

SECTION - 5

TECHNICAL SPECIFICATION

GENERAL TECHNICAL SPECIFICATIONS

FOR ROAD /BRIDGE WORKS

Name of Work-	C.R. TO M.S.S. PAVER PATTA ON VARIOUS ROADS OF MANGROL TALUKA UNDER R & B SUB-DIVISION-1, KESHOD (PART-1), DIST.JUNAGADH
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C.R. TO M.S.S. PAVER PATTA ON VARIOUS ROADS OF MANGROL TALUKA UNDER R & B SUB-DIVISION-1, KESHOD (PART-1), DIST.JUNAGADH			
SPECIFICATION INDEX			
Sr No. of the Aplicable in the B.O.Q. of the tender	Specifi - cation Referanace	Description of Item	Page No.
1	MORD / MORTH	Providing & Laying 20mm thick MSS.using stone chipping and aggregate as per MORTH with bitumen asphalt viscocity grade VG-30.at.2.50 kg/10 sq.m.on BT surface for mixing @ rate of 50.90 kg/mt.i.e.5.09% of total weight mix and including heating the aggregate and asphalt and continuous batching DMP/HMP and laid paver finisher machine including consolidation using vibratory power roller.using all necessary equipment tools, fire wood, oil kerosene, labor charges etc. complete (using contractors own machinaries)	
2	MORD / MORTH	Providing, laying and rolling of 25 mm thick open graded premix bitumenous carpet with B.T. aggregate as specified and using bitumen VG-30 for tackcoat at the rate of 2.50 Kg./10 Sq.Mt. on BT Surface and using bitumen VG-30 for mixing with aggregate at the rate of 3.36% i.e. 33.60 Kg./ M.T. of total mix including heating and mixing in drum mix plant, spreading the same manually excluding rolling including necessary fire wood, oil, lubricants, labor charges etc. using contractor's own drum mix plant and equipment, tools etc. completed in accordance with the requirement of specification.	

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Keshod-1

Executive Engineer
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Junagadh

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 template 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.
કોન્ટ્રાક્ટર ૬૦ દિવસની અંદર કામ શરૂ કર્યા પછી ગોઠુક કામ કરીને નીચે દર્શાવેલ સંજાગા. સિવાય કામ અઘેરા મેકશે તો જે દિવસથી કામ અધુરું મુકે તે દિવસથી કામ શરૂ કરે ત્યાં સુધી રૂ. ૫૦૦/- લેખે વળતર વસુલ કરવામા આવશે.
(૧) મશીનરી બ્રેકડાઉન થયેલ હોય અને તેટલા જ જુજ સમય પુરતુ કામ બંધ રહેલ હોય.
(૨) મશીનરી બ્રેકડાઉન સમય દરમ્યાન પેવર પ્લાન્ટ પણ ત્યાથી ખસેડવામા આવેલ ન હોય અથવા ત. જ પ્લાન્ટ પ.વર થી અન્ય જગ્યાએ કામગીરી કરવામા આવી ન હોય.
5. The contractor shall invariable 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 contractor 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 asphaltting 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 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
Tests on residue from thin film over test / RTFOT :				
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 parametre 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 parametres 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 & Laying 20mm thick MSS.using stone chipping and aggregate as per MORTH with bitumen asphalt viscosity grade VG-30.at.2.50 kg/10 sq.m.on BT surface for mixing @ rate of 50.90 kg/mt.i.e.5.09% of total weight mix and including heating the aggregate and asphalt and continuous batching DMP/HMP and laid paver finisher machine including consolidation using vibratory power roller.using all necessary equipment tools, fire wood, oil kerosene, labor charges etc. complete (using contractors own machineries)

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

509. MIX SEAL SURFACING

509.1. Scope

509.1.1. This work shall consist of the preparation, laying and compaction of mix seal surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

509.1.2. Mix Seal surfacing shall be of Type A or Type B as specified in the Contract documents.

509.2. Materials

509.2.1. Binder: VG-30 grade bitumen

509.2.2. Coarse aggregates: The provisions of Clause 508.1.2.2. shall apply.

509.2.3. Fine aggregates: The fine aggregates shall consist of crushed rock, quarry sands, natural gravel/sand or a mixture of both. These shall be clean, hard, durable un-coated, mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious substances.

