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**SERIES 700**  
**ROAD PAVEMENTS - GENERAL**

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**NATIONAL ALTERATIONS OF THE  
OVERSEEING ORGANISATIONS OF  
SCOTLAND, WALES AND NORTHERN  
IRELAND**

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# denotes a Clause which has a substitute National Clause for one or more of the Overseeing Organisations of Scotland, Wales or Northern Ireland.

# ROAD PAVEMENTS — GENERAL

## 701 Pavement Construction

1 Road pavements shall be constructed from one of the permitted options described in Appendix 7/1 and in compliance with this Series and the appropriate Clauses of the 800, 900 and 1000 Series.

## #702 Horizontal Alignments, Surface Levels and Surface Regularity of Pavement Courses

### Horizontal Alignments

1 Horizontal alignments shall be determined from one edge of the pavement surface as described in Appendix 1/12. The edge of the pavement as constructed and all other parallel alignments shall be correct within a tolerance of 25 mm therefrom, except for kerbs, channel blocks and edge lines which shall be laid with a smooth alignment within a tolerance of  $\pm 13$  mm.

### Surface Levels of Pavement Courses

2 The design levels of pavement courses shall be calculated from the vertical profile, crossfalls and the pavement course thicknesses described in Appendix 7/1. The level of any point on the constructed surface of the pavement courses shall be the design level subject to the appropriate tolerances stated in Table 7/1.

**TABLE 7/1: Tolerances in Surface Levels of Pavement Courses**

Road surfaces - general - adjacent to a surface water channel*	$\pm 6$ mm + 10 - 0 mm
Basecourse *	$\pm 6$ mm
Top surface of roadbase in pavements without basecourse *	$\pm 8$ mm
Roadbase other than above *	$\pm 15$ mm
Sub-base under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	$\pm 10$ mm
Sub-bases other than above	+ 10 - 30 mm

\* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table 7/1.

3 Notwithstanding the tolerances permitted in surface levels of pavement courses, the cumulative tolerance shall not result in a reduction in thickness of the pavement, excluding the sub-base, by more than 15 mm from the specified thickness nor a reduction in the thickness of the bituminous wearing course by more than 5 mm from that specified.

4 For checking compliance with sub-Clause 2 of this Clause, measurements of the surface levels of all courses will be taken on a grid of points located as described in Appendix 7/1. In any length of pavement, compliance shall be deemed to be met for all surfaces, other than the final road surface, when not more than one of ten consecutive measurements taken longitudinally or one in any transverse line, exceeds the tolerances permitted in Table 7/1, provided that this one measurement shall not exceed by more than 5 mm the tolerance for the course concerned. For the final road surface the tolerance given in Table 7/1 shall apply to any point on that surface.

### Surface Regularity

5 The longitudinal regularity of the surfaces of wearing courses, basecourses, roadbases in pavements without basecourse and concrete slabs shall be such that the number of surface irregularities is within the relevant limits stated in Table 7/2.

An irregularity is a variation of not less than 4 mm or 7 mm of the profile of the road surface as measured by the rolling straight-edge, of the type designed by the Transport and Road Research Laboratory set at 4 mm or 7 mm as appropriate, or equivalent apparatus capable of measuring irregularities within the same magnitudes over a 3 m length. No irregularity exceeding 10 mm shall be permitted.

6 Prior to checking any final road surface, basecourse or top surface of roadbase in pavements without basecourse for level, regularity or texture depth, it shall be cleaned of loose or extraneous materials. These operations shall be carried out without damaging the surface of the pavement, as soon as possible and within 3 working days of construction of the pavement.

7 Compliance with Table 7/2 shall be checked by the rolling straight-edge along any line or lines parallel to the edge of pavement on sections of 300 m at regular intervals as stated in Appendix 7/1, whether or not it is constructed in shorter lengths. Sections shorter than 300 m forming part of a longer pavement shall be

assessed using the number of irregularities for a 300 m length pro-rata to the nearest whole number.

Where the total length of pavement is less than 300 m, the measurements shall be taken on 75 m lengths.

**8** Pavements shall be measured transversely for irregularities at regular intervals as stated in Appendix 7/1, by a 3 m long straight-edge placed at right angles to the centre line of the road. The maximum allowable difference between the pavement surface and the straight-edge shall be 3 mm.

**9** A straight-edge 3 metres long, shall be used to check longitudinal surface regularity in the following cases:

- (i) for lengths of less than 75 m of wearing course, basecourse, top surface of roadbase in pavements without basecourse and concrete slabs;
- (ii) where use of the rolling straight-edge or equivalent apparatus is impracticable;
- (iii) for all lengths of sub-base under concrete pavement slabs laid full thickness in one operation by machine with surface compaction.

The maximum allowable difference between the surface and the underside of the straight-edge, when placed parallel with, or at right angles to, the centre line of the road shall be:

for pavement surfaces	3 mm
for basecourses	6 mm
for the top surface of roadbase in pavements without basecourse	6 mm
for sub-bases under concrete pavements (as in (iii) above)	10 mm

**TABLE 7/2: Maximum Permitted Number of Surface Irregularities**

Irregularity	Surfaces of carriageways, hard strips and hard shoulders				Surfaces of lay-bys, service areas, all bituminous basecourses and top surface of roadbases in pavements without basecourses			
	4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
Category A* Roads	20	9	2	1	40	18	4	2
Category B* Roads	40	18	4	2	60	27	6	3

\* The Category of each section of road is described in Appendix 7/1.

**Rectification**

**10** Where any pavement area does not comply with the Specification for regularity, surface tolerance, thickness, texture depth, material properties or compaction, the full extent of the area which does not comply with the Specification shall be made good and the surface of the pavement course shall be rectified in the manner described below.

(i) Unbound sub-bases

The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 20 m long and 2 m wide.

