Passage of Traffic along a part of the Existing Carriageway under Improvement.**

For widening/strengthening existing carriageway where part width of the existing carriage way proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm. thick granular base course covered with bituminous surface dressing in a width of at least xxxx and surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the engineer. The continuous length in which such work shall be carried out, would be limited normally to 500 m. at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20m. long with additional paved width of 2.5 m shall be provided at every 0.5 km. interval.

In case of widening existing two lane to four lane, the additional two lanes would be constructed first and the traffic diverted to it and only there after the required treatment to the existing carriageway would be carried out. However, in case where on the request of the contractor, work on existing two lane

carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled the debris disposed of and the area cleared as per the direction of the Engineer.

## **MEASUREMENTS FOR PAYMENT**

The payment shall be made on the tonnage (MT) basis of the weight of mix of aggregates and bitumen. For the purpose, the contractor shall have to install a weight bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site.

Department will be free to get some loaded dumpers test checked at other weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be exceed respectively.

Weight of mix materials will be done in presence or responsible person, not less than the rank of supervisor of department and the measurement shall be recorded by the Deputy Executive or Assistant Engineer or Addl. Asst. Engineer. If so authorized, Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representative and signed by the contractor, proper gate pass system shall be established for the vehicle coming to the plant site and out going from the plant site. The location of the kiloMetre, hectoMetre and Metre in which individual dumper are unloaded shall be recorded carefully.

### **Rate :**

The contract unit rate for the work shall be payment in full for carrying out the required operations including full compaction for.

- (i) Making arrangements for traffic to Clause 112 of MORTH specification except or initial treatment to verge, shoulders and construction of diversion.
- (ii) preparation of base except for laying of profile corrective course
- (iii) but including filling of potholes.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.
- (iv) All labor, tools, equipment, plant including installation of hot mix plant, power supply units and all machineries, incidental to complete the work to the specifications.
- (v) Carrying out the work in part widths of the road where directed.
- (vi) Carrying out all tests for control of quality.

### Item No.3

Providing and laying sealcoat using asphalt viscosity grade of VG-30 with BT aggregate as specified using aggregate at the rate of 0.18 Cum/10 Sqm and bitumen for mixing with aggregate at the rate of 4.50% i.e. 45.00 Kg/MT of total mix including heating and mixing in drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller including necessary using contractor's own drum mix plant, machineries and equipment, tools etc. complete in accordance with the requirement of specification.

( Read as “ Viscosity Grade bitumen VG-30” inplace of “ Penetration grade 60/70”)

#### 1. DESCRIPTION

The work shall consist of construction of premix seal coat as wearing course, on a previously prepared base. to the requirement of these specification.

#### 2. MATERIALS

**2.1 Binder :** The binder shall be straight run bitumen of Voscosity grade VG-30 grade satisfying the requirement of IS : 73. The actual grade of the binder to be used shall be decided by the Engineer in charge and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

**2.2 Coarse aggregates :** The course aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shll stisfy the physical requirements set forth in Tablegiven in Item No 8 Para - 2.

**2.3 Fine Aggregates :** The fine aggregates shall consist of crushe run screenings natural sand or a maxture of both. These shall be clean, hard durable, uncoated , dry and free from injurious, soft of flaky pieces and organic or deleterious substances.

**2.4 Filter :** The filter , where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, headrated time ,, fly ash and other non-plastic mineral matter approved by the engineer in charge.

**2.5 Aggregate gradation :** The mineral aggregates including mineral filler, shall be so graded or combined as to combined as to conform to gradings set forth in tables below.

**Table : Aggregate gradation pre- mix seal coat**

Sieve designation	percentage by wt passing through sieve	
	For type 'A'	For type 'B'
12.5mm	-	100
10mm	100	70-100

4.75mm	40-85	20-40
2.35	5-20	5-20
75 micron	0-4	0-4

**2.6 Proportioning of materials :** The binder content for premixing shall be 45.00 kg per M.T. ( 4.5 % by weight) for mixing aggregate.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer in charge before starting the work.

**2.7 variation in Proportioning of Material :** The contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of  $\pm 0.3$  percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST specification Section 900.

### 3. CONSTRUCTION OPERATIONS

**3.1 Weather and seasonal limitation :** Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.

**3.2 Preparation of base :** The base on which semi dense carpet is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification clause 601 as directed by the Engineer in charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

**3.3 Tack coat :** Application of binder, binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer in charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 3.5 kg per 10 square metre area for an existing bitumen treated surface and 4 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

**3.4 Preparation of the mix :** Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for measuring out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150 C - 163 C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14 C .

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer in charge.

**3.5 Spreading :** The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading , tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in that range of 121 C - 163 C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road, longitudinal joints shall be offset by at least 150 mm from those in the binder course. All



joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

**3.6 Rolling :** Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, of suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubrication oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions. it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

#### **4. OPENING TO TRAFFIC**

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

#### **5. SURFACE FINISH AND QUALITY CONTROL OF WORK**

The surface finish of construction shall conform to the requirements of most specification clause 901 control on the quality of material and works shall be exercised by the Engineer in charge in accordance with MOST specification clause 902.

#### **6. ARRANGEMENT FOR TRAFFIC**

The provision of MOST specification clause 105 shall apply as regards the flow to traffic during construction.

#### **7. MEASUREMENT FOR PAYMENT.**

The payment shall be made on the tonnage (MT) basis of the weight of mix aggregates and bitumen. For this purpose the contractor shall have to install a weigh, bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field. then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Dept. Deputy Executive engineer or assistant engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometre, hectometre in which individual dumper are unloaded will be recorded carefully.

#### **8. Rate :**

The contract unit rate for semi - dense carpet shall be payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification clause 503.8.

Signature of Contractor

Executive Engineer  
Panchayat (R&B) Division  
Surendranagar