509.2.4. Aggregate gradation: The coarse and fine aggregates shall be so graded or combined as to conform to one or the other gradings shown in Table 500.15 as specified in the contract.

TABLE 500.15 : AGGREGATE GRADATION

IS Sieve Designation (mm)	Cumulative per cent by weight of Total Aggregate Passing
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	Type A	Type B
13.2 mm	-	100
11.2 mm	100	88-100
5.6 mm	52-88	31-52
2.8 mm	14-38	5-25
0.090 mm	0-5	0-5

509.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cu.m per 10 sq.m area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 50.90 kg/MT i.e. 5.09% of total mix.

509.3. Construction Operations

The provisions of Clauses 508.1.3.1 to 508.1.3.5 shall apply, except that the laying of Mix Seal Surfacing shall be carried out by a mechanical paver. 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 bitumen for tack coat shall be 2.5 kg per 10 square Metre aread for any existing bitumne treated surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the on comming bitunious construction.

Table 500-2: Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celcius)

BITUMEN VISCOSITY GRADE	BITUMEN TEMPERATURE	AGGREGATE TEMPERATURE	MIXED MATERIAL TEMPERATURE	LAYING TEMPERATURE	*ROLLING TEMPERATURE
VG-40	160-170	160-175	160-170	150 Min	100 Min
VG-30	150-165	150-170	150-165	140 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

Rolling must be completed before the mat cools to these minimum temperatures.

509.4. Opening to Traffic

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Excessive traffic speeds should not be permitted.

509.5. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 1802. For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 1800 shall apply.

509.6. Arrangements for Traffic

During the period of construction, arrangements for traffic shall be in accordance with the provisions of Clause 111.

509.7. Measurements for Payment

The payment shall be made on the tonnage (MT) basis of the weight for mix of aggregate and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity of or the purpose of weighing of dumpers at suitable place at his cost as directed.

Item No.

2

Providing, laying and rolling of 25 mm thick open graded premix bituminous carpet with B.T. aggregate as specified and using bitumen VG-30 for tackcoat at the rate of 2.50 Kg/10 Sq.Mt. on BT Surface and using bitumen VG-30 for mixing with aggregate at the rate of 3.36% i.e. 33.60 Kg/ M.T. of total mix including heating and mixing in drum mix plant, spreading the same manually excluding rolling including necessary fire wood, oil, lubricants, labor charges etc. using contractor's own drum mix plant and equipment, tools etc. completed in accordance with the requirement of specification.

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

1. The work shall consist of construction in single course of 25 mm, thick semi-dense carpet as course, on a previously prepared base single course shall also include additional thickness if any to remove unevenness of the existing surface.

2. The course aggregates shall consist of crushed stone only. These shall be clean, strong durable for fairly cubical shape, free of disintegrated pieces organic or other deleterious matter and adherent coating. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth as under.

Physical Requirements of Aggregates for Bituminous Macadam.

Sr No	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value	IS : 2386 (Part IV)	30 % Maximum
2.	Aggregate Impact Value	IS : 2386 (Part IV)	30 % Maximum
3.	Flakiness Index	IS : 2385 (Part I)	30 % Maximum
4.	Stripping Value	IS : 6241	25 % Maximum
5.	Water Absorption	IS : 2386 (Part III)	02 % Maximum

* Aggregate may satisfy requirement of either of the two tests.

3. The fine aggregates shall consist of crusher run screening, natural and or mixture of both, these shall be clean, hard durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substance.

4. The filler where required shall be an inter material, the whole of which passes 600 micron sieve as least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust hydrated lime or fly ash approved by the Engineer in charge.