(ii) Cement bound sub-bases and roadbases

The method of correction will depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours, the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with sub-Clause 704.6. Alternatively, for sub-bases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this Clause with a 1:4 cement and sand mortar or with 3 mm size fine graded wearing course complying with BS 4987: Part 1.

(iii) Bituminous roadbases

With coated macadam or asphalt roadbases, the full depth of the top layer as laid shall be removed and be replaced with fresh material laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous roadbases to be overlaid with a base course, the Contractor may make up the level with additional basecourse material.

- (iv) Wearing courses, basecourses and top surface of roadbases in pavements without basecourse

These shall have the full depth of the course removed, or in the case of roadbase in pavements without base course, the topmost layer, and replaced with fresh material laid and compacted in accordance with the Specification.

The area rectified shall be the full width of the paving laid in one operation, and at least 5 m long if basecourse or roadbase on pavements without basecourse, or 15 m if wearing course.

Where the number of surface irregularities exceeds the limits in Table 7/2, the area to be rectified shall be as necessary to make the number of surface irregularities conform with the limits and shall be the full width of the lanes affected.

Checking of the wearing course for compliance with this Clause shall be carried out as soon as possible after completion of the surfacing and remedial works completed before the road is opened to traffic.

Where the texture depth requirement is not met for:

- (a) a section 1000 m in lane length; or
- (b) the full lane length of a section less than 1000 m long as the balance of a complete scheme; or
- (c) the full lane length of a scheme less than 1000 m long;

then sufficient 50 m lengths shall be replaced, starting with that length having the least texture depth, until the average requirement for the section length is complied with.

A minimum length of 50 m and the full lane width shall be removed and replaced either:

- (a) to the full depth of the wearing course; or
- (b) to a depth of 20 mm when replaced by the repave method process in compliance with Clause 926.

Areas to be removed shall be delineated both longitudinally and transversely by saw cutting prior to the material being removed. Joints shall be formed either by coating the exposed sawn face with hot bitumen or heating by a suitable heater. The heater shall raise the temperature of the full depth of the course immediately before laying the new material to a figure within the range of minimum rolling

temperature and maximum temperature at any stage specified for the material and for a width of not less than 75 mm.

- (v) Concrete slabs

Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt with in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair complying with Clause 1032.

Retexturing of hardened concrete shall be carried out by sawing grooves in accordance with the Specification. Texturing of replaced surfaces shall be by brushing in accordance with the Specification. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength to have developed as required in Clause 704, before that section of pavement is opened to traffic.

### 703 Weather Conditions for Laying of Unbound Granular and Cementitious Materials

1 Road pavement materials in a frozen condition shall not be incorporated in the Works but may be used, if acceptable, when thawed.

2 Road pavement materials shall not be laid on any surface which is frozen or covered with ice.

3 The temperature of concrete or cement-bound material in any pavement layer shall not be less than 5°C at the point of delivery. These materials shall not be laid when the air temperature falls below 3°C and laying shall not be resumed until the rising air temperature reaches 3°C unless all surfaces of the concrete slabs are protected by thermal insulation blankets laid immediately after placing and finishing the concrete. The insulation shall be placed before the temperature of the concrete surface has dropped below 2°C and shall be retained for a minimum of 3 days or until the concrete is assessed to have reached 50% of the specified characteristic compressive strength provided the air temperature is above 0°C and rising at that time. Thermal insulation blankets shall be closed cell polyethylene foam sheets, minimum 10 mm thick with a 'U' value of 4 watts/mC (or K value of 0.04 watts/m Kelvin) or suitable material with an equivalent or lower thermal conductivity. They shall be sufficiently robust and capable of being held in place against variations in wind and weather conditions for the necessary curing time.

## 704 Use of Surfaces by Traffic and Construction Plant

1 Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed.

2 The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

3 Where the Contractor proposes to use the sub-base for construction plant he shall improve the sub-base where necessary, to accommodate the method of construction and the type of plant and vehicles which he proposes to use, in order to avoid damage to the sub-base, any capping and the subgrade. Any permanent thickening shall be across the whole width of the pavement. Temporary thickening shall not impede drainage of the sub-base or the subgrade.

4 Concrete slabs may be used by traffic when the characteristic compressive strength is assessed to have reached 25 N/mm<sup>2</sup> for pavement surface slabs, or 20 N/mm<sup>2</sup> for roadbases with asphalt surfacing. The method of assessing the time when this strength is reached shall be as described in Clause 1004.

5 In the absence of test data establishing compliance with sub-Clause 4 of this Clause, no vehicle with an axle loading greater than 2 tonnes shall run on concrete slabs within a period of 14 days after placing the concrete. Vehicles with rubber tyres with an axle loading less than 2 tonnes, or wheels or tracks of concreting plant, shall not use any part of a newly constructed pavement within 7 days. The above periods before traffic may run on the pavement shall be increased if the 7-day cube strength is below that required in the Specification. These periods shall be extended by one day for each night on which the temperature of the layer falls to 0°C or below.

6 Unless the next pavement layer is laid on a cement bound roadbase or sub-base within 4 hours of laying and compaction, the cement bound layer shall not be used by traffic until the minimum 7-day cube compressive strength specified in Table 10/8, is assessed to have been reached. Similarly, if the next layer is laid within 4 hours, the pavement shall not be used by traffic until this strength requirement has been met. Otherwise no vehicle shall run on cement bound material within 7 days of construction. This period shall be extended by one day for each night on which the temperature of the layer falls to 0°C or below.

### Porous Asphalt Surfacing

7 Landscaping operations shall be carried out such that soil and other materials are not placed on the

surface or cause any clogging of the porous asphalt.

8 Porous asphalt shall be allowed to cool to ambient temperature before opening to any traffic.

9 To avoid damage and to prevent detritus being spread over the surface, traffic and construction plant shall be kept off the surface after its completion and until opening of the highway or until issue of any certificate of completion for the relevant section of the Works, whichever is the earlier.

