
SECTION 304 - UNBOUND FLEXIBLE PAVEMENT CONSTRUCTION

304.01 DESCRIPTION

This section covers the requirements for the placement of gravel, sand, soft or ripped rock, crushed rock, crushed scoria or crushed concrete pavement materials, for the construction of unbound flexible pavement layers.

304.02 DEFINITIONS

Unbound Flexible Pavement

A pavement consisting of an unbound granular base and subbase materials, with a thin asphalt or sprayed bituminous seal surfacing.

Pavement Course

For the purpose of this specification, the pavement base, upper subbase and lower subbase shall each be termed a pavement course. A pavement course may comprise one or more layers.

Base

One or more layers of material usually constituting the uppermost structural element of a pavement on which the surfacing may be placed, which may be composed of crushed rock, or other materials as specified in Clause 304.03. Typically, base is the top 200 mm of the pavement or the pavement base thickness as specified or shown on the drawings.

Subbase

The pavement material constructed on the subgrade to the underside of the base either for the purpose of making up the additional pavement thickness required, or to provide a working platform. The subbase may be constructed of the same material type or may comprise two different material types as follows:

- (a) Upper Subbase - the better quality material immediately below the base; and
- (b) Lower Subbase - the lower quality material immediately above the subgrade.

If only a single layer of subbase is specified or shown on the drawings, the specified requirements for subbase material shall conform to the requirements of an upper subbase material.

Subgrade

Subgrade is the trimmed or prepared portion of the formation on which the pavement including shoulders is constructed.

Segregated Area

An area of a pavement layer, which does not comply with the grading requirements of Clause 304.10. Typically this is where the finer material is either not present or has settled to the bottom of the layer leaving the coarser materials at the surface.

304.03 MATERIALS

Unless otherwise specified, the Contractor shall be responsible for the procurement of sufficient specified material to complete the work. The Contractor shall supply details demonstrating compliance of the materials with Sections 801, 811 and 812.

Water added to the pavement material, shall be clean and substantially free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances. Water shall contain a maximum of 1000 mg/L of suspended solids. Water supplied from sources where dissolved salts are known or likely to be present shall be tested for electrical conductivity prior to use. The electrical conductivity shall not be more than 3500 $\mu\text{S}/\text{cm}$. Water sources classified by the relevant Water Authority as potable water shall be exempt from this requirement.

304.04 SUBGRADE PREPARATION

Prior to placing subbase material, the subgrade shall meet the requirements of Section 204.

304.05 DELIVERY DOCKETS

Where material is scheduled for measurement by loose volume in delivery vehicles or by mass, a delivery docket for each load shall be issued to the Superintendent at the point of delivery.

Where material is measured by other means and for Lump Sum Contracts, the Contractor shall make delivery dockets available for inspection on request by the Superintendent.

Delivery dockets shall show:

- (a) name of the supplier, and location of quarry, pit or plant;
- (b) docket number;
- (c) name of user;
- (d) project name and location (or contract number);
- (e) registered number or fleet number of the vehicle;
- (f) date and time of loading;
- (g) nature and source of material;
- (h) empty and loaded masses of the vehicle (where material is scheduled for measurement by mass);
- (i) loose volume in delivery vehicle (where material is scheduled for measurement by loose volume);
- (j) supplier's stockpile identification number if applicable; and
- (k) legible signature of person receiving the material at the point of delivery.

304.06 CONFORMITY WITH DRAWINGS

All pavement courses shall, after compaction, be finished to smooth and uniform surfaces, free of segregated areas, and conforming to the limits for level, line, grade, thickness and cross section shown on the drawings or as specified.

Any material that has been compacted and then trimmed from the compacted surface to conform to the correct level or thickness as shown on the drawings shall not be re-used in the pavement construction without the approval of the Superintendent.

(a) Width and Alignment

The width of each side of the pavement shall not be less than the specified offset width or more than 50 mm outside the specified offset width when measured at right angles from the centre line or design line.

(b) Surface Level of Pavement Courses

The surface level of the pavement courses shall be measured in accordance with the requirements of Section 173 and every test lot shall meet either Scale A, B or C requirements as specified in Clause 304.12.

The maximum lot size for measurement and assessment of surface level shall be 4000 m² but may be increased to match the maximum lot size for assessment of compaction specified in Table 304.111.

