ROAD PAVEMENTS – BITUMINOUS BOUND MATERIALS

Contents

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NG 901 Bituminous Roadbase and Surfacing Materials

General

1 Requirements included in Appendix 7/1 may include grade of binder and binder modifier and aggregate properties such as polished stone value, aggregate abrasion value, aggregate impact value, soundness value and water absorption.

Aggregates for Bituminous Materials

2 There is no current test procedure for cleanness other than the requirement for aggregates to meet the specified BS 594 and BS 4987 requirements for the fraction passing the 75 micron sieve. Provided the aggregates meet requirements for particle size distribution, based on the washing and sieving techniques of BS 812, it is considered the cleanness aspect of the aggregates will be acceptable.

The Engineer should, however, check the coarse aggregates to ensure they are not coated with clay or silt after having gone through the drying plant and before being coated with bitumen.

The soundness value test should initially be used for source approval of aggregates, and thereafter only in cases where the Engineer suspects their durability. The soundness value test is not intended as a routine test for known durable aggregates. The water absorption test can be used as a routine check test of such aggregates.

Transporting, Laying and Compacting

3 The purpose of Clause 901 is to place reliance on mechanisation of operations to facilitate compliance with the thickness and surface regularity requirements, particularly of wearing courses, and to ensure operation of the paver is such that hand raking and making up of wearing course material is virtually eliminated, except at edges and joints. Hand-laying is also limited to places where operation of a paver is impracticable. Insulated trucks may not be required when weather conditions are favourable and where there is a short haul from mixing plant to laying site.

4 Clause 901 does not relate to laying waterproofing systems on bridge decks. The laying of hot paving materials on bridge deck waterproofing systems should be adequately supervised to ensure the waterproofing system is not damaged by excessive heat. Stock piling of hot materials should take place off the structure or on suitably protected areas.

5 There is no conclusive evidence to show all vibratory rollers provide consistently greater compaction than that achieved with conventional deadweight rollers. It is desirable that compaction should be maximised so a requirement for site trials of vibratory rollers, proposed as an alternative to conventional deadweight rollers, is included. The trial should not only determine the required number of passes of the vibratory roller, but also the frequency and amplitude of the vibrating rolls and roller speed. Additional advice is included in TRL Report LR 1102. Where evidence is provided by the Contractor to indicate a proposed vibratory roller will achieve adequate compaction, it should be examined to determine whether the evidence is representative of the conditions likely to be encountered in the Works. Factors which are relevant include types of compacted material and source of aggregate, the thickness and temperature of layers and the condition of the proposed roller compared with that previously used.

6 The frequency and amplitude of vibrating roll and travelling speed of the roller which have been found to be satisfactory in the trials should be used for compaction.

7 PRD is the ratio of the bulk density of core samples of laid material compared with the refusal density of the material when determined from the same core samples. It is therefore a direct measure of the degree of compaction of the material.

8 Values of PRD correlate closely with the performance of the material and are independent of aggregate grading and relative density. However, different degrees of compactive effort may be required for different aggregates in order to achieve the same level of PRD.

9 BS 4987: Part 2 provides for compliance testing based on material laid in areas of 1000 m^2 or the material laid in any one day where this is less than 1000 m^2. At the discretion of the Engineer a reduction may be made in the amount of testing by not carrying out the full PRD test method on each area of 1000 m^2 or days work when less. On those areas which are not cored, nuclear density gauges may be used on a relative basis, having first established the gauge density reading equivalent to a level of compaction of 93% PRD for a particular source

of material. Two determinations of density using a nuclear density gauge should be substituted for each core.

Nuclear density gauges should only be used for control purposes and compliance with the Specification should be judged from values determined from the coring procedure specified.

Further savings in the amount of testing can be made by not carrying out the part of the test method which determines refusal density of the core material. This should only be omitted, however, once a consistent level of refusal density has been established for a particular source of material.

In both cases full PRD tests should be carried out on a regular basis alongside the modified testing methods.

Further information regarding the use of nuclear density gauges is given in the Transport and Road Research Laboratory Supplementary Report SR 754.