## #705 General Requirements for Sub-bases and Roadbases

1 The Contractor shall, in his choice of permitted materials for sub-bases and roadbases have regard to the nature of those materials and of the subgrade or any capping and the need to protect them from deterioration due to the ingress of water, the adverse effects of weather and the use of constructional plant. The Contractor shall programme the laying and compaction of the sub-base and the subsequent pavement courses and take such other steps as may be considered necessary, to afford protection to the roadbase, sub-base and subgrade.

### Transporting

2 Unbound and cement bound plant-mixed material shall when mixed be removed at once from the mixer, transported directly to the point where it is to be laid and protected from the weather both during transit from the mixer to the laying site and whilst awaiting tipping.

### Laying

3 All material shall be placed and spread evenly. Spreading shall be undertaken either concurrently with placing or without delay. Unbound and cement bound roadbase material shall be spread using a paving machine or a suitable spreader box and operated with a mechanism which levels off the material to an even depth.

### Frost Heave

4 Subject to the tolerances given in Table 7/1 and unless otherwise stated in Appendix 7/1, material shall not be frost susceptible if it is used within 450 mm of the designed final surface of a road or paved central reserve, or 350 mm if the Mean Annual Frost Index (MAFI) of the site is less than 50.

5 Material shall be classified as non-frost-susceptible if the mean heave is 15 mm or less, when tested in accordance with BS 812: Part 124: 1989, amended as follows:



- position 5, so that the junction is exposed at the centre of the disc and in contact with the upper surface of the test specimen.
- 10.1.3 Place the three reference specimens into positions 3, 5 and 7. Fill the other six positions with specimens which shall be a minimum of three for each material to be tested.
- 10.1.4 Delete the NOTE and insert a new NOTE:  
NOTE: Support the dowels either by drilling holes of the correct diameter or by flexible tubing placed on the dowel ends which are then pushed onto preset studs on the floor of the cradle. Care should be taken to ensure that particles of sand do not get under the dowels thus raising the thermocouples.
- 11 Delete 11.2 (a), (b) and (c) and 11.3  
Insert revised 11.2 (a) and (b) and 11.3:
- 11.2 (a) The mean heave of the three reference sand and filler specimens shall be in the range  $13.6 \pm 4.0$  mm.  
(b) The range (ie. highest - lowest) of results of each of the three sets of specimens in the test run shall not exceed 6 mm.
- 11.3 If either of the conditions given in 11.2 (a) or 11.2 (b) is not satisfied the results of the whole test run shall be rejected. The operating procedure and equipment shall then be examined and adjusted as necessary to ensure that the requirements for the range and mean of the standard sand and filler specimens are satisfied.
- 11.4 Data obtained on the reference specimens shall be tabulated and plotted on forms and charts issued by the supplier of the filler. Completed forms shall be sent to the supplier of the filler once a year. (Ref. Clause 5.17 NOTE).
- 12.1 Line 1. After 'determined' add: "without reference specimens".
- 12 Add new Clauses 12.5 and 12.6.
- 12.5 A further precision experiment included tests on Type 1 sub-base materials (crushed limestones) and on sand - filler mixes. The reproducibility value ( $R_2$ ) of the frost-heave of the crushed limestones was 11.3 mm. The use of reference sand - filler mixes to exclude tests where the frost-heave of the sand - filler mix deviated by more than 4.0 mm from the target value for the mix, reduced the value of  $R_2$  to 7.1 mm. This is the justification for the rule given in 11.2(a).
- 12.6 The target value of 13.6 mm for the standard sand and filler mix specified in Clause 9.4 was established by a trial carried out in 1990 involving 13 test cabinets.
- 13 Delete and insert revised Clause 13:
- 13 **Test Report**  
The test report shall affirm that the frost-heave was determined in accordance with Part 124 of BS 812: 1989 as amended by Clause 705 of the SHW and whether or not a copy of a certificate of sampling is available. If available, a copy of the certificate of sampling shall be provided. The test report shall contain the following information:  
*For the standard sand and filler mixture*  
(a) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.  
(b) The mean result reported under (a) above calculated to the nearest 0.1 mm.  
*For each of the other aggregates*  
(a) Sample identification.  
(b) The dry density at which the specimens were prepared.  
(c) The moisture content used to prepare the specimens.  
(d) The particle-size distribution of the test portion (8.1).  
(e) The particle-size distribution of the stable test specimen (8.2.2.7).  
(f) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.  
(g) The mean results reported under (f) above calculated to the nearest 0.1 mm.

## #706 Excavation, Trimming and Reinstatement of Existing Surfaces

### General

1 The Contractor shall not excavate pits, trenches or other openings in paved areas which have been constructed as part of the Permanent Works in order to construct other parts of the Works, including Statutory Undertakers and other service works, except with the prior approval of the overseeing organisation.

2 Where excavation and trimming of existing paved areas and highways not constructed as part of the Permanent Works are required in Appendix 7/2, they shall be carried out and reinstated in compliance with this Clause and with any additional requirements described in Appendix 7/2. Excavations shall be carried out to the dimensions described in Appendix 7/2, or, if not so described, to the minimum dimensions, subject to sub-Clause 3 of this Clause, necessary to carry out the work.

3 For roads carrying 30 msa or less, reinstatements of openings in highways shall comply with the "Specification for the Reinstatement of Openings in Highways" issued by the Highway Authorities and Utilities Committee.

The same requirements shall apply for roads carrying more than 30 msa except where otherwise stated in the appropriate clauses of the Specification for Highway Works including the requirements of Appendix 7/2.

4 Where foamed concrete is used for the reinstatement of openings in roads carrying more than 30 msa, the requirements of the foamed concrete shall comply with Clause 1043.