5. The mineral aggregates including mineral filler shall be so graded or combined as to conform to the grading as under.

Table : Aggregate Gradation for Asphalt Carpet

Sieve	% by weight passing the sieve for 20/25mm thickness
	16

20 mm	100
12.5 mm	70-100
10 mm	20-40
4.75 mm	0-5
2.36 mm	

6. The Samples of aggregates of requires gradings for the work shall be got approved from the Engineer in charge prior to transportation and collection on plant site, Unapproved materials shall have to be removed from the palnt site by the contractor at his own cost. If sontractor fails to remove the infrior type of materials form the plant site, the smae will be removed by the Department at the cost of the contractorm collection of aggregate shall be in different stacks according to various dizes of aggregates. For the purpose of collection of materials , plant site shall be established at surtable place, where hot mix plant shall be installed. Department will extend all necessary co-operation oin helping contractro to get nearby Govt. lan of establishing plant site. However, department is not responsible if no such land is made available to the Contractor will have to make his own arrangement for the same Incoming material shall be recorded in a register for the purpose of record.

7. The binder shall be straight run bitumen of a suitable grade satsfying the requirements of IS :

73 Bitumen shall be VG-30 grade and shall be supplied by the department at the rate and plance as mentioned in schedule "A" of the tender and it shall have to be carted, by the Contractor to the site of workat his own cost. Empty asphalt drums shall have to be returned free of cost to PWD store from where they are issued or as directed, if so proveded in shedule 'A' damage caused to the asphalt drums or loss of asphalt after issue from sture shall be the resposibility of the contractor, Drum of asphalt shall be so store so as to allow easy inspection and in such place as will not damage the drums and cause the leackge of allow water and the forign matter to enter. For the purpose of calculation consumption, wastage will not be allowed beyound 2.5 percent. Excess consumption over 2.5 percent. Excess consumption over 2.5 percent will be charged at a panl rate.

8. In case bitumen is to be issued by department in bulk, the same shall be issued to the Contractor at plant site by tankers at the same rate as shown in schedule "A" contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site according to ther requirement. No deduction in rate will be made for supplying hated bulk asphalt.

9. The asphalt should not be used as a fuel, If however , contractor is found to be using asphalt as fuel, the quantity of assphalt utilised shall be assessed, by the Executive Engineer whose decision will be final and binding to the Contractor who will be charged at double the rate provided is Schedule 'A' of the agreement even though the total consumption of asphalt may be within the theoretical consumption.

10. Department shall be keep a day to day account of the supply and consumption of bitumen in a separate bound register having numbered pages and the proforman prescribed by the Department day to day signature of the Contractor's representatie shall be obtained in this register. Issue rate of bitumen includes (i) Obtaining asphalt Dept. Store (ii) Transporting to dite (iii) Storing and stacking (iv) Keeping records of supply and consumption and (v) returning the empty drums in good condition to the Department.

11. Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.

12. The base on which semi dense carpet is to be laid shall be thoroughly swept and scraped clean and free of dust and foreign matter.

Table 500-2: Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celcius)

BITUMEN VISCOSITY GRADE	BITUMEN TEMPERATURE	AGGREGATE TEMPERATURE	MIXED MATERIAL TEMPERATURE	LAYING TEMPERATURE	*ROLLING TEMPERATURE
VG-40	160-170	160-175	160-170	150 Min	100 Min
VG-30	150-165	150-170	150-165	140 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

Rolling must be completed before the mat cools to these minimum temperatures.

13. 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 straight run Emulsion RS1 for tack coat shall be 2.5 kg per 10 square Metre area for any existing bitumen treated surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the ongoing bituminous construction. In case carpet is to be laid on WBM surface, rate of spread of Emulsion RS1 for tack coat will be 4.0kg./10 sqm. & in that case, additional 1.5 kg. / 10 sqm. will be paid to the contractor at the rate provided in schedule "A".