10 The objective of the PRD specification is to obtain uniform compaction of 95% Refusal Density in the dense macadam. The Specification limit of 93% has been chosen following precision trials which have indicated a standard deviation for the test used on macadam roadbase of about 1.5% on single core pairs (TRL Reports SR 717 and CR1 refer). Using this data it can be shown that for a mean density of 95% Refusal Density not more than one in one hundred results of the average of three core pairs should fall below 93%. For compliance with the Specification this can be taken as no result falling below 93%.

11 When reliance is placed on a method specification for the control of compaction of bituminous materials, close attention should be paid to the temperature of the material. BS 594 : Part 2, BS 4987 : Part 2 and Clauses 930, 932 to 934 lay down minimum temperatures at which compaction should be substantially complete. It will therefore be necessary to commence rolling at temperatures exceeding the minimum, making due allowance for weather conditions which may affect the rate of cooling of the laid material. TRL Report RR4 "Cooling of Bituminous Layers and Time Available for their Compaction" gives useful advice on the subject. For all practical purposes where material is tested for adequacy of compaction in accordance with sub-Clause 901.19, the PRD requirements should have been achieved above the minimum rolling temperature. Any subsequent rolling at temperatures below the minimum should only be necessary to remove roller marks and regulate the surface.

NG 911 Rolled Asphalt Wearing Course (Design Mix)

1 Rolled asphalt wearing course design mixtures should be considered only for roads carrying more than 30000 AADT at the date of opening to traffic.

2 The special requirements included in Appendix 7/1 may include the appropriate table and column numbers of permitted mixtures from BS 594 : Part 1. Additionally the required Marshall stability and flow and the required properties for coated chippings, such as PSV and AAV, should be included.

3 The method of determining the design binder content for wearing course mixtures is described in BS 598 : Part 107. Determination of the target binder content, by adjustment of the design binder content, is described in BS 594 : Part 1 for wearing course design mixtures. The target binder content is always at or above the design binder content. The design binder content is the quantity of bitumen required for the mix in order to achieve the required stability. There are occasions when this design binder content would be too low for long term durability. Therefore a minimum target binder content is required by the British Standard and this may be above the design binder content.

4 The required Marshall stability and flow values, when tested on laboratory specimens made in accordance with BS 598 : Part 107, should comply with the requirements of BS 594 : Part 1, Appendix B (1985). Verification of the design should be carried out in accordance with that Appendix. Samples prepared from plant-produced material, and tested in accordance with the procedures of BS 598 : Part 107, are not directly comparable with those obtained on laboratory prepared specimens. The range of values of Marshall stability given in BS 594 : Part 1, Appendix B (1985) permit a number of mixtures using locally available materials; however the specified stability range should be the mid-point of the range.

5 Checks on production material should be by analysis, in accordance with BS 598 : Part 102 and comparison with the composition of the approved design, together with checks on the properties of the constituent materials.

NG 912 Close Graded Bitumen Macadam Wearing Course

1 Caution should be exercised in considering the use of close graded bitumen macadam wearing

courses on roads where speed limits exceed 30 mph.

2 The nominal size of aggregate for close graded bitumen macadam wearing course will depend upon the required layer thickness for the compacted wearing course and should be selected from BS 4987 : Part 2, Table 1 and stated in Appendix 7/1.

3 The traffic category in relation to the tables of BS 4987 : Part 1 should be specified in Appendix 7/1.

NG 915 Coated Chippings for Application to Rolled Asphalt Wearing Course

1 Design mix rolled asphalt wearing course materials are often stiffer than recipe mix compositions. They are less workable and, to obtain effective compaction and retention of chippings rolled into the surfacing, constraints on laying conditions may have to be considered.

2 Coking of chippings can occur during prolonged storage at high temperature. BS 594 : Part 1 covers action to be taken, including cooling of the chippings and limiting the height of stacking to reduce the possibility of coking occurring.

3 The hot sand test described in BS 598 : Part 108 provides a means of identifying and rejecting chippings which are unlikely to be retained in the surfacing under traffic due to coking or contamination.

NG 916 Open Graded Bitumen Macadam Wearing Course

1 The nominal size of aggregate for open graded macadam wearing course will depend upon the required layer thickness for the compacted wearing course and should be selected from BS 4987 : Part 1 and stated in Appendix 7/1.

NG 917 Cold-milling (Planing) of Bituminous Bound Flexible Pavement

1 Clause 917 relates to the milling of pavements on existing road carriageways. It is not relevant to the rectification of bituminous layers in new construction. Rectification of new construction should be carried out in accordance with sub-Clause 702.10.

NG 918 Slurry Sealing

These notes include and extend in some respects the main points of advice on slurry sealing given in BS 434 : Part 2.

1 For works of magnitude the full control testing programme should be undertaken, but for a small area of work the Engineer may prefer to judge the material on the basis of the required field trials.

2 Gradings of blended aggregate for 1.5 mm and 3 mm thick finished surface are given. In the event of a greater thickness being required the grading should be revised in consultation with the manufacturer of the particular process.

3 The usual additives used to control consistency, mix segregation, and setting rate are Portland cement to BS 12 or hydrated lime to BS 890. However, it is advisable to consult the emulsion manufacturer for advice on this point.

4 Techniques for mixing and laying vary according to the type of emulsion used and in some cases the use of a cationic tack-coat Class K1-40 is recommended before laying the slurry. The machines should be equipped to give a light spray of water onto the tack-coat film just before the slurry is spread. After the slurry has set sufficiently it may sometimes be necessary to roll it with a multiwheeled smooth tread rubber-tyred roller. The manufacturer of the emulsion should be consulted on the desirability of rolling and also tack coating.

5 Variation in colour of the slurry seal which can sometimes occur should normally be self-rectifying within 24 hours, but this period may be extended depending on weather conditions and traffic. With some processes using hydrated lime as the additive a degree of efflorescence can become apparent during the first 24 hours and persist for a while afterwards. This is not an indication of uneven mixing or segregation and it should disappear after 2-3 weeks.

6 Slurry seal made with emulsions specially formulated for the slurry seal process is sufficiently stable to form a free flowing slurry and is capable of sustaining this condition throughout the laying procedure adopted. Setting time of the mix may be within a few minutes or extended as desired. For less rapid setting slurry the emulsion should be Class A4

slow setting. This can be used where the rate of set is not important, i.e. when work is being carried out on areas where the slurry can be expected to dry out naturally before being subjected to traffic or rain.

NG 919 Surface Dressing

1 Before work commences, early consultation is necessary between the Engineer and the Contractor on the method of working and the materials to be used. The weather and the nature of the surface to be surface dressed affect the choice of material to be used. As both these are variable, daily consultations between the Engineer and the Contractor are advisable on choice and programme of work.

2 Coating chippings with a thin film of binder improves adhesion of the chippings to the sprayed binder film and is particularly recommended when surface dressing heavily trafficked roads, difficult sites or in unsettled or adverse weather conditions. When emulsion binders are used for surface dressing, the chippings should be uncoated.

3 Steel tyred rollers tend to crush chippings so pneumatic tyred multiwheel rollers should be specified in Appendix 7/3 when hard substrates or heavily trafficked roads are surface dressed. These should always be used on motorways and when surface dressing concrete. Complaints about loose chippings left on carriageways are often received from road users and representative organisations so it is emphasised that the aftercare treatment should be strictly complied with by the Contractor.

NG 921 Surface Texture of Rolled Asphalt Wearing Courses

1 For a given set of traffic and site conditions the resistance to skidding of a wet road surface at low vehicle speeds, i.e. below 50 km/h, depends almost entirely on the properties and proportions of the materials incorporated in the road surface. At vehicle speeds above 50 km/h the resistance to skidding of a wet road surface is affected not only by the properties of the surface materials but also by the macrotexture of the surface. Surface texture is therefore essential for adequate skidding resistance at high speeds.

2 The level of surface texture required for 1000 metre sections of carriageways with bituminous surfacings is an average of 1.5 mm or more. This is easily achieved with surface dressings. Experience with rolled asphalt wearing course indicates that the required texture can be consistently achieved if proper attention is paid to all the relevant factors at time of laying and applying the chippings.

3 To achieve high rates of spread, chippings must be of good shape and free flowing. The chipping machine must be capable of spreading coated chippings at a uniform and consistently high rate. Regular checking of the rate of spread, together with any necessary adjustments to the machine, should be carried out throughout the laying of the wearing course.

4 In addition to ensuring the provision of a stable wearing course careful control over the surfacing temperature during rolling is necessary. Compaction should be substantially completed before the temperature of the asphalt falls to 110°C.

5 Whilst measurement of texture depth for compliance purposes is to be by the sand patch method specified in BS 598 : Part 105 only, the TRL Mini Texture Meter, may be used as a screening procedure, as recommended by BS 598 : Part 105.

6 Calibration trials should be undertaken at the start of work to derive a relationship between the sand patch method and the TRL Mini Texture Meter.

7 In the event of dispute, or discrepancy between the two methods, only results obtained using the sand patch method will be considered for compliance purposes.

8 Calibrations carried out on site are only applicable to that site and that surfacing.

9 Sensor Measured Texture Depth (SMTD) is numerically different from texture depth measured by the sand patch method. Sand patch texture depth is a measurement of the average depth of the hollows in the surface below the general level of the peaks. SMTD is the standard deviation of the sample height measurements.

NG 924 Resin Based High Skid Resistant Surface Treatment

1 High skid resistant durable surface treatments are now available which consist of a thin film of resin based binder sprayed on to a sound surface

and covered with small size calcined bauxite aggregate of high PSV. Surface treatments comprising high PSV aggregates mixed with resin before spreading on the surface do not comply with the requirements of Clause 924.

2 Experience has shown these surfacings are highly effective in reducing traffic accidents on sites with high traffic density and skidding risk. Typical sites are the approaches to signal controlled junctions, roundabouts and pedestrian crossings subject to a heavy flow of vehicles.

3 These surfacings are very expensive, particularly where productivity is affected by the geometry of the site and the number of areas to be treated. They should only be used after consideration has been given to the use of cheaper alternative measures such as surface dressing with a high PSV natural aggregate, improved road signs and markings, improved street lighting, etc.

4 The Specification is based on high skid resistant surface treatments which have been proven over a number of years and are known to give very good skid resistance and a high level of durability. The treatment should only be used on surfaces which are dry, clean, hard and sound. Surfaces not suitable for treatment include slurry seals, fatted and multilayer surface dressings and surface dressings over soft or unsound bases. Performance on concrete may not be as good as on bituminous surfacings.

5 Attention is required to ensure the surface is properly prepared. The surface to which resin is applied shall be dry and free from dust, oil, excess bitumen and other contaminant that may cause lack of adhesion.

6 The level of relative humidity and temperature affects production rates so levels should be stated in Appendix 7/1. The manufacturer's recommendations should be sought for the particular system in use.

7 The polished stone value test cannot be carried out on material supplied to site. The supplier has to provide a suitably graded sample.

NG 925 Testing of Bituminous Mixtures and Their Component Materials

1 Methods of sampling and testing of mixtures or materials not covered by a British Standard, e.g. sampling plates behind the paver, should be specified in Substitute or Additional Clauses. Non-standard sampling or testing procedures are not recommended.

2 Where alternative sampling procedures are given in the British Standard it is recommended that site sampling should be adopted, however, the procedures should be agreed with the Contractor at the start of the work.

3 The frequency of acceptance testing for mixed materials should be approximately one test for every 100 tonnes of material laid in straight runs, but not less than two samples of mixed material manufactured to any one specification should be taken daily. If the quality of the mixed material is doubtful, the frequency of testing should be increased to one test for every 50 tonnes of material or as otherwise decided by the Engineer. On contracts where the output of mixed materials is large, frequency of testing may be reduced, to a minimum frequency of one test for every 200 tonnes of material, if the Engineer is satisfied with the quality of the material being supplied.

4 The Hot Sand Test is not to be used to assess the suitability of coated chippings to be used in surface dressing.

The following provisional precision data is given for the Hot Sand Test:

Repeatability (r) – 8g/kg

Reproducibility (R) – 12g/kg

NG 930, 932, 933 and 934 Heavy Duty Bitumen Macadam and Dense Bitumen Macadam With Grade 50 Penetration Binder

1 The stiffer binder in these materials requires a higher mixing temperature to achieve the required binder viscosity and coat the aggregate properly. A longer mixing time should be expected with the increased proportion of filler in heavy duty macadam in order to distribute the binder and coat the aggregate properly. It may be possible for manufacturers to avoid increased mixing times by increasing the binder content within the permitted range. Inspectors should ensure that the material is properly mixed and coated, especially with the first deliveries to the site. Laying temperatures will normally be higher to achieve the required workability with stiffer binder.