### Excavations

5 Excavations in existing pavements and other paved areas, except those described in sub-Clause 6 of this Clause, including surfacing, roadbase and sub-base, shall be cut to neat lines to dimensions at least 75 mm greater on each side than the dimensions of any further excavation below formation level. Excavations in capping shall be taken at least 75 mm outside the dimensions of any excavation below. Road surfacing of bituminous material shall be cut back by sawing or planing to a further 75 mm on each side. Planing shall be carried out in accordance with Clause 917. Concrete surfacing and concrete roadbases, except CBM, shall be cut back by sawing by at least 300 mm on each side to the level of any reinforcement in reinforced slabs and to the full depth of the slab in unreinforced slabs.

If excavations are required to inspect the condition of lower layers, each layer shall be excavated separately and cleaned of debris to permit inspection.

6 Concrete blocks, clay pavers and precast concrete flags, kerbs and channels shall be lifted without cutting, to the nearest joint satisfying sub-Clause 5 of this Clause and carefully stored for re-use or dealt with as described in Appendix 2/3. In situ kerbs and channels shall be broken out to at least 150 mm beyond the excavation.

### Reinstatement of Paved Areas

7 Immediately before bituminous layers are reinstated, the edges of the existing material shall be cleaned of all loose material and be coated with an appropriate hot bituminous binder. Where joints in concrete slabs are affected by the excavation they shall be reinstated by cutting back to at least 0.5 m on each side of a transverse joint and forming an expansion joint on one side of the excavation and a contraction joint on the other and provide longitudinal joints where necessary in the same line before reinstatement in compliance with the 1000 Series to match the existing construction.

### Junctions Between New Pavement Construction and Existing Pavement or Other Paved Areas

8 Where new pavement construction abuts an existing bituminous pavement which has to be reduced in level or overlaid to match alignment and levels, the existing surface shall be trimmed by the minimum amount of cold-milling (planing) to a depth which will allow the specified thickness of wearing course to be laid, the edge being trimmed and treated in compliance with this Clause. Where the difference in level makes it necessary, a regulating course as described in Appendix 7/2 and surfacing material complying with the appropriate Clauses in the 900 Series shall be provided over the areas described in Appendix 7/2. Junctions between concrete pavements and between concrete and bituminous pavements shall be constructed as described in Appendix 7/2. Junctions in porous asphalt surfacing shall comply also with Clause 938. Junctions between porous asphalt surfacing and other pavement surfaces shall be in accordance with Appendix 7/2.

### 707 Breaking Up or Perforation of Redundant Pavement

1 Where redundant pavement construction is to be perforated or broken up, the pavement shall be treated as described in Appendix 7/6.

## 708 Weather Conditions for Laying of Bituminous Materials and Dense Tar Surfacing

### General

1 Laying of road pavement materials containing tar or bitumen binders, or mixtures thereof, may proceed during light precipitation provided that both the surface to be covered and the air temperature are above 0°C, except where otherwise specified in this Clause. Responsibility for working methods shall remain with the Contractor including all necessary adjustments to suit changes in weather conditions.

2 Laying of road pavement materials containing tar or bitumen binders, or mixtures thereof, may proceed provided that the temperature of the surface to be covered is 0°C or more, the air temperature is at or above -1°C and rising and the surface to be covered is dry, unfrozen and free from ice, snow, salt and grit, except where otherwise specified in this Clause.

### Hot Rolled Asphalt

3 Unless otherwise specified in Appendix 7/1, hot rolled asphalt wearing course materials incorporating 30% coarse aggregate shall have a minimum delivery temperature of 155°C and shall be laid 45 mm thick, within the constraints of wind speed and temperature given in Figure 7/1. When an anemometer is not available hot rolled asphalt wearing course materials incorporating 30% coarse aggregate shall have a minimum delivery temperature of 165°C and shall be laid 45 mm thick. It shall not be laid when the air temperature falls below 5°C unless the temperature of the surface to be covered is 3°C or more.

4 Alternatively, unless otherwise specified in Appendix 7/1, hot rolled asphalt wearing course materials incorporating 35% coarse aggregate shall be laid 50 mm thick, within the following constraints of delivery temperature, wind speed and air temperature.

Air temperature (minimum): 0°C

Wind speed (maximum at any air temperature):  
40 km/hr (at 2 m height) or 50 km/hr (at 10 m height)

Minimum delivery temperature of materials: 155°C.

5 Unless otherwise specified in Appendix 7/1, hot rolled asphalt basecourse and roadbase materials shall be laid in accordance with the requirements of sub-Clause 4 above, except the minimum delivery temperature shall be 135°C.

### Dense and Heavy Duty Macadams

6 Unless otherwise specified in Appendix 7/1, dense and heavy duty macadams shall be laid in accordance

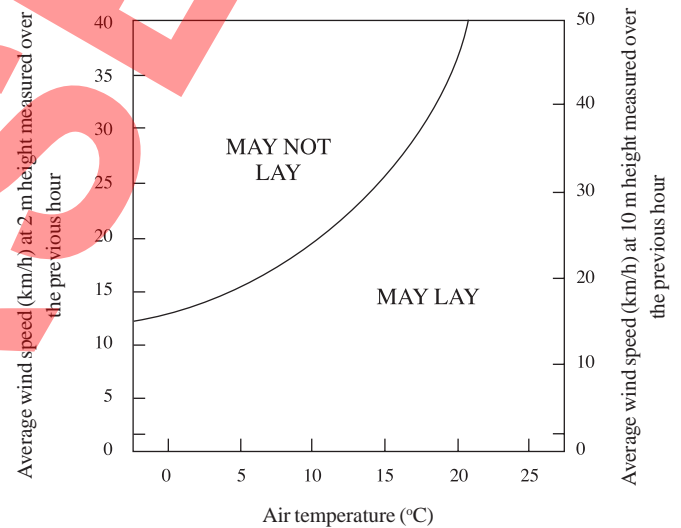
with the requirements of sub-Clauses 1 and 2 above, and shall be at least 50 mm thick, in the case of wearing course or basecourse materials.

7 Dense macadam wearing course and dense or heavy duty basecourse layers shall be laid and compacted within the constraints of wind speed and temperature given in Figure 7/2, and the requirements of sub-Clauses 1 and 2 above, unless their compaction is assessed in accordance with Clause 929.