14. The binder content for premixing shall be 3.36 percent by weight of the total mix unless otherwise specified. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

15. The contractor shall be the job mix formula for the mix approved by the engineer in charge before starting the work. In order to obtain the required type of mix, the department may change the proportion of bitumen and gradings of aggregate and contractor shall have to collect the materials accordingly in case of increase in proportion of bitumen the increased or decreased quantity will be adjusted at the rate provided in schedule "A". 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.

16. Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may be either a batch type or a continuous one, having coordinated set of essential units such as dryer for heating the aggregates, a binder heating and control unit for measuring out the correct quantity of heated binder; together with a paddle mixer for intimate mixing of the binder and aggregate.

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

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

19. The mix transported from the hot mix plant to the site, shall be spread by means of a self propelled mechanical paver with suitable crews capable of spreading, tamping and finishing the mix, to specified grade, lines and cross sections.

20. 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 150mm 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.

21. Immediately after the spreading of mix, it shall be thoroughly compacted by 8-10 tonnes 3 wheel roller moving at a speed not exceeding 5 km per hour.

22. The roller wheels shall be kept damp to prevent the mix from 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 on super elevated portions. When it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or mixed wheel leading or as to minimize 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.

23. Sand or stone dust flushing at the rate of 0.03 cmt. / 10 smt. shall be done on asphalt surface for which no separate payment will be made.

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

25. Surface finish and quality control of work : Control on the quality of material and works shall be exercised by the Engineer in charge by carrying out the following test at the frequencies shown against each :

26.

Sr No	Type of Construction	(i) Test	Frequency
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1	Tack Coat Semi dens e carpet	(ii) Binder temprerature for application (iii) Rate of spread of binder (i) Aggregate impact value (ii) Flakiness index of aggre. (iii) Stripping value (iv) Mix Grading (V) Temprature of binder in the boiler , aggregate in the dryer and mix at the time of laying and rolling (vi) Control of binder content and gradation in the mix (Binder content test vide (ASTM D -2172) (vii) rate of spread mix material	At regular close intervals Two test per day One test per 100cu.m of aggre -Do- -Do- One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a minimum of two test per day At regular close intervals. One test for each 100 tonnes of mix subject it nix if twin test per day per plant. Regular control through checks on layer thickness
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27. The contractor shall at all times carry out times carry out work on the highway in a manner crating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway, the contractor shall in accordance with the directives if the Enginner in charge provide and maintain, during the execution of the work, a passage for traffic either along a part of the existing carriage way under improvement or on diversion.

28. In case of the improvement works namely widening strengthening of the existing payment or reconstruction repairs to cross drainage works. Where such works could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part ; the road shoulder shall be dressed and brought in line with the payment and maintained throughout out the duration of the work to the satisfaction of the engineer in charge. Where work in continued on long stretches, passing places, at least 20 meter long and 6 meter wide inclusive of the width of the existing carriage way shall be provided at half or one kilo Meter intervals as directed by the Engineer in charge. Extra treatment to shoulder where necessary, shall be given as ordered by the engineer in charge.

29. The contractor shall take the all necessary measures for the safety of traffic during construction and provided by the engineer in charge for the information and protection of traffic approaching or passing through the section, of the highway under improvement. Before talking up any construction an agreed phased programme for the control of traffic on the highway shall be drawn up in consultation with the engineer in charge.

30. The barricades erected on either side of the carriage way / portion of the carriage way closed to trafic shall be strong to resist violation, and painted with alternate

black and white stripes road lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise. At the points where traffic is to deviate from its normal path the channel for traffic shall be clearly marked with the aid of pavement marking, painted drums or a similar device to the direction of engineer in charge. At night the massages shall be delineated with lanterns or other suitable light source.

31. One way traffic operation shall be established whenever the traffic is to be passed over part of the carriage way inadequate for two lane traffic. This shall be done with the help of flagmen kept positioned on opposite side during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lantern lights. On both sides suitable regulatory/. warning signs shall be installed for the guidance of carriage way begins and the other 120 metres away. The signs shall be of approved design and the refractory type if so directed.