Where pavement is to be constructed to the lip level of kerb and channel, it shall be constructed flush with the lip of the channel or not more than 5 mm above.

(i) Scale A and B Surface Level Requirements

Each level measurement shall be taken at random locations over the area of the lot in accordance with the VicRoads Test Method and the number of measurements taken within each lot shall not be less than the number specified in Table 304.061.

The mean and standard deviation of the departures from the design surface level for the pavement courses at their respective levels within each lot shall meet the requirements of Table 304.062.

Table 304.061 - Minimum Number of Level Measurements per Lot

Scale of Surface Level Measurement	Minimum Number of Measurements Per Lot
Scale A	80
Scale B	40

Table 304.062 - Surface Level Tolerances for the Pavement Courses

Scale of Level Measurement	Lower Subbase		Upper Subbase		Base	
	\bar{x} Range (mm)	Max. S (mm)	\bar{x} Range (mm)	Max. S (mm)	\bar{x} Range (mm)	Max. S (mm)
Scale A	+6 to -10	10	+4 to -8	8	± 5	8
Scale B	+8 to -16	15	+ 6 to -12	13	± 8	10

Notes:

- \bar{x} is the mean value of all level readings taken in the lot
- S is the standard deviation of all level readings taken in the lot
- A negative value designates a measured departure below the design level and positive value designates a surface level above the design level

Where the surface does not meet the relevant surface tolerance in Table 304.062, the Contractor shall undertake further work to bring the surface into the specified tolerance and shall re-survey the test lot in accordance with this clause. The Contractor shall accept all costs associated with the necessary additional works and survey.

For Scale A and Scale B level requirements, the Superintendent may agree to accept a lot which does not conform with the limits of Table 304.062 at a reduced payment subject to the lot not exceeding either of the limits specified in Table 304.063. Where the Superintendent agrees to accept the lot, payment for the work will be reduced as shown in Table 304.063. The value of the lot of work shall be reduced as calculated from the percentages specified in Table 304.063 and the unit rates for pavement construction as specified in Clause 304.12(b).

Table 304.063 - Payment Deduction for Surface Level

Variation	Payment Reduction
Mean (\bar{x}) exceeding the specified limit up to a maximum of 25% of the permitted range	8% plus 4% reduction for each 1 mm of \bar{x} outside the tabulated limit
Standard Deviation (S) exceeding the specified limit up to a maximum of 35% of the permitted range	8% plus 4% reduction for each 1 mm of S greater than the tabulated limit
If both \bar{x} and S vary by more than the specified limit, the payment reduction shall be the sum of the payment reductions for both \bar{x} and S.	

(ii) Scale C Surface Level Requirements

Surface level measurement shall be undertaken in accordance with the procedure specified in Section 173.

The surface level of the pavement courses shall comply with the requirements of Table 304.064.

Table 304.064 - Level Tolerances at the Surface of Pavement Courses

Lower Subbase (mm)	Upper Subbase (mm)	Base (mm)
+ 15 to - 25	+ 10 to - 25	± 15

(c) Thickness of Pavement Layers

In addition to complying with pavement layer surface tolerances specified in Clause 304.06(b), the following tolerances shall apply to the thickness of any pavement layer:

- (i) the subbase course shall be not less than the specified thickness by more than 15 mm;
- (ii) the base course shall be not less than the specified thickness by more than 10 mm and the average thickness of base over every 100 m section, over the full carriageway width, shall be not less than the specified thickness;
- (iii) the combined thickness of subbase and base courses shall be not less than the specified thickness by more than 15 mm.

Where the Contract does not require design finished surface level control but specifies a pavement composition or a minimum resheet thickness only, the Contractor shall construct the pavement to comply with the requirements of thickness of each pavement layer as specified in this sub-clause. The tolerance requirements of Clause 304.06(b) shall not apply.

(d) Shape

No point on the surface of any pavement layer shall vary by more than 8 mm from a 3 m straight edge, or 10 mm from a 6 m straight edge, placed in any direction.

At no location shall water pond on the surface of any pavement layer.

(e) Rideability

In addition to the above requirements for surface tolerance, the finished surface shall satisfy the requirements specified in Section 180.