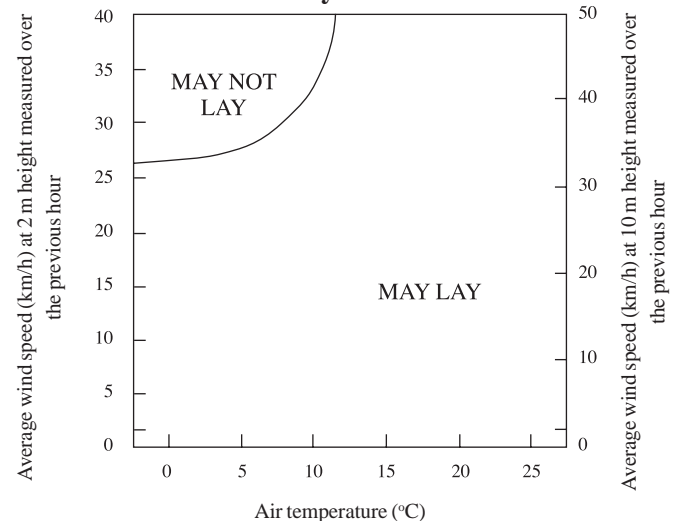
### Wind Speed

8 Wind speed shall be measured by anemometer positioned near the laying site to accurately reflect conditions at the laying site. The anemometer shall be fitted with a digital accumulative device.

**FIGURE 7/1: Wind Speed and Air Temperature Laying Restraints for 45 mm Thickness Rolled Asphalt Wearing Course**



**FIGURE 7/2: Wind Speed and Air Temperature Laying Restraints for Dense Bitumen Macadam Wearing Course or Basecourse, or Heavy Duty Macadam Basecourse Layers**



# NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATION OF NORTHERN IRELAND

## 702NI Horizontal Alignments, Surface Levels and Surface Regularity of Pavement Courses

### Horizontal Alignments

1 Horizontal alignments shall be determined from one edge of the pavement surface as described in Appendix 1/12. The edge of the pavement as constructed and all other parallel alignments shall be correct within a tolerance of  $\pm 25$  mm therefrom, except for kerbs, channel blocks and edge lines which shall be laid with a smooth alignment within a tolerance of  $\pm 13$  mm.

### Surface Levels of Pavement Courses

2 The design levels of pavement courses shall be calculated from the vertical profile, crossfalls and the pavement course thicknesses described in Appendix 7/1. The level of any point on the constructed surface of the pavement courses shall be the design level subject to the appropriate tolerances stated in Table 7/1NI.

**TABLE 7/1NI: Tolerances in Surface Levels of Pavement Courses**

Road surfaces - general - adjacent to a surface water channel*	$\pm 6$ mm $+ 10 - 0$ mm
Basecourse *	$\pm 6$ mm
Top surface of roadbase in pavements without basecourse *	$\pm 8$ mm
Roadbase other than above *	$\pm 15$ mm
Sub-base under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	$\pm 10$ mm
Sub-bases other than above	$+ 10 - 30$ mm

\* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table 7/1.

3 Notwithstanding the tolerances permitted in surface levels of pavement courses, the cumulative tolerance shall not result in a reduction in thickness of the pavement, excluding the sub-base and filter layer, by more than 15 mm from the specified thickness nor a

reduction in the thickness of the bituminous wearing course by more than 5 mm from that specified.

4 For checking compliance with sub-Clause 2 of this Clause, measurements of the surface levels of all courses will be taken on a grid of points located as described in Appendix 7/1. In any length of pavement, compliance shall be deemed to be met for all surfaces, other than the final road surface, when not more than one of ten consecutive measurements taken longitudinally or one in any transverse line, exceeds the tolerances permitted in Table 7/1NI, provided that this one measurement shall not exceed by more than 5 mm the tolerance for the course concerned. For the final road surface the tolerance given in Table 7/1NI shall apply to any point on that surface.

### Surface Regularity

5 The longitudinal regularity of the surfaces of wearing courses, basecourses, roadbases in pavements without basecourse and concrete slabs shall be such that the number of surface irregularities is within the relevant limits stated in Table 7/2NI.

An irregularity is a variation of not less than 4 mm or 7 mm of the profile of the road surface as measured by the rolling straight-edge, of the type designed by the Transport and Road Research Laboratory set at 4 mm or 7 mm as appropriate, or equivalent apparatus capable of measuring irregularities within the same magnitudes over a 3 m length. No irregularity exceeding 10 mm shall be permitted.

6 Prior to checking any final road surface, basecourse or top surface of roadbase in pavements without basecourse for level, regularity or texture depth, it shall be cleaned of loose or extraneous materials. These operations shall be carried out without damaging the surface of the pavement, as soon as possible and within 3 working days of construction of the pavement.

7 Compliance with Table 7/2NI shall be checked by the rolling straight-edge along any line or lines parallel to the edge of pavement on sections of 300 m at regular intervals as stated in Appendix 7/1, whether or not it is constructed in shorter lengths. Sections shorter than 300 m forming part of a longer pavement shall be assessed using the number of irregularities for a 300 m length pro-rata to the nearest whole number.

Where the total length of pavement is less than 300 m, the measurements shall be taken on 75 m lengths.

**8** Pavements shall be measured transversely for irregularities at regular intervals as stated in Appendix 7/1, by a 3 m long straight-edge placed at right angles to the centre line of the road. The maximum allowable difference between the pavement surface and the straight-edge shall be 3 mm.

**9** A straight-edge 3 metres long, shall be used to check longitudinal surface regularity in the following cases:

- (i) for lengths of less than 75 m of wearing course, basecourse, top surface of roadbase in pavements without basecourse and concrete slabs;
- (ii) where use of the rolling straight-edge or equivalent apparatus is impracticable;
- (iii) for all lengths of sub-base under concrete pavement slabs laid full thickness in one operation by machine with surface compaction.