32. The payment shall be made on the tonnage (MT) basis of the weight for mix of aggregate of bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity of or 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 site.

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

33. Weight of mix materials will be done in presence of responsible person. Not less than the rank of supervisor of department and the measurements shall be recorded by the Deputy Engineer, junior engineer or supervisor if so authorised, Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the department representative 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 hectometre in which individual dumpers are unloaded shall be recorded carefully.

34. The contract unit rate for Semi dense carpet shall be in full for carrying out the required operation including full compensation for :

1. Making arrangements of control and safety of traffic
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lifts.
4. All labour, tools equipment and incidentals to complete the work to the specification.

Sign of Contractor

Deputy Executive Engineer
Panchayat R&B Sub Division
Keshod-1

21

Executive Engineer
Panchayat R&B Division
Junagadh

**C.R. TO M.S.S. PAVER PATTA ON VARIOUS ROADS OF MANGROL TALUKA UNDER R & B SUB-DIVISION-1,
KESHOD (PART-1), DIST.JUNAGADH**

Schedule for Testing of Material

For ensuring quality control and workmanship, various test prescribed below corresponding to the material concerned shall be taken as periodic intervals as stipulated below.. The Material shall be got tested at GERI or Govt. recognized Laboratory or field Laboratory of GERI for which 1 % of the estimated amount put to tender shall be recovered from the contractor from the R.A. Bill and Final Bills as the testing charges shall be paid by the Govt. to the Laboratory. However if the charges increase over 1 % no excess recovery shall be made from the contractor as per resolution of B&C department dated 10th May 1985, vide TNC/1085 (4) S.

TEST SCHEDULE

Sr. No.	Material /Item	Approx. Qty.		Description of tests.	Frequency of test	No. of reqd. tests
1	Asphalt VG-30	211.8	MT	Penetration, Ductility, Softening point, Viscosity,	1 test / 10 tankers	3
2	M.S.S.					
	12.50 to 10 mm	716.2	Cum	Elongation, Gradation, Flakiness ,Water absorption, Impact, Abrasion etc	Up to 100 Cum - 1 Test 101 to 500 Cum - 3 Test 501 to 1500 Cum - 5 Test 1500 to 5000 Cum - 7 Test	5
	10 to 4.75 mm	1193.7	Cum	Elongation, Gradation, Flakiness ,Water absorption, Impact, Abrasion etc		5
	4.75 to 2.36 mm	358.1	Cum	Elongation, Gradation, Flakiness ,Water absorption, Impact, Abrasion etc		3
	2.36 mm to 75 mic.	119.4	285	Elongation, Gradation, Flakiness ,Water absorption, Impact, Abrasion etc		3
3	Carpet					
	20 to 10 mm	90.8	Cum	Elongation, Gradation, Flakiness ,Water absorption, Impact, Abrasion etc	Up to 100 Cum - 1 Test 101 to 500 Cum - 3 Test 501 to 1500 Cum - 5 Test 1500 to 5000 Cum - 7 Test	1
	10 to 6 mm	45.4	Cum	Elongation, Gradation, Flakiness ,Water absorption, Impact, Abrasion etc		1

The Number of tests will be as per Manual of quality control or latest Govt. G.R./Circular and it will be considered final

The contractor shall have to pay 1% of the estimated cost put to tender towards all testing of materials and the same shall be deducted from their bills for the works.

Testing charges of GERI shall be borne by Govt. No refund be made nor extra charges over 1% shall be recoverable from the contractor.

If directed by the Engineer in charge, the materials intended to be used for the work but not included in the above schedule shall also be got tested at Government recognized Laboratory or field Laboratory.

The Numbers of tests will be as per manual of quality control or latest Govt. G.R./Circular will be final.

Sign of Contractor

Deputy Executive Engineer
Panchayat R&B Sub Division
Keshod-1

Executive Engineer
Panchayat R&B Division
Junagadh