304.07 JOINTING

Unless otherwise specified, the layout of joints shall conform to the following requirements:

- (a) material shall be spread in such a manner as to minimize the number of joints;
- (b) for all pavement layers, transverse joints in adjoining paver runs shall be offset by not less than 2 m;
- (c) transverse joints shall be offset from one layer to the next by not less than 2 m;
- (d) longitudinal joints shall be offset from one layer to the next by not less than 150 mm;
- (e) longitudinal joints shall be located within 300 mm of the planned position of traffic lanes lines or within 300 mm of the centre of a traffic lane.

The exposed end of each lot and the exposed edges of any part width construction shall be kept moist until spreading and compaction has been completed over the entire layer.

304.08 REQUIREMENTS FOR TESTING AND ACCEPTANCE OF COMPACTION

(a) General

Unless otherwise specified, material during compaction shall have a moisture content of not less than 85% of optimum. After completion of compaction of a layer, the moisture content of the material in the layer shall be maintained at a moisture content of not less than 85% of optimum until test rolling has been completed. All segregated areas shall be rectified as construction proceeds, prior to the completion of compaction and in such a way as to mitigate the potential for segregation to re-occur.

(b) Material of Nominal Size 40 mm or Less

Material having a nominal size after compaction of 40 mm or less shall be compacted to comply with the following requirements:

- (i) The calculation of density ratio shall be based on tests performed using Modified compactive effort. The work shall be assessed for compliance with Scale A, Scale B or Scale C requirements for testing and acceptance of compaction as specified in Clause 304.12 and as provided in Tables 304.081 and 304.082.
- (ii) A lot shall consist of a single layer of work and its size shall not exceed that given in Table 304.111.
- (iii) For work to be tested for compliance with Scale A or Scale B requirements, the number of tests per lot shall be six. For work to be tested for compliance with Scale C requirements, the number of tests per lot shall be three.
- (iv) All pavement layers shall be compacted to withstand rolling and shall be test rolled in accordance with Section 173, prior to acceptance of the layer. For pavement construction, any lot that has a surface area less than 500 m² may be treated as a small area and tested in accordance with Section 173.

The Contractor shall provide for the Superintendent to be present during all test rolling.

- (v) The maximum thickness of any pavement base layer shall not exceed 150 mm and the maximum thickness of any subbase layer shall not exceed 200 mm.
- (vi) The minimum thickness of any pavement layer shall be 4 times the nominal size of the material.

Table 304.081 - Acceptance Limits for Scale A and Scale B Standards of Compaction

Compaction Scale	Characteristic Value of Density Ratio % (six tests)			
	Lower Subbase Layers	Upper Subbase Layers	Base Layers	
			Layer directly beneath the Bituminous Surfacing	Other Layers
A	Not less than 98.0	Not less than 98.0	Not less than 100.0	Not less than 99.0
B	Not less than 97.0	Not less than 97.0	Not less than 98.0	Not Less than 98.0

Table 304.082 - Acceptance Limits for Scale C Standard of Compaction

Compaction Scale	Mean Value of Density Ratio % (three tests)	
	Subbase Layers	Base Layers
C	Not less than 98.0	Not less than 100.0

(c) Material of Nominal Size Greater than 40 mm

Unless otherwise specified, the first lot shall be placed as a trial section. Following acceptance of the trial section, the Contractor shall then confirm the moisture control and compaction procedure and submit the procedure to the Superintendent for review and record.

The Superintendent may require that further trial sections be constructed to verify that the proposed compaction routine is acceptable. No additional payment will be made for any such request.

Acceptance of work as far as compaction is concerned will be based on compliance with the accepted moisture control and compaction procedure and test rolling carried out in accordance with Section 173.

The Contractor shall provide for the Superintendent to be present during all test rolling.

The Contractor shall rectify any unstable areas detected by test rolling.

Prior to any layer being covered by a successive layer, the Superintendent may require further test rolling to confirm that the layer is sound. No additional payment will be made for any requirement to carry out such further test rolling.

304.09 MAINTENANCE OF COMPACTED LAYERS

The surface of any compacted pavement layer or prepared subgrade shall be maintained in such a way as to minimise dust, prevent ravelling, erosion, deformation or any other damage to the layer resulting from environmental conditions, traffic or construction activities. The layer shall be kept free from contamination until any subsequent pavement work under the Contract is commenced or the Superintendent accepts and takes responsibility for that part of the Works.