The maximum allowable difference between the surface and the underside of the straight-edge, when placed parallel with, or at right angles to, the centre line of the road shall be:

for pavement surfaces	3 mm
for basecourses	6 mm
for the top surface of roadbase in pavements without basecourse	6 mm
for sub-bases under concrete pavements (as in (iii) above)	10 mm

**TABLE 7/2NI: Maximum Permitted Number of Surface Irregularities**

Irregularity	Surfaces of carriageways, hard strips and hard shoulders				Surfaces of lay-bys, service areas, footways, all bituminous basecourses and top surface of roadbases in pavements without basecourses			
	4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
Category A* Roads	20	9	2	1	40	18	4	2
Category B* Roads	40	18	4	2	60	27	6	3

\* The Category of each section of road is described in Appendix 7/1.

**Rectification**

**10** Where any pavement area does not comply with the Specification for regularity, surface tolerance, thickness, texture depth, material properties or compaction, the full extent of the area which does not comply with the Specification shall be made good and the surface of the pavement course shall be rectified in the manner described below.

- (i) Unbound sub-bases and roadbases

The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 30 m long and 2 m wide or such area as necessary to obtain compliance with the Specification.

- (ii) Cement bound sub-bases and roadbases

The method of correction will depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours, the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with sub-Clause 704.6. Alternatively, for sub-bases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this Clause with a 1:4 cement and sand mortar or with 3 mm size fine graded wearing course complying with BS 4987: Part 1.

- (iii) Bituminous roadbases

With coated macadam or asphalt roadbases, the full depth of the top layer as laid shall be removed and be replaced with fresh material laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous roadbases to be overlaid with a base course, the Contractor may make up the level with additional basecourse material.

- (iv) Wearing courses, basecourses and top surface of roadbases in pavements without basecourse

These shall have the full depth of the course removed, or in the case of roadbase in pavements without basecourse, the topmost layer, and replaced with fresh material laid and compacted in accordance with the Specification.

The area rectified shall be the full width of the paving laid in one operation, and at least 5 m long if basecourse or roadbase on pavements without basecourse, or 15 m if wearing course.

Where the number of surface irregularities exceeds the limits in Table 7/2NI, the area to be rectified shall be 300 m or 75 m long as appropriate and the full width of the lanes affected, or such lesser area as necessary to make the number of surface irregularities conform with the limits.

Checking of the wearing course for compliance with this Clause shall be carried out as soon as possible after completion of the surfacing and remedial works completed before the road is opened to traffic.

Where the texture depth requirement is not met for:

- (a) a section 1000 m in lane length; or
- (b) the full lane length of a section less than 1000 m long as the balance of a complete scheme; or
- (c) the full lane length of a scheme less than 1000 m long;

then sufficient 50 m lengths shall be replaced, starting with that length having the least texture depth, until the average requirement for the section length is complied with.

A minimum length of 50 m and the full lane width shall be removed and replaced either:

- (a) to the full depth of the wearing course; or
- (b) to a depth of 20 mm when replaced by the repave method process in compliance with Clause 926.

Areas to be removed shall be delineated both longitudinally and transversely by saw cutting prior to the material being removed. Joints shall be formed either by coating the exposed sawn face with hot bitumen or heating by suitable heater. The heater shall raise the temperature of the full depth of the course immediately before laying the new material to

a figure within the range of minimum rolling temperature and maximum temperature at any stage specified for the material and for a width of not less than 75 mm.

- (v) Concrete slabs

Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt with in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair complying with Clause 1032.

Retexturing of hardened concrete shall be carried out by sawing grooves in accordance with the Specification. Texturing of replaced surfaces shall be by brushing in accordance with the Specification. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength to have developed as required in Clause 704, before that section of pavement is opened to traffic.

## 705NI General Requirements for Sub-bases and Roadbases

1 The Contractor shall, in his choice of permitted materials for sub-bases and roadbases have regard to the nature of those materials and of the subgrade or any capping and filter layer and the need to protect them from deterioration due to the ingress of water, the adverse effects of weather and the use of constructional plant. The Contractor shall programme the laying and compaction of the sub-base and the subsequent pavement courses and take such other steps as may be considered necessary, to afford protection to the roadbase, sub-base and subgrade.

### Transporting

2 Unbound and cement bound plant-mixed material shall when mixed be removed at once from the mixer, transported directly to the point where it is to be laid and protected from the weather both during transit from the mixer to the laying site and whilst awaiting tipping.

### General Requirements for Sub-bases and Roadbases — Laying

3 The Contractor shall at no time permit the leading edge of any individual layer of the material to extend more than 100 metres beyond the leading edge of the succeeding layer of the material or 1,000 metres beyond the leading edge of the succeeding layer of bituminous roadbase or basecourse material.

Where the material is used for roadbases up to 225 mm compacted thickness it shall be spread in one layer so that after compaction the total thickness is as specified. Roadbase material of compacted thickness greater than 225 mm shall be laid in 2 or more layers and the minimum compacted thickness of any such layer shall be 110 mm. The final layer of roadbase material shall be laid using a paving machine.

### Frost Heave

4 Subject to the tolerances given in Table 7/1NI and unless otherwise stated in Appendix 7/1, material shall not be frost susceptible if it is used within 450 mm of the designed final surface of a road or paved central reserve, or 350 mm if the Mean Annual Frost Index (MAFI) of the site is less than 50.

5 Material shall be classified as non-frost-susceptible if the mean heave is 15 mm or less, when tested in accordance with BS 812: Part 124: 1989, amended as follows:

3	Principle. Line 3. After '(SRU)' add 'and compared with reference specimens'.	
5	Delete the NOTE and insert a new NOTE: NOTE: The tolerances on the dimensions given in Figures 1 and 2, subject to the compatibility of parts, shall be:	
	Dimensions in excess of 100 mm	± 10 mm
	Dimensions in excess of 25 mm	± 5 mm
	Other dimensions	± 1 mm

The dimensions of the support frame and push rods are nominal, and can be altered to suit the equipment.

