# Pavements And Shoulders

DIPL - Roadworks Master - October 2019

## Standards, Codes and Test Methods

Conform to the following Standards and Publication unless specified otherwise:

AS 1141(set) Methods for Sampling and Testing Aggregates.

AS 1289(set) Methods of Testing Soils for Engineering Purposes.

NTMTM NT Materials Testing Manual accessible via <https://transport.nt.gov.au/infrastructure/technical-standards-guidelines-and-specifications/materials-testing-manual>.

NTTM NT Test Methods

NTCP 107.1A Surface Roughness

## Definitions

BASE (BASECOURSE): That upper-most layer of constructed material immediately above the subgrade or sub‑base and below the pavement surface (sealed or unsealed) extending for the full width of the pavement and shoulder.

IRI: International Roughness Index

PAVEMENT: That portion of a road constructed for the structural support of, and to form the running surface, for traffic. The pavement structure refers to the pavement layers, in combination, above the subgrade surface, to support the traffic loadings. May be sealed or unsealed. Excludes the shoulders.

SHOULDER: That portion of a road carriageway adjacent to the pavement, and flush with the surface of the pavement. Provides run-off for vehicles from traffic lanes. May be sealed or unsealed.

SUB‑BASE: One or more layers of material placed over the subgrade and below the basecourse extending for the full width of the pavement and shoulder.

[If no sub‑base delete "sub‑base". If no bituminous surfacing delete "bituminous"]

## Material Properties

### Natural Gravel

Obtain material from sources of naturally occurring deposits.

Produce required properties by crushing, screening, blending, mixing or other processes necessary.

Ensure particles are tough, durable and of a tightly binding nature free of organic or other deleterious matter.

Conform to the ***Table - Natural Gravel Particle Sizes*** and the ***Table - Natural Gravel Properties*** in the finished condition.

| **Table– Natural Gravel Particle Sizes** | | | | |
| --- | --- | --- | --- | --- |
| **AS Sieve (mm)** | **Percentage Passing** | | | |
| **Type 1** | **Type 2** | **Type 3** | **Type 4** |
| 75.0 | 100 |  |  | 100 |
| 37.5 | 80 ‑ 100 | 100 |  | 80 ‑ 100 |
| 19.0 | 50 ‑ 80 | 70 ‑ 100 | 100 | 60 ‑ 100 |
| 9.5 | 35 ‑ 65 | 50 ‑ 80 | 70 ‑ 100 | 50 ‑ 95 |
| 4.75 | 25 ‑ 50 | 35 ‑ 65 | 50 ‑ 80 | 40 ‑ 80 |
| 2.36 | 15 ‑ 40 | 25 ‑ 50 | 35 ‑ 65 | 30 ‑ 65 |
| 0.425 | 7 ‑ 20 | 10 ‑ 30 | 15 ‑ 35 | 20 ‑ 50 |
| 0.075 | 3 ‑ 13 | 4 ‑ 16 | 6 ‑ 20 | 5 ‑ 25 |

[Insert the appropriate grading curve numbers and delete those not applicable. Generally 2 or 3 for Base (Sealed/Unsealed)

1, 2, 3 or 4 for Sub‑base, 3 for Shoulder Material]

| **Table – Natural Gravel Properties** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Attribute** | **Application** | | | | |
| **Northern Area - Sealed Base** | **Southern Area – Sealed Base\*** | **Unsealed Base And Shoulder Material** | | **Sub-Base** |
| Liquid Limit (LL) | 25% max | 30% | 35% max | | 30% max |
| Plasticity Index (PI) | 1-6% | 1 ‑ 10% | 4 – 12 % | | 1-10% |
| Linear Shrinkage (LS) | 0-3% | 0 ‑ 6% | 2 – 8 % | | 0-6% |
| PI x % passing 0.425 mm Sieve | 180 max | 300 max | 400 max | | 400 max |
| California Bearing Ratio (CBR)  4 day soaked (AS 1289) | 80 min | 80 min | 50 min | | 30 min |
| at a relative density of | 100% MMDD | 100% MMDD | 95% MMDD | | 95% MMDD |
| (Highest CBR value to be reported) | | | | | |
| Los Angeles Abrasion (LAA) Loss | 50 max | 50 max | 60 max | 60 max | |
| \* Note: Southern Area- Sealed Base\* applies to south of a line connecting Birrindudu - Dunmarra - Wollogorang. | | | | | |

### Fine Crushed Rock

[Delete when not required.]

Manufacture from hard rock quarry operations by crushing clean, hard, durable rock, of single source, free from natural gravel, clay, organics or other deleterious materials.

Conform to the ***Table - Fine Crushed Rock Particle Sizes*** and ***Table - Fine Crushed Rock Properties*** in the finished condition.

|  |  |
| --- | --- |
| **Table– Fine Crushed Rock Particle Sizes** | |
| **AS Sieve (mm)** | **Percentage Passing** |
| 37.5 | 100 |
| 19.0 | 90 ‑ 100 |
| 13.2 | 75 ‑ 90 |
| 9.5 | 60 ‑ 80 |
| 4.75 | 38 ‑ 60 |
| 2.36 | 25 ‑ 45 |
| 0.425 | 12 ‑ 26 |
| 0.075 | 6 ‑ 14 |

| **Table– Fine Crushed Rock Properties** | |
| --- | --- |
| **Property** | **Value limit(s)** |
| Liquid Limit (LL) | 25% maximum |
| Plasticity Index (PI) | 1 ‑ 6% |
| Linear Shrinkage (LS) | 3% |
| Dust Ratio (DR)  (% passing 0.075 mm)/(% passing 0.425 mm) x 100 | 25 ‑ 50 |
| CBR, 4 day soaked at 100% MMDD to AS 1289 | 100 minimum |
| Los Angeles Abrasion (LAA) Loss: coarse grained rock  fine grained rock | 35 maximum  25% maximum |
| PI x % passing 0.425 mm sieve | 180 maximum |

### Blends of Natural Gravel and Fine Crushed Rock

Not permitted in urban areas for sealed pavements.

Conform to the ***Table - Natural Gravel Particle Sizes*** and the **Table - Natural Gravel Properties** in the finished, blended condition. Use for heavily trafficked situations and where material is available.

[Delete when not required.]

### Sand Clay

[Use when it forms an integral part of the pavement and/or shoulder design]

Obtain Sand Clay from sources of naturally occurring deposits.

Produce required properties by screening, mixing or other processes necessary, to produce a material of a tightly bound nature, free of organic or other deleterious materials.

Conform to the following requirements in the finished condition:

|  |  |
| --- | --- |
| **Table - Sand Clay Particle Size Distribution** | |
| **AS Sieve (mm)** | **Percentage Passing** |
| 4.75 | 80 ‑ 100 |
| 2.36 | 60 ‑ 100 |
| 0.425 | 30 ‑ 60 |
| 0.075 | 14 - 28 |

| **Table- Sand Clay Properties** | | |
| --- | --- | --- |
|  | **Property** | **Value limit(s)** |
| 1. | Plasticity Index (PI) – Sealed Roads | 20% maximum |
| 2. | Plasticity Index (PI) – Unsealed Roads | 15% maximum |
| 3. | Linear Shrinkage (LS) | 1 - 8% |
| 4. | CBR, 4 day soaked at 95% MMDD to AS 1289 | 50 minimum |

## Construction of Pavement Layers

### Process Control Testing – Hold Point

**Hold Point -** Provide the Superintendent with a program and procedure for process control testing for the project within 14 days of the awarding of the contract and before work is commenced on site. Base the process control testing on lots and comply with the clause ***Conformance of Compaction of Soils*** in CONFORMANCE TESTING.

Include the following activities, as applicable:

* Extraction area investigative sampling, on a grid basis
* Extraction area confirmatory sampling, on a windrow/ stockpile basis
* On-formation testing, on a lot basis.

Include the following elements of the work in the process control testing program as applicable;

* Fill
* Sub-grade
* Sub-base
* Base course
* Shoulders
* Stabilisation

[Edit this list as required, to suit the particular project.]

Rework and retest failed lots a maximum of two times subsequent to an initial test failure.

Following a third test failure rip up, remove and replace the entire failed layer before carrying out any further testing.

Where relevant, provide additional process control testing procedures for concrete, bitumen and other elements subject to conformance testing by the Superintendent.

The Contractor is responsible for the ordering up and payment of all process testing costs.

Refer to the ***Conformance Testing*** clauses in the MEASUREMENT AND PAYMENT section.

### Production of Natural Gravel and Sand Clay Materials

**Extraction Area**

Work extraction areas to achieve conforming material. Control depth of winning to avoid contamination of gravel by clay and other fine materials.

Use front-end loaders or dozers to win, push up and windrow materials. Use of other plant requires approval from Superintendent.

Screen, blend and condition materials to achieve specified material property requirements.

### On-Formation Mixing and Placing

Place material in uniform and level layers over subgrade surface or lower layers of the pavement.

Remove segregated and contaminated material from the site.

Remove organic materials such as timber, roots and the like by manual stick picking methods.

Do not place material on a previous layer that has

* become waterlogged or cracked; and/or
* otherwise deteriorated.

Condition and mix the material uniformly throughout with water to achieve a moisture content suitable for the specified Dry Density Ratio to be achieved.

Ensure water is clean and free from oil, alkali, organic or any other deleterious substances, and that the total soluble salts content is less than 3,000 mg/litre (total dissolved salts). Provide evidence of construction water salt content level.

### Compaction

Compact in uniform layers not less than 100 mm nor greater than 200 mm compacted thickness.

Achieve a homogeneous mass with no compaction planes.

Conform to the Dry Density Ratios specified in the ***Table - Dry Density Ratios for Conformance*** in the CONFORMANCE TESTING Section.

Maintain the prepared pavement layer.

## Reconstruction and Rehabilitation Of Existing Pavements

### Widening

Saw cut back the existing pavement by not less than 150 mm width on each edge to sound material.

Excavate boxing for widening to the required depth below finished surface.

Construct subgrade as specified in the EARTHWORKS Section.

Construct pavement and shoulder as specified.

### Strengthening by Granular Overlay on Existing Pavement

Saw cut across existing pavement at each end of work. Cut shall be vertical and at least 100 mm deep to allow smooth transition to new work.

Remove seal from existing pavement.

[Delete if pavements are not sealed]

Scarify local high spots to 75 mm below finished surface.

Construct a strengthening layer over the full width of the existing pavement and shoulder and the widening as specified.

### Strengthening by Granular Overlay on Re-Worked Existing Pavement

[Delete if pavements are not sealed]

Saw cut across existing pavement at each end of work. Cut shall be vertical and at least 100 mm deep to allow smooth transition to new work.

Cut and/or add top-up gravel where required to achieve levels and grade lines.

Wet mix existing seal into existing base layer, with pulveriser-mixing plant, to nominal depth specified.

Moisture condition and compact re-worked existing pavement to the Dry Density Ratios specified in the ***Table - Dry Density Ratios For Conformance*** in the CONFORMANCE TESTING Section for sub-base requirements.

Construct a new strengthening basecourse layer over the full width of the re-worked pavement and shoulder, and any widening, to thickness specified. Moisture condition and compact pavement to the Dry Density Ratios specified in the ***Table - Dry Density Ratios For Conformance*** in the CONFORMANCE TESTING Section for sealed basecourse requirements.

## Supply to Stockpile

Comply with the following stockpile requirements;

* Clear the site.
* Ensure the area is free draining.
* Spread and compact a 75 mm thick layer of sub‑base gravel to 95% relative compaction.
* Trim stockpile to a uniform shape for ease of measurement.

## Pavement Acceptance

### Pavement Acceptance Requirements – Hold Point

**Hold Point** – Obtain the Superintendent’s approval for pavement and shoulders acceptance prior to any surfacing work, including satisfying all requirements for:

* Proof Rolling
* Conformance testing
* Dry back
* Final Pavement Layer Integrity
* Surface Roughness
* Other Tolerances

For unsealed pavements, obtain the Superintendent’s approval for pavement conformance at conclusion of pavement works.

[Delete items if not applicable]

### Proof Rolling Requirement- Witness Point

Proof roll all areas of final pavement surface to the satisfaction of the Superintendent.

Submit a proof rolling procedure to the Superintendent for approval including the method of preparing an area and the extent of proof rolling.

**Witness Point -** Give the Superintendent not less than 24 hours notice of the location and commencement time for the proof rolling. Give 48hrs notice for remote work (greater than 5hrs travel one way from regional centre).

**Plant Requirements;** use plant in proof rolling procedures that comply with the following requirements:

* For urban areas only, fully loaded water cart, minimum size 12 tonne, on standard pneumatic road tyres, fully inflated.
* Fully loaded, minimum single trailer articulated heavy vehicle, on standard pneumatic road tyres, fully inflated.
* Pneumatic tyred compaction plant with a mass of not less than 20 tonnes and with a ground contact pressure under either the front or rear wheels of not less than 450 kPa per tyre and a ground contact area of not less than .035 m2 per tyre.
* Do not use flat drum rollers.

Check areas for level tolerance and layer thickness before proof rolling.

Proof roll each layer when the pavement is green. If proof rolling is carried out at a later time, water the surface and roll with the test roller prior to commencement of proof rolling.

**Compliance;** The proof rolling requirements are deemed to comply when an area withstands proof rolling without visible deformation, cracking, heaving, or springing. Provide uniform and stable support to rear wheel loads, at walking pace.

**Remedial work**; Remove and reconstruct areas that deform, break up, or show signs of distress.

### Conformance Testing Requirement

Ordering procedures; Refer to the CONFORMANCE TESTING section for testing requirements and test ordering procedures.

Only the finished compacted base, sub‑base and shoulder will be subject to conformance testing. Test in the green condition prior to dry back.

Pavements and shoulders will be considered as separate lots.

Backfill test holes in accordance with CONFORMANCE TESTING section.

**Remedial work**; rework or reconstruct areas that do not conform.

### Surface Roughness Requirement

Surface Roughness: IRI less than 2.4.

Test Method: NTCP 107.1A

Surface Roughness requirements represent an absolute upper limit and all Lane Roughness Values to be less than value specified.

Lotting and averaging out of field values not permitted.

Rectify all areas where Surface Roughness exceeds specified value.

**Ordering procedures:** Refer to the CONFORMANCE TESTING section for test ordering procedures.

**Roughness testing sequence:** Roughness testing must be collected in the sequence shown in the table within 7 days of completion of testing of the relevant pavement layer. Multiple adjacent lots can be tested.

Ensure that the pavement is free of loose material and debris when testing is done, for unbound granular bases, measurements must be undertaken prior to brooming of the pavement, and free water is not present on the pavement when testing is undertaken.

|  |  |
| --- | --- |
| ***Table - Testing sequence for pavement type*** | |
| **Pavement type** | **Testing sequence** |
| Spray seal on granular base | Before application of spray seal. |
| Asphalt surface on new granular pavement (thickness 40 mm and over) | On finished base layer, to meet requirements of PAVEMENTS AND SHOULDERS.  On final wearing surface, to meet requirements of DENSE GRADED ASPHALT. |

Refer to NTCP 107.1A for exclusions to surface roughness testing. In these locations, the requirements of the **Other Tolerance Requirements** sub-clause, in this clause, still apply. Undertake best efforts to achieve a smooth ride to minimise driver discomfort in the finished condition.

### Final Pavement Layer Integrity Requirement – Witness Point

Final pavement layers must be homogeneous in appearance, uniformly bonded, free from layering, cracking, disintegration or surface tearing, uniformly hard and dense, free of laminations and roller indentations, with the coarse fraction slightly exposed. The pavement layer must retain these characteristics after rotary brooming and be suitable to receive bituminous surfacing.

Slurried up surfaces are not permitted.

Remove sticks and any loose material.

Do not introduce new material to the surface after final compaction.

**Witness Point** - Give the Superintendent not less than 24 hours notice of the location and commencement time for the inspection of the prepared layer. Give 48hrs notice for remote work (greater than 5hrs travel one way from regional centre).

**Remedial work**; remove and reconstruct areas that do not conform.

Ball Penetration testing to conform to **Other Tolerance Requirements** sub-clause, in this clause, ordered as detailed in CONFORMANCE TESTING.

### Dry Back Requirement

Allow the top 75 mm of the pavement layer to dry back to a Moisture Ratio (Rm) equal or less than 65% for FCR and 70% for natural gravel.

Moisture Ratio (Rm) is defined as follows:

|  |  |
| --- | --- |
| Rm = | (100 x wf) |
| wr |

where:

Rm = Moisture Ratio, in percent

wf = field moisture content, in percent

wr = adjusted optimum moisture content, in percent.

The Superintendent will carry out all testing to determine the Moisture Ratio.

### Remedial Work

Where pavement thickness is 200 mm or greater, scarify to not less than 100 mm depth and recompact where finish not achieved. Where pavement thickness is less than 200 mm scarify and recompact to full depth where finish not achieved.

### Other Tolerance Requirements

Refer MISCELLANEOUS PROVISIONS, Level Checking and Level Auditing.

Refer to ***Table – Final Surfaces Tolerances***.

|  |  |
| --- | --- |
| **Table - Final Surfaces Tolerances** | |
| Final surfaces shall conform to the following: | |
| ALL AREAS / SECTION TYPES | |
|  | **Tolerance** |
| Straight edge deviation | 5 mm in 3 m |
| Compacted thickness | Not less than specified |
| Width | Not less than specified |
| Surface roughness | IRI less than 2.4 (averaging not permitted) |
| Ball Penetration test (before priming) | Less than or equal to 3mm, for any individual test result (averaging not permitted).  Not required for asphalt surfacing, when thickness 50mm or greater. |
|  | |
| URBAN (KERBED AND ASPHALT) | |
|  | **Tolerance** |
| Kerb level | -0 mm to +10 mm |
| Asphalt level | -0 mm to +10 mm |
| Base surface level | -5 mm to +10 mm |
| Sub-base surface level | -10 mm to +10 mm |
| Sub-grade surface level | Refer to EARTHWORKS, Tolerances sub-clause |
|  | |
| RURAL (UNKERBED) | |
|  | **Tolerance** |
| Base surface level | -20 mm to +20 mm |

[If any of the exclusions listed are required to conform to an IRI of less than 2.4 delete them from the list.]