304.10 POST COMPACTION REQUIREMENTS FOR PAVEMENT MATERIAL

If specified in Clause 304.10(c) or Clause 304.10(d), following completion of compaction, material shall be tested for post-compaction grading or Plasticity Index (PI) at the frequency specified in Clause 304.11 for the appropriate Scale of Testing specified in Clause 304.12(a).

The test samples to be used for post-compaction grading and PI tests shall be a combined sample made up from six randomly selected increments extracted from the lot of pavement construction being assessed.

(a) Assessment of Post-compaction Grading

Assessment of post-compaction grading shall be based on a sieve analysis on a sub-sample of the combined sample. The post-compaction grading shall comply with the requirements of Tables 304.101 or 304.102.

Where the post-compaction grading for gravel, sand, and soft or ripped rock base and subbase materials is not specified in Table 304.102, the post-compaction grading of gravel and sand shall comply with Table 6.10 of VicRoads Technical Bulletin No. 39 and the post-compaction grading of ripped rock shall comply with Table 6.11 of VicRoads Technical Bulletin No. 39.

(b) Assessment of Post-compaction Plasticity Index (PI)

The assessment of post-compaction PI shall be based on the mean value of a pair of test results determined from two single results from separate sub-samples taken from the combined sample. The mean PI shall comply with the limits on PI specified in Table 304.103 or such value as approved by the Superintendent to meet the permeability requirement specified in Section 812.

(c) Post-compaction grading testing is required: ~~is not required:~~ (refer to Clause 304.11(c))

(d) Post-compaction Plasticity Index testing is required: ~~is not required:~~ (refer to Clause 304.11(c))

Table 304.101 - Post-Compaction Grading Requirements for Crushed Materials

Sieve Size (mm)	Post-Compaction Grading Limits (% Passing by Mass)		
	Class 1 or Class 2 Crushed Rock Crushed Scoria Base Class CC2 Crushed Concrete	Class 3 Crushed Rock Crushed Scoria Upper Subbase Crushed Concrete Class CC3	
	Nominal Size (mm)	Nominal Size (mm)	
	20	20	40
53.0	-	-	100
37.5	-	-	95 - 100
26.5	100	100	75 - 95
19.0	95 - 100	95 - 100	64 - 70
13.2	78 - 92	75 - 95	-
9.5	63 - 83	60 - 90	42 - 78
4.75	44 - 64	42 - 76	27 - 64
2.36	30 - 49	28 - 61	20 - 51
0.425	14 - 23	14 - 29	10 - 24
0.075	6 - 12	6 - 14	6 - 13

~~**Table 304.102 - Post-compaction Grading Requirements for Gravel, Sand, and Soft or Ripped Rock Base and Subbase Materials**~~

*** ## in the table below, delete all # symbols, even where no value is to be specified:

Sieve Size (mm)	Post-compaction Grading Limits (% Passing by Mass)			
	Base		Upper Subbase	
	Natural Sands or Gravel	Ripped Rock	Natural Sands or Gravel	Ripped Rock
75.0				
53.0				
37.5		##:		
26.5	##:	-	##:	
19.5	##:	-	##:	
9.5	##:	-	##:	
4.75	##:	##:	##:	
2.36	##:	-	##:	
1.18	##:	-	##:	
0.425	##:	##:	##:	
0.075	##:	##:	##:	

Table 304.103 - Post-compaction Requirements for Plasticity Index

Material	Plasticity Index	
	Minimum	Maximum
Class 1 Crushed Rock	2	6
Class 2 Crushed Rock	0	6
Class 3 Crushed Rock	0	10
Gravel, Sand or Ripped Rock Base Material	2	##:6
Gravel, Sand or Ripped Rock Upper Sub-base Material	2	##:12

304.11 MINIMUM FREQUENCY OF TESTING

(a) General

The Contractor shall carry out compaction density testing and post-compaction grading and PI testing at a frequency sufficient to ensure that work performed under the Contract complies with the specified requirements but shall not be less than that shown in Table 304.111.

The minimum test frequency specified in Table 304.111 shall not apply to small areas as defined in Section 173. In this case, every lot shall be tested separately for compliance with the specified requirements.

If the nature of material in any lot being placed has visibly altered when compared to previous lots placed, the Superintendent may require additional testing to be undertaken to confirm that the lot complies with the specified requirements for post-compaction grading and PI. No additional payment will be made for this testing.