5	Add additional items:	
5.3.4.10	Filter paper - (Whatman No. 40 is suitable)	
5.16	Standard sand for reference specimens shall be clean silica sand from the Leighton Buzzard district and shall comply with the grading requirements of Fraction C of BS 4550: Part 5. The sand shall not have been used previously for any other test.	9.4.2
5.17	Standard filler for reference specimens shall be a limestone filler from the designated source (see NOTE).	9.4.3

NOTE: The standard filler shall be obtained from the Transport Research Laboratory Scotland, Craigshill West, Livingston, West Lothian EH54 5DU. (Tel

01506 31921). Sources of sand are given in BS 4550: Part 5.

- 6.1 Add "use a spirit level in the base of the specimen cradle when properly seated, to level the apparatus".
- 6.6 Add a Note after (j):
- NOTE: The functioning of the CLD may be tested at the stage when the correct levels have been achieved, with the reservoir connected, but before specimens are put in place. This may be done as follows:
- (i) Using a 100 ml bulb pipette and suction bulb, withdraw water from the cabinet until a bubble separates from the constant head capillary. Measure the volume withdrawn by discharging the pipette into a 100 ml measuring cylinder.
  - (ii) Allow the levels to come to equilibrium again (bubbling ceases) and repeat the measurement.
  - (iii) Typical results are 62 ml, 56 ml, 52 ml, Mean 57 ml. This demonstrates that a drop in water bath level of 0.23 mm is corrected by the CLD arrangement and represents an outside estimate of the differential over which the device works.

Add a new section 9.4:

### Preparation of Reference Test Specimens

Take representative samples of the sand and filler. Oven-dry them separately to constant mass at 105°C - 110°C so that a mass of at least 7.5 kg of sand and 1.3 kg of filler is obtained. After drying, store the sand and filler separately in sealed containers and allow to cool to room temperature.

Weigh out to the nearest 1 g representative portions of 2338 g of sand and 412 g of filler and place both together in a suitable container (eg. a plastic bag). Shake the contents of the container in the dry state for half a minute to ensure that the sand and filler are thoroughly mixed.

Place the sand - filler mixture into the mixer (see 5.6). Add 250 ml of distilled or demineralised water. Mix the sand, filler and water for five minutes. Store the mixed material in a sealed container for a minimum period of 16 hours before proceeding with the tests.

9.4.4	Weigh out to the nearest 1 g, 2562 g of the mixed material and prepare a frost-heave specimen as described in Clauses 9.3.1.2 - 9.3.3.1. Repeat to prepare two further reference specimens.		range and mean of the standard sand and filler specimens are satisfied.
10.1.1	Add: "If fine grained material or soils are to be tested, place a filter paper on the porous disc."  Delete 10.1.2 and 10.1.3 and insert:	11.4	Data obtained on the reference specimens shall be tabulated and plotted on forms and charts issued by the supplier of the filler. Completed forms shall be sent to the supplier of the filler once a year. (Ref. Clause 5.17 NOTE).
10.1.2	Locate thermocouples between the bottom of the porous disc and the copper carrier in each of the specimen positions 1, 3, 5, 7, 9 as in Figure 2. Ensure that the tip of the thermocouple is not in contact with the copper carrier and is 5 to 10 mm into the water bath when the carrier is loaded with specimens, and as central as possible in each specimen position. Also fix a thermocouple under the Tufnol disc in position 5, so that the junction is exposed at the centre of the disc and in contact with the upper surface of the test specimen.	12.1 12 12.5	Line 1. After 'determined' add: "without reference specimens".  Add new Clauses 12.5 and 12.6.  A further precision experiment included tests on Type 1 sub-base materials (crushed limestones) and on sand - filler mixes. The reproducibility value ( $R_2$ ) of the frost-heave of the crushed limestones was 11.3 mm. The use of reference sand - filler mixes to exclude tests where the frost-heave of the sand - filler mix deviated by more than 4.0 mm from the target value for the mix, reduced the value of $R_2$ to 7.1 mm. This is the justification for the rule given in 11.2(a).
10.1.3	Place the three reference specimens into positions 3, 5 and 7. Fill the other six positions with specimens which shall be a minimum of three for each material to be tested.	12.6	The target value of 13.6 mm for the standard sand and filler mix specified in Clause 9.4 was established by a trial carried out in 1990 involving 13 test cabinets.
10.1.4	Delete the NOTE and insert a new NOTE:  NOTE: Support the dowels either by drilling holes of the correct diameter or by flexible tubing placed on the dowel ends which are then pushed onto preset studs on the floor of the cradle. Care should be taken to ensure that particles of sand do not get under the dowels thus raising the thermocouples.	13 13	Delete and insert revised Clause 13:  <b>Test Report</b>  The test report shall affirm that the frost heave was determined in accordance with Part 124 of BS 812: 1989 as amended by Clause 705 of the SHW and whether or not a copy of a certificate of sampling is available. If available, a copy of the certificate of sampling shall be provided. The test report shall contain the following information:  <i>For the standard sand and filler mixture</i>  (a) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.  (b) The mean result reported under (a) above calculated to the nearest 0.1 mm.  <i>For each of the other aggregates</i>  (a) Sample identification.  (b) The dry density at which the specimens were prepared.
11	Delete 11.2 (a), (b) and (c) and 11.3 Insert revised 11.2 (a) and (b) and 11.3:		
11.2	(a) The mean heave of the three reference sand and filler specimens shall be in the range $13.6 \pm 4.0$ mm.  (b) The range (ie. highest - lowest) of results of each of the three sets of specimens in the test run shall not exceed 6 mm.		
11.3	If either of the conditions given in 11.2 (a) or 11.2 (b) is not satisfied the results of the whole test run shall be rejected. The operating procedure and equipment shall then be examined and adjusted as necessary to ensure that the requirements for the		

- (c) The moisture content used to prepare the specimens.
- (d) The particle-size distribution of the test portion (8.1).
- (e) The particle-size distribution of the stable test specimen (8.2.2.7).
- (f) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.
- (g) The mean results reported under (f) above calculated to the nearest 0.1 mm.

## 706NI Excavation, Trimming and Reinstatement of Existing Surfaces

### General

1 The Contractor shall not excavate pits, trenches or other openings in paved areas which have been constructed as part of the Permanent Works in order to construct other parts of the Works, including Statutory Undertakers and other service works, except with the prior approval of the overseeing organisation.

2 Where excavation and trimming of existing paved areas and highways not constructed as part of the Permanent Works are required in Appendix 7/2, they shall be carried out and reinstated in compliance with this Clause and with any additional requirements described in Appendix 7/2. Excavations shall be carried out to the dimensions described in Appendix 7/2, or, if not so described, to the minimum dimensions, subject to sub-Clause 3 of this Clause, necessary to carry out the work.

### Excavations

3 Excavations in existing pavements and other paved areas, except those described in sub-Clause 4 of this Clause, including surfacing, roadbase and sub-base, shall be cut to neat lines to dimensions at least 75 mm greater on each side than the dimensions of any further excavation below formation level. Excavations in capping shall be taken at least 75 mm outside the dimensions of any excavation below. Road surfacing of bituminous material shall be cut back by sawing or planing to a further 75 mm on each side. Planing shall be carried out in accordance with Clause 917. Concrete surfacing and concrete roadbases, except CBM, shall be cut back by sawing by at least 300 mm on each side to the level of any reinforcement in reinforced slabs and to the full depth of the slab in unreinforced slabs.

If excavations are required to inspect the condition of lower layers, each layer shall be excavated separately and cleaned of debris to permit inspection.

4 Concrete blocks, clay pavers and precast concrete flags, kerbs and channels shall be lifted without cutting, to the nearest joint satisfying sub-Clause 3 of this Clause and carefully stored for re-use or dealt with as described in Appendix 2/3. In situ kerbs and channels shall be broken out to at least 150 mm beyond the excavation.

5 All excavations shall be carried out in compliance with the Specification and adequately supported at all times. Support shall be withdrawn as backfilling proceeds.

### Backfilling

6 Backfilling of excavations shall be carried out as quickly as possible after completion of the work for which the excavation is required, to formation or sub-formation, in compliance with the appropriate Clauses in the 500, 600, 1200, 1300 and 1400 Series or as otherwise described in Appendix 7/2 using fill material and compaction described therein.

### Reinstatement of Paved Areas

7 The layers of capping and pavement and other paved area materials shall be reinstated consecutively, as soon as possible, in compliance with the appropriate Clauses in the 600, 700, 800, 900, 1000 and 1100 Series, to match the thicknesses and constituents of the existing material or as otherwise described in Appendix 7/2. They shall be laid and compacted in compliance with the appropriate Clauses in the above Series within the tolerances given in Table 7/1.

To allow for settlement in backfill under concrete pavements, temporary repairs to the pavement shall be carried out using bituminous materials. Alternatively, foamed concrete shall be used up to the base of the slab and the slab reinstated as soon as possible. The reinstatement of the concrete slab shall be carried out as described in Appendix 7/2.

8 Block and flag paving and precast and in situ kerbs and channels shall be reinstated in compliance with the 1100 Series to match the existing construction.

9 Where settlement of the reinstatement occurs, the surface level shall be brought to correct levels and surface regularity. Where an existing pavement has been trimmed for a new pavement to abut it, regulating layers for changes in crossfall or level shall comply with the requirements for the appropriate sub-base, roadbase or surface layer.

10 Immediately before bituminous layers are reinstated, the edges of the existing material shall be cleaned of all loose material and be coated with an appropriate hot bituminous binder. Where joints in concrete slabs are affected by the excavation they shall be reinstated by

cutting back to at least 0.5 m on each side of a transverse joint and forming an expansion joint on one side of the excavation and a contraction joint on the other and provide longitudinal joints where necessary in the same line before reinstatement in compliance with the 1000 Series to match the existing construction.

### **Reinstatement of Unpaved Areas and Other Surfaced Highways**

**11** Where the excavation affects verges, grassed areas, footpaths and bridleways they shall be reinstated to match the existing surface, after backfilling in compliance with sub-Clause 6 of this Clause to a depth of 150 mm below the existing surface. The reinstatement shall be completed by topsoil and seeding or turfing in compliance with the Specification, in both cases re-using any topsoil or turves cut and stored for re-use, or, when surfaced, with material matching the existing foundation and surface.

**12** Levels between existing and newly constructed footpaths, footways, verges and bridleways shall be matched by removing the minimum area of existing material necessary, to enable the total thickness of surfacing material to be laid abutting the existing surface. Where settlement of the reinstatement occurs the levels shall be brought up to existing levels.

Surfaces may be left proud of the adjacent existing surfaces by an amount not exceeding 50 mm, adequately ramped to avoid sharp changes in level, to cater for subsequent settlement.

### **Junctions Between New Pavement Construction and Existing Pavement or Other Paved Areas**

**13** Where new pavement construction abuts an existing bituminous pavement which has to be reduced in level or overlaid to match alignment and levels, the existing surface shall be trimmed by the minimum amount of cold-milling (planing) to a depth which will allow the specified thickness of wearing course to be laid, the edge being trimmed and treated in compliance with this Clause. Where the difference in level makes it necessary, a regulating course as described in Appendix 7/2 and surfacing material complying with the appropriate Clauses in the 900 Series shall be provided over the areas described in Appendix 7/2. Junctions between concrete pavements and between concrete and bituminous pavements shall be constructed as described in Appendix 7/2. Junctions in porous asphalt shall comply also with Clause 938. Junctions between porous asphalt surfacing and other pavement surfaces shall be in accordance with Appendix 7/2.