(b) Compaction

The Contractor shall initially test every lot for acceptance of compaction in accordance with the requirements of the Specification. Testing of every lot shall continue until three consecutive lots of like material and/or work have achieved the standards specified in Clauses 304.08 and 304.10 when tested for the first time. The Contractor may reduce the frequency of compaction testing to the minimum test frequency as specified in Table 304.111 after satisfying this requirement.

The Contractor may continue to test at the minimum frequency until such time as a lot fails to achieve the specified requirements. All subsequent lots shall be tested until three consecutive lots of like material and work have achieved the specified standard, at which time the frequency of testing may revert to the minimum test frequency.

If the Contractor is testing at the minimum frequency and any test lot does not meet specification requirements, the Superintendent may require any previous untested lots between the last lot to be tested and the failed lot to be tested. This testing shall be carried out at no additional cost to VicRoads.

(c) Post-compaction Grading and Plasticity Index (PI)

(i) Scale A Requirements for Post Compaction Grading and PI Testing

Where Scale A is specified in Clause 304.10(c) or (d), all pavement layers shall be tested for post-compaction grading and PI at the frequency specified in Table 304.111.

The first lot of each pavement layer shall be tested for post-compaction grading and PI. If the lot satisfies the requirements specified in Clause 304.10(a) and (b) as applicable, the Contractor may test at the minimum frequency as specified in Table 304.111. The Contractor shall immediately notify the Superintendent of any lot that does not meet the specified requirements and any subsequent lot shall be tested as if it were the initial lot. If any lot meets the specified requirements but is reworked to comply with the specified compaction requirements, it shall be retested for compliance with specified requirements.

If the Contractor is testing at the minimum frequency and any test lot does not meet specification requirements, the Superintendent may require the testing of the post-compaction grading and PI of all lots constructed after the last tested lot. This testing shall be carried out at no additional cost to VicRoads.

(ii) Scale B Requirements for Post Compaction Grading and PI Testing

Where Scale B is specified in Clause 304.10(c) or (d), the first lot of each pavement course shall be tested for post-compaction grading and PI.

If the first lot each pavement course satisfies the specified post compaction requirements in Clause 304.10(a) and (b), as applicable, no further post-compaction testing will be required for that pavement course.

If the first lot does not meet the requirements specified in Clause 304.10(a) and (b), the Contractor shall then seek approval from the Superintendent before work proceeds.

(iii) Scale C Requirements for Post Compaction Grading and PI Testing

Post compaction grading and PI testing is not required.

Table 304.111 - Maximum Lot Size and Minimum Frequency of Testing for Compaction, Post-compaction Grading and PI (after passing the minimum number of qualifying lots)

Pavement Layer	Maximum Allowable Lot Size for a Single Layer of Work	Minimum Frequency of Testing for Compaction	Minimum Frequency of Testing for Scale A Post-compaction Grading	Minimum Frequency of Testing for Scale A Post-compaction PI
Upper Base Layer	The lesser of 4000 m ² or one day's production	One per 2 lots	One per 2 lots	One pair per 4 lots
Lower Base Layer	The lesser of 4000 m ² or one day's production	One per 2 lots	One per 2 lots	* One pair per 8 lots
Upper Subbase	The lesser of 4000 m ² or one day's production	One per 2 lots	One per 4 lots	* One pair per 8 lots

304.12 SCHEDULES OF DETAILS – REFER TO TENDER DOCUMENT PART 4, SECTION 1.2.

(a) Requirements for Testing and Acceptance of Surface Level Measurement, Compaction and Post-compaction Gradients and PIs (Clauses 304.06, 304.08, 304.10 and 304.11)

Table 304.121 – Testing Levels

Roadway	Road Chainage / Location	Scale of Surface Level Measurement (A, B or C)	Scale for Assessment of Compaction (A, B or C)	Scale for Assessment of Post-Compaction Grading and PI (A, B or C)
##:	## to ##:	##:	##:	##:

Where for any location a specific scale has not been nominated, Scale A shall apply.

(b) Basis for Price Reduction for Departure from Specified Surface Level (Clause 304.06(b)(i))

Table 304.122 – Rates for Price Reduction

Location	Pavement Course	Unit Price \$/m ²
##:	Upper Subbase	##:
	Lower Subbase	##:
	Base	##:
##:	Upper Subbase	##:
	Lower Subbase	##:
	Base	##: