

**CONSTRUCTION SPECIFICATION
2016**



**Wollondilly
Shire Council**

SUBDIVISION & ENGINEERING STANDARD



AUS-SPEC #1

Development Specification Series

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CONSTRUCTION SPECIFICATION

C101

GENERAL

SPECIFICATION C101 : CONSTRUCTION – GENERAL

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Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

Details are provided below outlining the clauses amended from the Wollondilly Shire Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	ADAC requirements	C101.11	A	MM	1/3/16
2	Prior to Commencing Construction Works	C010.04	A	MM	1/3/16

SPECIFICATION C101 : CONSTRUCTION - GENERAL**PROJECT SPECIFIC INFORMATION****C101.01 NOT USED****C101.02 SCHEDULE OF WORKS**

1. A minimum of seven (7) days prior to commencement of any work on the site, the Contractor shall make application to Council for a 138 Consent (Section 138 of the *Roads Act* for approval to work on a public road) and include copies of current public liability insurance for a value of \$10M and payment of the current fee. References for previous work experience may be requested by Council.

2. The Contractor, if requested by Council's Supervising Engineer shall provide a Schedule Of Works. This schedule is to show the logical commencement order of each work activity to be undertaken and includes but is not limited to the following items of construction.

EXAMPLE (TO BE COMPLETED FOR EACH SPECIFIC PROJECT)**(a) General**

- *Provision for control, protection and safety of traffic during construction including notifications to and obtaining approvals from Authorities.*
- *Setting out the Works.*
- *Erosion and sedimentation control of the Works, including stockpile areas.*
- *Site clearing and grubbing. Topsoil to stockpile.*
- *Site regrading.*
- *Topsoil spreading and revegetation to disturbed areas.*

(b) Roadworks

- *Earthworks, including excavation and embankment construction.*
- *Stormwater drainage, including kerb and gutter, pipes, pits and headwalls.*
- *Sub-surface drainage.*
- *Pavement, consisting of unbound granular subbase and base, bituminous primer seal, and asphaltic concrete wearing surface.*
- *Guardrail.*
- *Signposting and linemarking.*
- *Ancillary works, including medians, paved footpath, turfing and landscaping.*

(c) Structures

- *retaining wall*
- *Bridge, single span, comprising driven prestressed concrete piles, prestressed concrete bridge beams, and cast-in-situ reinforced concrete headstocks and deck.*

(d) Not used

(e) **Work by Others**

- *Provision of electricity and gas services and the like to the subdivision by the relevant authorities will be the responsibility of the Developer*

101.03 NOT USED

GENERAL REQUIREMENTS

C101.04 PRIOR TO COMMENCING CONSTRUCTION WORKS

**Pre-
Construction
Requirements**

1. Construction works shall not commence on the site or on any adjoining road, unless the appropriate approvals and Construction Certificates have been issued by Council and the following items have been satisfactorily addressed:

a. Approvals

- A Section 138 Road Occupancy Permit must be obtained from Council a minimum 7 days prior to commencing works.
- Subdivision/Civil Construction Certificate must be obtained from Council or nominated Accredited Certifier prior to any works commencing. Copies of approved plans must be kept on site.
- Controlled Activity Permit issued by Department of Primary Industries – DPI Water for any works within 40m of a watercourse.

b. Preconstruction Site Meeting

- Written notification to be provided to Council or Principal Certifying Authority a minimum two (2) days prior to commencing works.
- A pre commencement site meeting is to be arranged between Council or Principal Certifying Authority and the Principal Contractor to discuss Construction Methodology, Traffic Management and Site Management.
- Qualified and experienced Site Supervisor to be nominated for the site. Contact details including after hours contact to be provided to Council and the Principal Certifying Authority.

c. Site Management

- Service Authority searches to be obtained and services potholed where required. Services protection to be installed as per Authority requirements. Notifications to Service Authorities to be made where required.
- Notification to adjoining owners that works are to commence. A copy of the notification to be forwarded to Council or Principal Certifying Authority.
- Site to be secured from public access using appropriate security fencing and construction site warning signs to be displayed.
- Provision of worker facilities such as toilets etc to be installed.
- Signs to be displayed in the site fencing in clear view of the public notifying the name, contact phone number of the Principal Contractor.
- Sign to be displayed in the site fencing in clear view of the public notifying the name, address and contact number of the Principal Certifying Authority.

d. Erosion and Sediment Controls

- Install Erosion and Sedimentation control devices as per the approved Erosion and Sedimentation Control Plan.
- Stabilised construction vehicle access installed.
- Stockpile site prepared and Erosion and Sedimentation controls

installed.

e. Traffic Management

- i. Prepare site specific Traffic Control Plan (TCP) to manage traffic as per the approved Traffic Management Plan.
- ii. Obtain Section 138 Road Occupancy Permit from Council or Roads and Maritime Services.
- iii. Obtain Permit to Erect Construction Site Speed Zone (if speed reduction zone proposed on the TCP) from Council or Roads and Maritime Services.
- iv. Obtain Permit to Erect Temporary Construction Zone Traffic Lights (if proposed on the TCP) from Council or Roads and Maritime Services.
- v. Notification (letter drop) to be given to all adjoining properties and properties that may be affected by the proposed Traffic Control Plan. A copy of the notification to be forwarded to Council as the roads Authority.
- vi. Install traffic control devices as per the Traffic Control Plan. Only authorised personal to implement the approved Traffic Control Plan and control traffic as per the requirements of the Traffic Control Plan.

C101.05 STANDARDS AND TEST METHODS

1. Unless otherwise specified herein, and where applicable, materials and workmanship shall be in accordance with the relevant standard of the Standards Association of Australia. **Australian Standards**
2. A standard applicable to the Works shall be the edition last published 14 days prior to the issue of the Construction Certificate unless otherwise specified.
3. Overseas standards and other standard documents named in this Development Specification shall be applicable in the same manner as Australian Standards to relevant materials and workmanship. **Overseas Standards**
4. Copies of any standards quoted or referred to in this Development Specification shall be kept on the site. **Copies to be kept on Site**
5. Where no suitable AS test methods are available, those of the relevant State Road Authority shall be used. These are typically designated T123 etc. **Other Test Methods**

C101.06 TESTING AND SURVEY

1. All testing and survey as required by this Development Specification shall be arranged and carried out by the Contractor and all test results and survey records made available to Council's Supervising Engineer. The cost of all such testing, survey and report preparation shall be borne by the Contractor. **Contractor's Cost**
2. The minimum frequency of testing and survey shall be in accordance with Annexure CQS-C. **Minimum Frequency**

C101.07 WORKING AREAS

1. Not Used
2. If existing fencing is cut or altered by the Contractor, the Contractor shall provide and maintain temporary fencing to the satisfaction of Council's Supervising Engineer to maintain security during the works, and shall reinstate the fencing and remove temporary fencing on completion of the work. **Temporary Fencing**

GENERAL

C101.08 SMOOTH JUNCTIONS

1. Construction work carried out under this development adjacent to, or adjoining existing private property or Council infrastructure or works, shall make smooth junctions with that which is existing.

C101.09 SETTING OUT THE WORKS

1. The Contractor will establish bench marks related to Australian Height Datum.

Provision of Marks

2. Before any survey marks are affected by the works, the Contractor shall transfer such survey marks to side positions clear of operations and shall note, and inform Council's Supervising Engineer in writing, of the extent of such movement. Council's Supervising Engineer has the discretion to waive the requirement for the provision of written advice on a case-by-case basis.

Transfer of Marks

3. The Contractor shall give Council's Supervising Engineer not less than two full working days' notice of the intention to perform any portion of the relocation of survey control, establishment of recovery pegs, or setting out or levelling, so that suitable arrangements can be made for checking of the work by Council's Supervising Engineer. If no such notification is given and a control mark is disturbed or destroyed, then the cost of re-establishing the control shall be borne by the Contractor.

Notice for Relocation

Contractor's Cost

4. The Contractor shall provide and fix adequate recovery pegs in suitable locations adjacent to the elements of work to enable location and construction to be checked.

Recovery Pegs

5. All pegs and profiles placed by the Contractor shall be removed on completion of work unless otherwise directed by Council's Supervising Engineer.

Removal

C101.10 SITE MEETINGS

1. Regular site meetings will be held for the purpose of discussion of the progress and co-ordination of the work and any matters of doubt regarding the intent or interpretation of the Drawings or the Development Specification. The Contractor shall arrange for relevant parties or their responsible representatives to be present at these meetings. The meetings will be held at a mutually convenient time in consultation with Council's Supervising Engineer.

Representation

2. The Contractor shall also give Council's Supervising Engineer 48 hours notice of the date, time and location of any meetings.

Advice to Council

3. The Council's Supervising Engineer or a representative shall chair site meetings. The Contractor shall keep minutes of the proceedings and shall provide copies of the minutes for Council and all others present at the meeting and others concerned with the matters discussed.

Responsibility for Minutes

C101.11 WORK-AS-EXECUTED DRAWINGS

1. The Contractor shall supply Council's Supervising Engineer with fully marked-up and certified Work-as-Executed Drawings for the whole of the works prior to issue of the Certificate of Practical Completion. The Contractor will supply, free of charge, prints and suitable electronic versions of the Drawings.

Submission

2. Full and complete electronic versions of the drawings must be supplied in AutoCAD DWG format or a similar format as approved by Council. Council requires ADAC “as constructed” asset information to be supplied as electronic files. Information supplied in this format does not replace hard copy plans. Hard copy and electronic plans are to be amended to reflect changes during construction to ensure they are identical to the ADAC content and vice versa. The ADAC file shall contain all relevant information for each asset group and shall be created using a recognised ADAC compliant tool using the most recent ADAC schema. All modules in the latest ADAC schema are to be completed to represent the As Constructed attributes of the infrastructure.

***ADAC and
Electronic
Design Files***

Detailed instructions in the compilation of ADAC .xml files can be found in Council’s “Guidelines for the Submission of ADAC .xml Files”.

3. Work-as-Executed Drawings for Roadworks shall show in red ink all changes to the approved Drawings and actual values of all levels shown on the Drawings. The Drawings shall be certified by a Civil Engineer or Surveyor and by the construction contractor.

Roadworks

4. Work-as-Executed Drawings for Bridgeworks and other structural works shall show in red ink all changes to the approved Drawings, including variations to levels, dimensions, concrete, reinforcement, prestressing and other materials, all non-conformances accepted without rectification, suppliers and model numbers of bearings and proprietary joints and type of barrier railings installed where both steel and/or aluminium alternatives are detailed. The Drawings shall be certified by a practising Structural Engineer and by the construction contractor(s).

***Bridgeworks &
Structural
Works***

C101.12 ITEMS TO BE SUPPLIED BY THE COUNCIL

1. Items to be supplied by the Council (TBS Items) will be supplied and delivered free on truck by the Council free of cost to the Contractor at points to be nominated. The Contractor shall give Council’s Supervising Engineer a minimum of two weeks notice of the time he requires delivery of TBS Items in accordance with the requirements of the Development Specification or as specified below.

Delivery

2. If any TBS Item is found to be damaged or defective the Contractor shall so inform Council’s Supervising Engineer within 24 hours of taking delivery of such item. If the Contractor does not report damage or defect, it shall be deemed that the TBS Item was free from damage or defect when received. The Contractor shall then be responsible for any replacement or making good as may be directed by Council’s Supervising Engineer.

***Damage or
Defect***

3. The Contractor shall be responsible for the storage, protection and insurance of all TBS Items from the time of receipt.

***Contractor’s
Responsibility***

C101.13 NOT USED

ENVIRONMENTAL REQUIREMENTS

C101.14 PROTECTION OF THE ENVIRONMENT

1. All work shall be carried out in such a manner as to avoid nuisance and/or damage to the environment. The Developer and all parties involved in the construction of the development shall comply with the requirements of the conditions of approval imposed by Wollondilly Shire Council, the Environment Protection Authority, the *Protection of the Environment (Operations) Act*, the *Noise Control Act*, the *Rural Fires Act* and any other relevant legislation.

***Conformance
to Acts***

2. The Contractor shall plan and carry out the Works to avoid erosion, contamination and sedimentation of the site and its surroundings including maintenance of all erosion and sediment control devices/structures.

***Erosion
Control***

GENERAL

3. Herbicides and other toxic chemicals shall not be used on the site without the prior written approval of Council's Supervising Engineer. ***Herbicides and Toxic Chemicals***
4. No noise or smoke or other nuisance, which in the opinion of Council's Supervising Engineer is unnecessary or excessive shall be permitted in the construction of the development. Should work outside customary working hours be approved, the Contractor shall not use, during such period, any plant, machinery or equipment which, in the opinion of Council's Supervising Engineer is causing or is likely to cause a nuisance to the public. No noisy works and/or works likely to disturb nearby residents shall be undertaken during the hours precluding such activity as specified by Council in accordance with the requirements for development consent and/or building approval made under the Local Government Act and the *Noise Control Act*. ***Noise, Smoke or Other Nuisances***
5. The Contractor shall ensure that dust originating from the development is controlled to meet the requirements of the *Protection of the Environment (Operations) Act*. ***Dust Control***

C101.15 DRAINAGE OF WORKS

1. The control and management of stormwater drainage through the site is important during construction of the Works. ***Stormwater Control***
2. The Contractor shall at all times provide for the effective diversion of surface water from the Works and provide and ensure proper flushing for storm and subsoil water across and beyond the Works. The flow of stormwater and drainage along existing gutters and water tables shall not be interrupted. ***Stormwater Diversion***
3. The Contractor shall provide efficient pumping equipment on site and shall keep trenches and excavations dewatered at all times during construction. ***Pumping***
4. All permanent retention basins, and temporary erosion and sedimentation control shall be completed prior to commencement of any other ground disturbance including tree and/or stump removal and stripping of topsoil prior to earthworks.

C101.16 BLASTING

1. Blasting will not be permitted without the specific approval of the Council. If such approval is given then blasting shall be carried out strictly in accordance with the Specification – C213 – EARTHWORKS.

C101.17 LIMITS ON NOISE

1. The Contractor shall only use plant that has effective residential class silencers fitted to all engine exhausts, has engine covers fitted, is maintained in good order, and in addition meets the following requirements. ***Plant with Silencers***
- (a) On purchase have met the NAASRA Specification for Noise levels of plant and equipment, or
- (b) Have a Maximum Noise level (L_{AMAX}) less than 80 dBA when measured at a distance of 7 metres.
2. Operational hours of plant, including the entry and/or departure of heavy vehicles, shall be restricted to 7 a.m. to 5 p.m. Monday to Friday and 8 am to 1 pm Saturday and at no times on Sundays or public holidays. Work outside of the hours specified shall not be undertaken without the prior written approval of Council's Supervising Engineer. ***Working Hours***
3. Notwithstanding noise emission limits on plant, noise emanating from the construction site when measured at any noise sensitive location (such as a residential ***Maximum Noise Levels***

premise), as determined by the Environment Protection Authority shall not exceed an L10 sound pressure level (noise level exceeded for 10% of the sample time) the greater of:

- (a) Short term (period of up to 1 month) 65dBA or 20dBA above ambient
- (b) Medium term (period of 1 month up to 6 months) 55dBA or 10dBA above ambient
- (c) Long term (any period of more than 6 months) 50dBA or 5dBA above ambient

4. The monitoring positions and time period for monitoring purposes shall be set by the EPA with the time period generally based on a series of 10 to 15 minute measurements which shall be averaged over the entire daily working period for the activity concerned.

Monitoring

5. The Contractor will be responsible for any damage and compensation payments as a result of non-observance of the above requirements. The Council will not consider any claim by the Contractor arising out of these requirements.

**Contractor's
Responsibility**

C101.18 LIMITS ON GROUND VIBRATION

1. It is the intent of this Development Specification that ground vibration levels, transmitted from operating items of plant in the vicinity of residential premises shall not exceed levels that are close to the lower level of human perception inside the premise nor will cause structural damage to the building.

Levels

2. Vibration (RMS Z-Axis) generated by construction works shall not exceed

Limits

Curve 4 - for the period of 1 month or less

Curve 2 - for the period of more than 1 month

as defined in British Standard BS6472 "Evaluation of Human Exposure to Vibration in Buildings (1 HZ to 80 HZ)" when measured inside nearby residential premises.

3. Ground vibrations generated by construction works shall not exceed a peak particle velocity (V_R max) limit of 5 mm/sec when measured within one metre of any residential premise.

**Peak Particle
Velocity**

4. The Contractor shall be responsible for any testing, damage and compensation payments as a result of non-observance of the above requirements. The Council will not consider any claim by the Contractor.

**Contractor's
Responsibility**

SPECIAL REQUIREMENTS

C101.19 RESERVED

C101.20 RESERVED

C101.21 RESERVED

CONSTRUCTION SPECIFICATION

C201

CONTROL OF TRAFFIC

SPECIFICATION C201 - CONTROL OF TRAFFIC

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CONTROL OF TRAFFIC

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Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	RMS Delegation	C201.33	A	BG	1/3/16

SPECIFICATION C201 : CONTROL OF TRAFFIC

GENERAL

C201.01 SCOPE

1. The work to be executed under this Specification consists of all work activities necessary to provide for the safe movement of traffic and the protection of persons and property on any public road through and/or around any work activities in relation to the site.
2. The extent of work includes the design, construction, maintenance and removal of temporary roadways and detours, the provision of traffic controllers, signposting, road markings, raised pavement markers, lights, barriers and any other items required **Works Included**
3. Control of traffic shall be in accordance with RMS manual Traffic Control at Work Sites, AS1742.3, SAA HB81, this Specification and the Drawings. **Standards**
4. Wherever the word 'should' occurs in AS 1742.3 the word 'shall' applies and the required action is the Contractor's responsibility. **Contractor's Responsibility**

C201.02 REFERENCES

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

(a) Australian Standards

- AS 1165 - Traffic Hazard Warning Lamps
- AS 1742.3 - Traffic Control Devices for Works on Roads
- AS 1743 - Road Signs Specifications
- AS 1744 - Standard Alphabets for Road Signs
- AS 1906 - Retro-reflective Materials & Devices for Road Traffic Control Purposes
- AS 1742.10 - Pedestrian Control and Protection
- AS 4191 - Portable Traffic Signal Systems
- AS/NZS 4192 - Illuminated flashing arrow signs
- SAA HB81 - Field Guide for Traffic Control at Works on Roads

(b) AUSTRROADS Publications

- AUSTRROADS - Guide to Traffic Engineering Practice - Intersections at Grade
- AUSTRROADS - Guide to the Geometric Design of Rural Roads

(c) RMS Publications

Traffic Control at Work Sites Manual

C201.03 TRAFFIC GUIDANCE SCHEME

1. The Contractor shall construct the work with the least possible obstruction to traffic. **Minimise Obstruction**

2. The Contractor shall obtain all necessary approvals from Council and other Authorities for temporary traffic arrangements except where specified otherwise. **Contractor's Responsibility**
3. A minimum of one (1) week prior to commencing work on the site, the Contractor shall submit to the Council a Traffic Management Plan (TMP) and Traffic Control Guidance Plan (TCGP or TCP) in accordance with RMS Traffic Control at Worksites Manual, AS1742.3 and AS 1742.10. The Roads Act requires RMS or Council, as the Roads Authority, to be informed of this TCGP. Consequently, Council reserves the right to concur with or require modification of the TCGP prior to its implementation. Submission of the TCGP constitutes a HOLD POINT **Traffic Control Guidance Plan**

HP

4. Where the TCGP involves Regulatory Traffic Control Signs or Devices, temporary roadworks, speed restrictions or temporary partial or full road closures, the period of notice shall be increased to five weeks in accordance with Clause C201.24. **Extended Notice**
5. The TCGP shall include for each activity of work that is on or involves the use of the road reserve: - **Control Plan Contents**
- (a) Design drawings for any temporary roadways and detours in accordance with Clause C201.11 showing pavement, wearing surface and drainage details,
 - (b) Details of arrangements for construction under traffic in accordance with RMS Traffic Control at Work Sites, and
 - (c) A signpost layout plan showing:
 - (i) Location, size and legend of all temporary signs
 - (ii) Temporary regulatory signs and temporary speed zones, and
 - (iii) All traffic control devices such as temporary traffic signals, linemarking, pavement reflectors, guideposts, guard fence and barrier boards.
 - (d) A maintenance plan for the above.
6. The TCGP shall be in accordance with the requirements of this specification and the Drawings.
7. Persons preparing TCGPs shall be suitably qualified under the provisions of RMS Traffic Control at Worksites and shall make their qualification available for inspection by the Council's Supervising Engineer upon request.
7. Special consideration to the safety of pedestrians and workers shall be given in the preparation of the TCGP. Particular care shall be taken when requiring reversal of traffic flows or the separation of unidirectional flow by medians or other physical separation. **Safety**

C201.04 SIDE ROADS AND PROPERTY ACCESSES

1. At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and stock to and from side roads and property accesses connecting to the roadway. Work which affects the use of side roads and existing accesses shall not be undertaken without providing adequate alternative provisions to the prior satisfaction of the Council's Supervising Engineer. **Access**
2. Where an existing access is to be restricted or prohibited during certain times, arrangements are to be made with the property owner or occupier by providing a minimum of one (1) weeks notice in writing prior to commencing the restriction/prohibition. **Notification**

CONTROL OF TRAFFIC

C201.05 TRAFFIC CONTROLLERS

1. All traffic controllers shall hold current traffic controller qualifications from an RMS approved training provider. The Contractor shall advise the Council's Supervising Engineer of the names of proposed traffic controllers and their qualification shall be made available to Council's Supervising Engineer for sighting on demand.

***Trained Traffic
Controllers***

C201.06 APPROVED CLOTHING FOR WORK PERSONNEL

1. All personnel working within the road reserve shall wear high visibility clothing to the requirements of AS 1742.3.

Safety Clothing

2. For night conditions, all personnel working within the road reserve shall wear clothing suited to the conditions, complying with Occupational Health, Welfare & Safety obligations and highlighting the wearer's presence to all other persons on or near the site through the use of retro-reflective silver tape of a suitable width (suggested 50mm wide) attached such that:-

- There are hoops of tape on each sleeve and each leg and

- The tape covers the torso area of the wearer's body (suggested minimum 30% of the front and 30% of the back of the torso area).

3. The traffic controller during night operations shall use an illuminated red cone wand with a minimum capacity of 30,000 candelas to control traffic.

C201.07 TEMPORARY SPEED ZONING

1. The implementation of a temporary speed limit must be approved by the relevant Road Authority. Application for Speed Zone Authority (RMS) or Permit to erect Construction speed limit (Wollondilly Shire Council) must be made along with a Road Occupancy Licence (ROL) or Section 138 Permit.

***Approval or
speed zone
restriction.***

2. Where a temporary speed limit has been approved, the Contractor shall arrange for the supply of appropriate temporary speed zoning signs, including posts and fittings, for erection. The Contractor shall erect these signs; cover the signs when the speed zone is not in use and remove the signs when the speed zone is no longer required as part of the provision for traffic. The Contractor shall keep a diary that records operation times of the speed zone.

***Speed Zone
Signs***

3. All costs associated with temporary speed zoning signposting shall be borne by the Contractor.

***Contractor's
Cost***

C201.08 PLANT AND EQUIPMENT

1. During the day plant and equipment working in a position adjacent to traffic and having a projection beyond the normal width of the item, for example, a grader blade shall have a fluorescent red flag attached to the outer end of the projection. During poor light conditions or at night, an additional traffic controller with an illuminated red wand shall direct traffic around such plant and equipment.

***Plant
Delineation***

2. At night, where traffic is permitted to use the whole or portion of the existing road, all plant items and similar obstructions shall be removed from the normal path of vehicles to provide a lateral clearance of at least 6 m where practicable, with a minimum clearance of 1.2 m.

***Night Time
Clearance***

3. At night, plant and equipment within 6 m of the normal path of vehicles shall be lit by not less than two yellow flashing lamps suspended vertically from the point of the obstruction nearest to a traffic lane, and one yellow flashing lamp at each end of the obstruction.

***Warning
Lamps***

TEMPORARY ROADWAYS, DETOURS AND CLOSURES

C201.09 APPROVAL

1. All temporary roadways, detours and temporary closures must be approved by the relevant Road Authority. Where Council is the delegated authority approval may be given in accordance with Council's Road Closures Policy. Approval is subject to compliance with the resolution of Council or the conditions placed by Council's Delegated Authority.

**Road Authority
Approval**

C201.10 DESIGN STANDARDS

1. The standard of alignment and grading adopted shall be in accordance with specific provisions of this Specification and shall otherwise be in accordance with the AUSTRROADS publication 'Guide to the Geometric Design of Rural Roads'.

**Alignment &
Grading**

2. Intersections shall be designed in accordance with the AUSTRROADS publication 'Guide to Traffic Engineering Practice - Intersections at Grade'.

Intersections

3. Design drawings, geometric standards, design speed, wearing surface type and pavement design of the proposed temporary roadways and detours shall be submitted by the Contractor with the TCGP.

**Standards &
Pavement**

C201.11 DESIGN DRAWINGS

1. Design drawings submitted for approval shall show:

- (a) Alignment and grading at a horizontal scale of 1:2000 for rural roads and 1:500 for urban roads. Where the temporary road rejoins the existing road, levels showing the full cross section shall be extended along the existing road for a minimum length of 200 m.
- (b) A sight distance diagram if opposing traffic is to use a single carriageway
- (c) Intersections, and any other locations where traffic may be required to make turning, merging or diverging movements, at a scale of 1:500.
- (d) Pavement marking details.
- (e) Sufficient cross-sections to indicate the feasibility of making connections between various parts of the work.
- (f) All proposed materials including sizes, quality grade, source of supply, etc

Contents

C201.12 DRAINAGE

1. Drainage structures and drains shall be constructed in accordance with the following Specifications:

Standard

- | | | |
|------|---|--|
| C220 | - | Stormwater Drainage - General |
| C221 | - | Pipe Drainage |
| C223 | - | Drainage Structures |
| C224 | - | Open Drains, including Kerb and Gutter |

2. Drainage proposed in accordance with Clause C201.03 shall be designed to carry the 1:5 year ARI storm event without overflow over the road.

**Design
Frequency**

3. Pavements shall be designed and constructed to not pond water on the wearing surface or shoulders. Temporary formations to be constructed shall not dam water.

**Pavement
Drainage**

CONTROL OF TRAFFIC

C201.13 CONSTRUCTION OF EARTHWORKS AND PAVEMENT

1. Temporary roadways shall be constructed in accordance with the following Specifications: **Temporary Roadways**
- C211 - Control of Erosion and Sedimentation
 - C212 - Clearing And Grubbing
 - C213 - Earthworks
 - C242 - Flexible Pavements

C201.14 SURFACING

1. The wearing surface width shall extend across the full width of the traffic lanes plus the width for each shoulder, or as shown on the Drawings. **Wearing Surface**
2. The wearing surface shall be carried onto any existing connecting roadway so as to finish square to the existing roadway centreline. **Tie-in to existing work**
3. Surfacing shall be constructed in accordance with: **Standards**
- C244 - Sprayed Bituminous Surfacing and/or
 - C245 - Asphaltic Concrete

C201.15 GUARDFENCE

1. Corrugated steel guard fence shall be erected on all temporary embankments where the vertical height between the edge of the shoulder and the intersection of the embankment slope and natural surface exceeds 1m and as otherwise shown on the drawings. **Warrant**
2. Guardfence shall be erected in accordance with: **Erection**
- C264 - Guardfence

C201.16 OPENING TO TRAFFIC

1. Temporary roadways and detours (including portable or temporary traffic signals sites) shall not be open to traffic until they have been inspected, approved and authorised in writing by the Council's Supervising Engineer. **Approval to use**
2. All signposting, pavement marking, guard fence and portable or temporary traffic signals shall be completed before the opening of temporary roadways to traffic. **Signposting**
3. Unless otherwise approved by the Council's Supervising Engineer, the opening of temporary roadways shall be arranged so that sections of existing roadway being replaced are not disturbed for a minimum of forty-eight hours in the event of temporary roadway failure and there is a warrant to redirect traffic back onto the existing roadway. The determination to redirect traffic shall be by the Council's Supervising Engineer. **Existing Roadway Retained**
4. The costs associated with the redirection of traffic back onto the existing roadway shall be borne by the Contractor. **Contractor's Cost**
5. Unless otherwise approved by the Council's Supervising Engineer, traffic shall be switched to a temporary roadway or detour only where the Contractor's usual workforce will be on site for a minimum of two days thereafter. **Traffic Switch**

C201.17 MAINTENANCE

1. The Contractor shall be responsible for the maintenance of temporary roadways and detours and shall ensure the road surface is kept safe for traffic. Any potholes or other failures shall be repaired without delay.

***Contractor's
Responsibility***

C201.18 REMOVAL

1. Upon completion of the Work the temporary roadways and/or detour arrangements shall be removed and the area restored to a condition equivalent to that which existed prior to the commencement of the work.

Restoration

ARRANGEMENTS FOR TRAFFIC

C201.19 CONSTRUCTION UNDER TRAFFIC

1. Where a temporary roadway or a detour is not provided or available, then subject to the approval of the Council's Supervising Engineer, construction under traffic may be permitted, provided that a minimum of 3.5 m lane width is available for through traffic on a two lane roadway. When working on multilane roads 3.5 m lanes are to be available in both directions for through traffic. Lane widths of 3.0m on some local roads may be approved by Council under a Section 138/ROL permit.

Lane Width

2. The carriageway/s shall be restored to a safe and trafficable state for through traffic prior to cessation of work each day.

***Carriageway
Restoration***

3. Full details of temporary signposting, traffic control devices and traffic control methods, in accordance with the appropriate arrangement diagrams in RMS Traffic Control at Work Sites, are to be submitted to the Council's Supervising Engineer at least five working days before undertaking any work that would involve construction under traffic.

***Signs and
Markings***

C201.20 OPENING COMPLETED WORK

1. The Contractor shall give the Council's Supervising Engineer at least two working days written notice confirming the date of opening completed work to traffic. The procedure for opening shall be determined through consultation between the Contractor and Council's Supervising Engineer.

Written Notice

2. The Contractor shall be responsible for the removal of all temporary traffic control devices no longer required for the safety of traffic, when the Works or part thereof are opened to traffic.

***Contractor's
Responsibility***

TRAFFIC CONTROL DEVICES

C201.21 ARRANGEMENT OF TRAFFIC CONTROL DEVICES

1. The arrangement and placement of traffic control devices shall be carried out in accordance with RMS

***Arrangement
Diagrams***

Traffic Control at Work Sites. The arrangement diagrams illustrate the more common examples of the arrangement of traffic control devices and set out the minimum requirements.

2. All temporary traffic control devices shall be covered and/or removed without delay when no longer required in order to maintain unambiguous safe guidance to traffic.

***Unnecessary
Signs***

CONTROL OF TRAFFIC

C201.22 MAINTENANCE OF TRAFFIC CONTROL DEVICES

1. All traffic control devices shall be maintained in accordance with AS 1742.3 so that they are in good order and in the correct positions day and night. They shall be neat and clean, and signs shall be clear and legible at all times. **Contractor's Responsibility**

2. The Contractor shall maintain a daily log that verifies that daily checks of all traffic control devices have been conducted. This log shall be made available for the Supervising Engineer's inspection upon demand. **Daily Log**

3. The Contractor may need to be contacted outside normal working hours to arrange for adjustments or maintenance of traffic control devices. The Contractor shall notify the Council's Supervising Engineer and the local Police, in writing, the names, addresses, and means of communicating with personnel nominated for this purpose. **Out of Hours Contact**

C201.23 ADEQUATE TRAFFIC CONTROL DEVICES

1. Where the Contractor fails to provide and maintain adequate traffic control devices specified in this Specification, the Council's Supervising Engineer shall arrange to have such items provided and maintained at the Contractor's cost. **Default by Contractor**

2. The cost of providing and maintaining adequate traffic control devices arranged by the Council's Supervising Engineer shall be borne by the Contractor. **Contractor's Cost**

C201.24 REGULATORY TRAFFIC CONTROL SIGNS AND DEVICES

1. A Regulatory Traffic Control Sign or Devices shall be in accordance with AS 1742.3, and shall require approval by the appropriate Authority before its erection. This approval should be obtained through Council's Supervising Engineer and/or the RMS where applicable. A minimum of five weeks written notice by the Contractor shall be required to ensure that approval is obtained before erection of these signs and/or devices. **Prior Approval**

C201.25 SIGNS

1. Signs shall be designed and manufactured in accordance with AS 1743. Details of each letter shall be as shown in AS 1744. **Specifications**

2. The reflective material used on signs shall be Class 2 material complying with AS 1906.1 except where otherwise specified. The fluorescent material used on signs shall be fluorescent red. **Reflective Material**

C201.26 SUPPLEMENTARY SIGNS

1. Signs supplementary to AS 1742.3 are shown in Annexure C201A. These signs may be used in lieu of or in addition to those shown in AS 1742.3.

(a) Heavy Machinery Crossing

This temporary sign, shown as Sign SW5-22, shall be used in lieu of W5-22, trucks entering.

(b) Cycle Hazard Grooved Road

This temporary sign, shown as Sign ST1-10, shall be used in addition to T1-10 of AS 1742.3 where the road is grooved and is a hazard to cyclists.

(c) Tar Spraying Possible Short Delay

This temporary sign, shown as Sign ST3-1, shall be used in addition to T3-1 for bituminous surfacing works.

(d) Changed Traffic Conditions Ahead

This temporary sign, shown as Sign ST1-6, shall be used in addition to T1-1, T1-6, T2-6 and T2-21 on long term works, sidetracks and detours.

C201.27 FLASHING ARROW SIGNS

1. Flashing arrow signs shall comply with AS 1742.3.

C201.28 BARRIER BOARDS

- | | |
|--|------------------------|
| 1. Barrier boards shall comply with AS 1742.3. | Standard |
| 2. Trestles supporting the barrier boards may be manufactured of timber, metal or other suitable material and shall be yellow. The trestles shall provide firm supports for the barrier board and be kept in place by sandbags or other devices. The bases of the trestles shall not protrude beyond the ends of the boards. | Trestle Support |

C201.29 HIGH VISIBILITY MESH FENCING

1. High visibility mesh fencing shall be constructed where shown on the Drawings, TCGP or as directed by the Council's Supervising Engineer.
2. High visibility mesh fencing shall be constructed in accordance with AS 1742.3, containment fences.
3. The mesh fencing shall be paraweb or equivalent as approved by the Council's Supervising Engineer.

C201.30 TEMPORARY POST-MOUNTED DELINEATORS

1. In addition to the requirements of AS 1742.3, temporary post mounted delineators shall be provided in conjunction with high visibility mesh fencing which is erected parallel to and in close proximity to traffic.

C201.31 CONES AND BOLLARDS

- | | |
|--|-------------------------------------|
| 1. Traffic cones and bollards shall comply with AS 1742.3 and be placed in accordance with the arrangement diagrams in RMS Traffic Control at Work Sites. | Standard and Placement |
| 2. Unless cones are firmly fixed in position they shall be used only while work is in progress, or in locations where there is an employee in attendance who shall immediately reinstate any of the cones that have been dislodged by traffic. Otherwise they shall be removed and bollards or barriers substituted. | Conditions of Use |
| 3. Cones and bollards used under night conditions shall be reflectorised in accordance with AS 1742.3. | Reflectorised for Night Work |

C201.32 TRAFFIC WARNING LAMPS

- | | |
|--|----------------------------------|
| 1. Traffic warning lamps shall comply with AS 1165 and shall be installed in accordance with AS 1742.3. The Contractor shall ensure that warning lamps are in good | Standards and Positioning |
|--|----------------------------------|

CONTROL OF TRAFFIC

working order, correctly aligned and positioned with respect to the direction of traffic flow each night, before the site is left unattended.

C201.33 TEMPORARY PAVEMENT MARKINGS

1. All pavement markings shall be reflectorised and consist of painted lines, road marking tape and/or raised pavement markers in accordance with the relevant Australian Standards or as otherwise approved by the Council's Supervising Engineer and shall be provided in accordance with AS 1742.3.

Reflectorised Markings

2. Where the adjoining roadway is edge lined, temporary roadways shall be similarly edge lined.

Adjoining Work

C201.34 TEMPORARY LINEMARKING

1. Where temporary linemarking is required on the final wearing surface, only pavement marking tape shall be used.

On Final Surface

2. Where the pavement linemarking has become ineffective in the opinion of the Council's Supervising Engineer, remarking shall be undertaken within forty-eight hours of direction so given by the Council's Supervising Engineer. The cost of remarking the pavement lines shall be borne by the Contractor.

Contractor's Cost

3. Where a single carriageway is opened adjacent to or used in lieu of an existing dual carriageway length, pavement arrows indicating the direction of flow of traffic shall be placed at not more than 50 m or at a spacing nominated by the Council's Supervising Engineer. The arrows shall be removed if the section is then reincorporated as dual carriageway.

Pavement Arrows

4. Immediately before or after placement of new markings all superseded pavement markings shall be obliterated or removed to the satisfaction of the Council's Supervising Engineer.

Old Markings Removed

5. On a final surface, obliteration by painting shall not be permitted.

C201.35 RAISED PAVEMENT MARKERS

1. Where raised pavement markers have become ineffective in the opinion of the Council's Supervising Engineer, they shall be replaced within twenty-four hours of a direction so given by the Council's Supervising Engineer.

Ineffective Markers

2. The cost of replacing ineffective pavement markers shall be borne by the Contractor.

Contractor's Cost

3. All superseded raised pavement markers shall be immediately removed from the pavement by the Contractor.

Removal of Superseded Markers

C201.36 TRAFFIC SIGNALS

1. Traffic Signals may be either portable or temporary as shown in AS 1742.3.

Portable or Temporary

(a) Portable Traffic Signals

(i). Portable traffic signals may be used for shuttle control where a single lane has to be used alternately by traffic from opposite directions or at road crossings or intersections. They are intended for relatively short-term applications.

Warrant for Use

(ii). Where the Contractor proposes to use portable traffic signals they shall be in accordance with AS 4191.

(b) Temporary Fixed Traffic Signals

- (i) Temporary fixed traffic signals may be used in accordance with AS 1742.3 for longer-term shuttle operations or for non-shuttle control of intersecting traffic flows. Warrant for Use
- (ii) Where the Contractor proposes to use temporary fixed traffic signals they shall be designed and installed in accordance with AS 1742.14.
- (iii) Approval of the RMS shall be sought prior to implementation. The RMS approval shall be provided to Council's Supervising Engineer 1 week in advance of action to employ such signals. RMS may delegate Council to provide such approval on some roads. **Approval**

C201.37 SUMMARY OF APPROVALS & SUBMISSIONS TO COUNCIL'S SUPERVISING ENGINEER

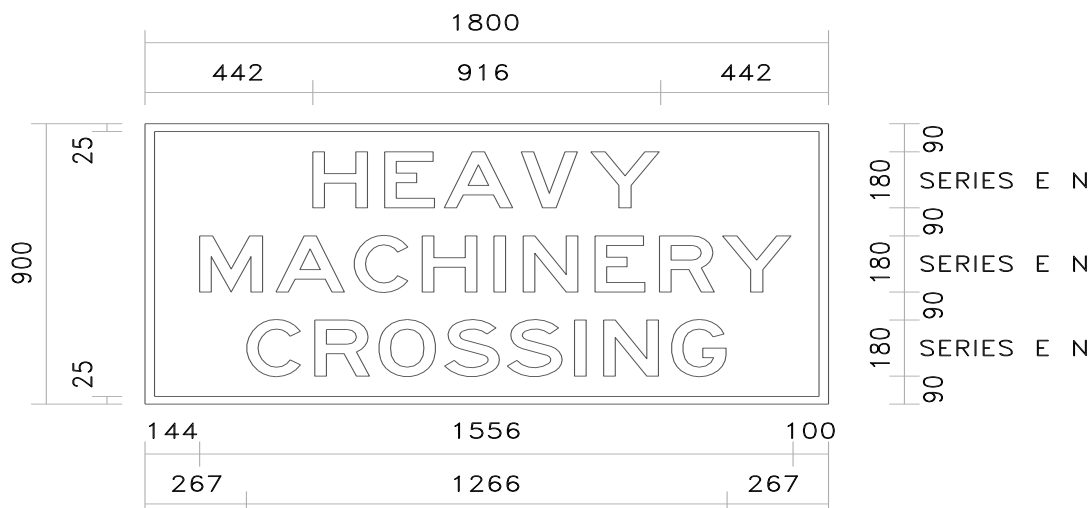
Activity	Notice Required	Spec Clause
Traffic Control Plan	Minimum One (1) week	C201.03
Regulatory Traffic Control Signs	Minimum Five (5) weeks	C201.03
Sighting of Traffic Controllers' Certificates		C201.05
Proposed Temporary Roadways and Detours		C201.09
Full details of temporary signposting, traffic control devices and traffic control methods for construction under traffic	Five (5) working days	C201.19
Consultation between the Contractor and the Council's Supervising Engineer when opening completed work	Two (2) working days	C201.20
Out of hours contact details for Contractor		C201.22
Use of regulatory traffic control signs and devices	Minimum Five (5) weeks	C201.24
Use of temporary Fixed Traffic Signals	Minimum Eight (8) weeks	C201.36

Table C201.1

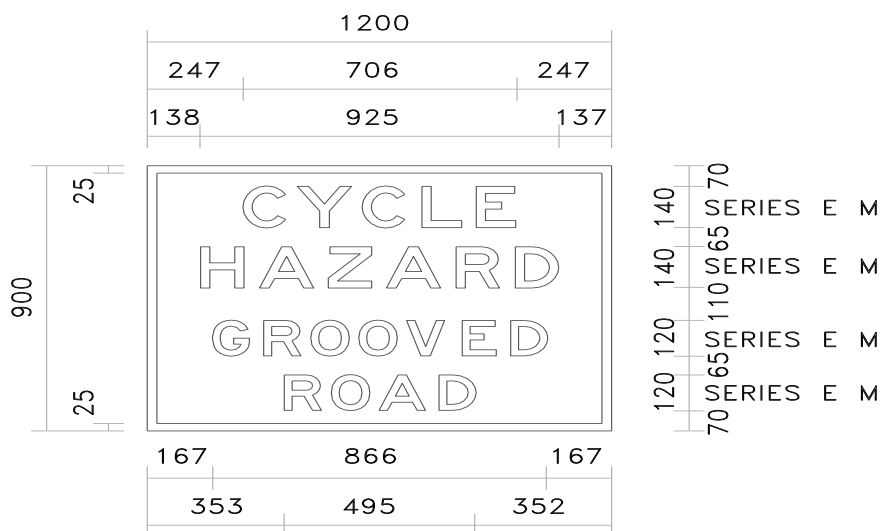
ANNEXURE C201.A : SUPPLEMENTARY TEMPORARY WARNING SIGNS TO AS 1742.3

Black letters and border on yellow reflectorised ground
 Dimensions are in mm

(i) SW5-22



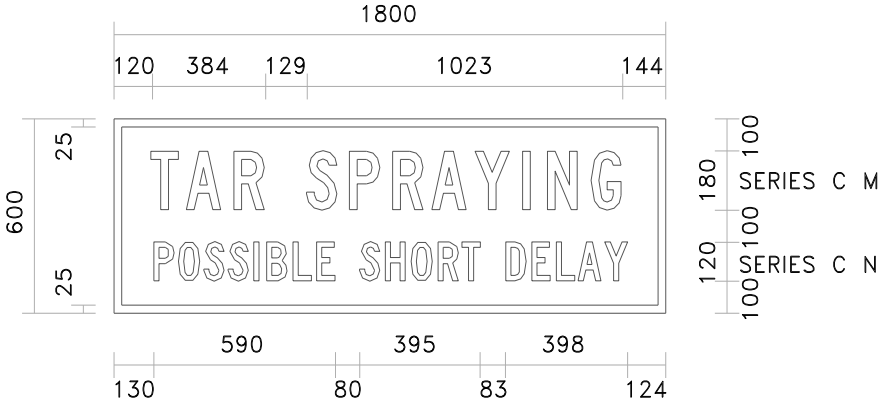
(ii) ST1-10



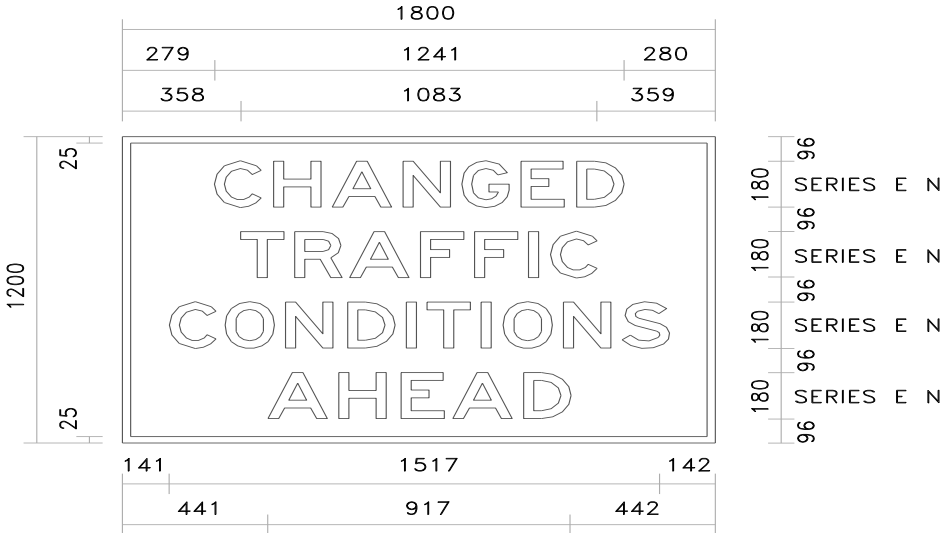
ANNEXURE
SUPPLEMENTARY TEMPORARY WARNING SIGNS TO AS 1742.3
Black letters and border on yellow reflectorised ground
Dimensions are in mm

C201A

(iii) ST3-1



(iv) ST1-6



**CONSTRUCTION
SPECIFICATION**

C211

**CONTROL OF EROSION AND
SEDIMENTATION**

SPECIFICATION C211 : CONTROL OF EROSION AND SEDIMENTATION

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SPECIFICATION C211 : CONTROL OF EROSION AND SEDIMENTATION

GENERAL

C211.01 SCOPE

1. The work to be executed under this Specification consists of the construction of structures and the implementation of measures to control erosion and sedimentation. These may be temporary or permanent.
2. The Contractor shall plan and carry out the whole of the Works to avoid erosion and sedimentation of the site, surrounding country, watercourses, waterbodies and wetlands.

C211.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

- C212 - Clearing and Grubbing
- C213 - Earthworks
- C273 - Landscaping

(b) RTA Test Methods

- T166 - Determination of Relative Compaction.

(c) State Legislation

- Protection of the Environment (Operations) Act 1997
- Soil Conservation Act, 1938
- Water Act, 1912

(d) Other

- NSW Department of environment and Conservation (DEC)
Urban Erosion and Sediment Control

C211.03 EROSION AND SEDIMENTATION CONTROL PLAN

1. For consideration of erosion and sedimentation control measures, the site shall be subdivided into sections based on the catchment area draining to each permanent drainage structure in the works. In addition to the area bounded by the road reserve, the sections shall include:

Site Sections

- (a) Access and haulage tracks,
- (b) Borrow pits and
- (c) Compound areas, such as Contractor's facilities and concrete batching areas.

2. If any construction works are within 40 metres of a watercourse no work is to commence on the site until a Controlled Activity Approval has been issued by the Department of Primary Industries Office of Water (NoW).

***Integrated
Development***

3. The Plan shall consist of scale diagrams indicating: **Plan Inclusions**
- (a) Features of the site including contours and drainage paths,
 - (b) Relevant construction details of all erosion and sedimentation control structures,
 - (c) All permanent and temporary erosion and sedimentation control measures, including the control measures to be implemented in advance of, or in conjunction with, clearing and grubbing operations as required under Specification C212 - CLEARING AND GRUBBING,
 - (d) An order of works based upon construction and stabilisation of all culverts and surface drainage works at the earliest practical stage, and
 - (e) Proposed time schedules for construction of structures and implementation of measures to control erosion and sedimentation.
4. The following publications provide guidance on typical permanent and temporary erosion and sedimentary control measures which may be required and guidance in the preparation of an Erosion and Sedimentation Control Plan: DEC publication Urban Erosion and Sediment Control, DEC (formerly DECC) publication Managing Urban Stormwater and Landcom publication Managing Urban Stormwater. **Guidance**
5. Any approval of the Erosion and Sedimentation Control Plan from DPI or Council shall not relieve the Contractor of the full responsibility to provide whatever measures are required for effective erosion and sedimentation control at all times. **Contractor's Responsibility**
6. The Contractor shall adhere to the approved Erosion and Sedimentation Control Plan. The Contractor shall submit a revised Erosion and Sedimentation Control Plan for approval by Council fourteen days in advance of any intended variation from the approved plan. **Adherence to Plan**

C211.04 EROSION AND SEDIMENTATION CONTROL MEASURES

1. Erosion and sedimentation control measures shall include, but shall not be limited to, the following: **Scope**
- (a) The installation of permanent drainage structures before the removal of topsoil and commencement of formation earthworks within the catchment area of each structure.
 - (b) The prompt completion of all permanent and temporary drainage works to minimise the period of exposure of disturbed areas.
 - (c) The stabilisation of diversion and catch drains to divert uncontaminated runoff from outside the site, clear of the site. Catch drains shall be installed and lined, as specified or as directed by Council's Supervising Engineer, before the adjacent ground is disturbed and the excavation is commenced.
 - (d) The passage of uncontaminated water through or around the site without mixing with contaminated runoff from the site.
 - (e) The provision of contour and diversion drains across exposed areas before, during and immediately after clearing and the re-establishment and maintenance of these drains during soil removal and earthworks operations.
 - (f) The provision of sediment filtering or sediment traps, in advance of and in conjunction with earthworks operations, to prevent contaminated water leaving the site.

CONTROL OF EROSION AND SEDIMENTATION

- (g) The restoration of the above drainage and sedimentation control works on a day-to-day basis to ensure that no disturbed area is left without adequate means of containment and treatment of contaminated water.
- (h) The limitation of areas of erodible material exposed at any time to those areas being actively worked.
- (i) The minimisation of sediment loss during construction of embankments by means such as temporary or reverse superelevations during fill placement, constructing berms along the edge of the formation leading to temporary batter flumes and short term sediment traps.
- (j) The progressive vegetation of the site, in accordance with Specification C273 - LANDSCAPING, as work proceeds.

PERMANENT EROSION AND SEDIMENTATION CONTROL

C211.05 EARTHWORKS FOR PERMANENT EROSION AND SEDIMENTATION CONTROL BASINS

- 1. Earthworks for permanent erosion and sedimentation control basins shall be to the planned levels and dimensions shown on the Drawings or such levels and dimensions as determined by Council's Supervising Engineer. ***Planned Levels***
- 2. The entire storage and embankment foundation area of permanent erosion and sedimentation control basins shall be cleared in accordance with Specification C212 - CLEARING AND GRUBBING and shall be stripped of topsoil and any unsuitable material under embankments removed in accordance with Specification C213 - EARTHWORKS. ***Site Preparation***
- 3. The embankments shall be constructed in layers not exceeding 200 mm in depth and compacted so that the relative compaction, determined by Test Method T166, shall not be less than 95 per cent for standard compactive effort. ***95% Compaction Requirements***

C211.06 INLETS, SPILLWAYS AND LOW FLOW OUTLETS FOR SEDIMENTATION CONTROL BASINS AND SEDIMENT TRAPS

- 1. Inlets and spillways shall be constructed using rock filled woven galvanised steel mattresses laid on a needle punched, mechanically bonded, non-woven geotextile filter fabric, as shown on the Drawings or as directed by Council's Supervising Engineer. The rock filled mattresses shall be laid in accordance with the manufacturer's instructions and Specification. ***Rock Mattresses***
- 2. A low flow outlet consisting of a 150 mm diameter plastic pipe shall be installed as shown in the Drawings. ***Plastic Pipe Outlet***

C211.07 DROP INLET SEDIMENT CONTROL

- 1. Drop inlet sediment traps and inlet control banks shall be constructed on completion of each gully pit unless otherwise directed by Council's Supervising Engineer. These drop inlet sediment traps and inlet control banks are additional to the temporary sedimentation control measures that may be required under Clause C211.10 during construction of the gully pits. ***Time of Construction***
- 2. The drop inlet sediment traps are intended to remove sediment from the surface flow before it enters the drainage system. The inlet control banks shall be constructed as required to prevent the surface flows bypassing the gully pits. ***Purpose***
- 3. The drop inlet sediment traps shall be constructed as shown on the Drawings. The associated inlet control banks shall consist of at least two courses of sandbags containing a ***Control Banks***

10:1 sand/cement mix. The bags shall be keyed at least 25 mm into the surface, dampened sufficiently to ensure hydration of the cement and tamped lightly to provide mechanical interlock between adjacent bags.

C211.08 CLEANING SEDIMENTATION CONTROL STRUCTURES

1. The permanent sedimentation control structures shall be cleaned out whenever the accumulated sediment has reduced the capacity of the structure by 50 per cent or more, or whenever the sediment has built up to a point where it is less than 300 mm below the spillway crest. Prior to issue of the Certificate of Practical Completion, all permanent sedimentation control structures shall be cleaned out

***Contractor's
Responsibility***

2. Accumulated sediment shall be removed from permanent sedimentation control structures in such a manner as not to damage the structures. The sediment removed shall be disposed of in such locations that the sediment will not be conveyed back into the construction areas or into watercourses. Suitable access to permanent sedimentation control structures to allow cleaning out in all weather conditions shall be provided and maintained.

***Removal of
Sediment***

C211.09 REMOVAL OF SEDIMENTATION CONTROL STRUCTURES

1. Prior to the end of the maintenance period, Council's Supervising Engineer may direct the removal and restoration of any sedimentation control structures or devices. The work shall result in the restoration of the ground surface disturbed by the construction of any sedimentation control structure or device to approximate that previously existing and shall include:

Restoration

- (a) Removal of the rock mattresses from the spillway and their subsequent burial into the basin area or their use as scour protection or their removal from site,
- (b) Spreading and compaction of the embankment material into the basin area and
- (c) Removal of access roads.

2. The disturbed material shall be compacted to at least the relative density of the material existing in the adjacent ground.

Compaction

3. Landscaping in the restored area shall be carried out in accordance with Specification C273 LANDSCAPING.

Landscaping

TEMPORARY EROSION AND SEDIMENTATION CONTROL

C211.10 GENERAL

1. The Contractor shall ensure that effective erosion and sedimentation control measures are installed and maintained at all times during the development of the site.

Responsibility

2. Runoff from all areas where the natural surface is disturbed by construction, including access roads, depot and stockpile sites, shall be free of pollutants as defined in the *Protection of the Environment (Operations) Act 1997* before it is either dispersed to stable areas or directed to natural watercourses. The Contractor shall be responsible for all temporary erosion and sedimentation control measures required for this purpose, and in this regard shall endeavour to prevent erosion and sediment transport occurring or control it at the source, rather than at the discharge point from the construction site.

Pollutant Free

Source Control

3. The Contractor shall provide and maintain slopes, crowns and drains on all excavations and embankments to ensure satisfactory drainage at all times. Water shall not be allowed to pond on the works unless such ponding is part of an approved Erosion and

Maintenance

CONTROL OF EROSION AND SEDIMENTATION

Sedimentation Control Plan.

C211.11 TEMPORARY DRAINS

1. Runoff from areas exposed during the work shall be controlled by construction of temporary contour drains and/or temporary diversion drains. Generally, a temporary contour drain or temporary diversion drain takes the form of a channel constructed across a slope with a ridge on its lower side. These may require progressive implementation and frequent alteration as the work progresses.

***Control of
Runoff***

2. Contour drains, which follow points on the natural surface of approximately the same elevation, shall be provided immediately after a construction site is cleared to intercept and divert runoff at non-erosive velocities from the site to nearby stable areas. Contour drains shall be formed with a grade of neither less than 1 per cent nor more than 1.5 per cent and shall be spaced at intervals of neither less than 20 m nor more than 50 m, depending on the erodibility of the exposed soil. Contour drains shall be constructed as shown on the Drawings.

Contour Drains

3. Diversion drains shall be provided across haul roads and access tracks when such roads and access tracks are identified as constituting an erosion hazard due to their steepness, soil erodibility or potential for concentrating runoff flow. Diversion drains shall be formed to intercept and divert runoff from the road or track to stable outlets. Spacing of diversion drains shall not be greater than that required to convey runoff at non-erosive velocities.

***Diversion
Drains***

C211.12 TEMPORARY SEDIMENT TRAPS

1. Temporary sediment-trapping devices shall be provided during construction to remove sediment from sediment-laden runoff flowing from all disturbed areas before the runoff enters natural watercourses or adjacent land.

***Sediment
Traps***

C211.13 BATTER PROTECTION

1. The Contractor shall take all necessary action to protect batters from erosion during the development of the site.

Responsibility

2. Scour of newly formed fill batters during and after embankment construction shall be minimised by diverting runoff from the formation away from the batter until vegetation is established.

Scour Control

C211.14 MAINTENANCE AND INSPECTION

1. The Contractor shall inspect all temporary erosion and sedimentation control works after each rain period and during periods of prolonged rainfall. Any defects revealed by such inspections shall be rectified immediately and these works shall be cleaned, repaired and augmented as required, to ensure effective erosion and sedimentation control thereafter.

Responsibility

2. The Contractor shall provide and maintain access from within the road reserve or from other locations acceptable to Council's Supervising Engineer, for cleaning out sedimentation control works.

Access

3. The Contractor shall cause a register to be maintained that lists all sedimentation and erosion control devices installed on the site, records the date of their inspection, such inspection to be no less frequent than weekly, their condition, and any maintenance, cleansing or desilting work conducted thereon. The register shall be made available for inspection to Council's Supervising Engineer on demand.

***Inspection
Register***

C211.15 REMOVAL

1. The Contractor with the approval of Council's Supervising Engineer shall remove all temporary erosion and sedimentation control works when revegetation is established on formerly exposed areas. All materials used for the temporary erosion and sedimentation control works shall be removed from the site or otherwise disposed by the Contractor to the satisfaction of Council's Supervising Engineer.

Responsibility

SPECIAL REQUIREMENTS

C211.16 RESERVED

C211.17 RESERVED

C211.18 RESERVED

C211.19 RESERVED

CONSTRUCTION SPECIFICATION

C212

CLEARING AND GRUBBING

SPECIFICATION C212 : CLEARING AND GRUBBING

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SPECIFICATION C212 : CLEARING AND GRUBBING

C212.01 SCOPE

- | | |
|--|--------------------------------------|
| <p>1. The work to be executed under this Specification consists of the clearing of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards) and all rubbish and other materials which, in the opinion of the Council's Supervising Engineer, are unsuitable for use in the Works; the chipping of the crowns of trees and the branches of shrubs, and the grubbing of trees and stumps from the area defined in Clause C212.02. The work also includes the disposal, in accordance with Clause C212.05 and C212.06, of all materials that have been cleared and grubbed.</p> | <p><i>Extent of Work</i></p> |
| <p>2. In advance of or in conjunction with clearing and grubbing operations, effective erosion and sedimentation control measures shall be implemented in accordance with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION.</p> | <p><i>Erosion Control</i></p> |

C212.02 LIMITS OF CLEARING

- | | |
|--|---|
| <p>1. Unless otherwise specified or directed, the area to be cleared is that required by site regrading works, including the area occupied by the completed road formation and associated drainage works and erosion and sedimentation measures, plus a clearance of 2m beyond tops of cuts and toes of embankments.</p> | <p><i>Limits of Clearing</i></p> |
| <p>2. The Contractor shall before clearing commences mark the limits of clearing by placing pegs at 25m intervals around the area to be cleared.</p> | <p><i>Indicator Pegs</i></p> |

C212.03 CLEARING OPERATIONS

- | | |
|--|--|
| <p>1. The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards) and all rubbish and other materials which, in the opinion of the Council's Supervising Engineer, are unsuitable for use in the Works, with the exception of certain trees marked for preservation.</p> | <p><i>Extent</i></p> |
| <p>2. The Contractor shall take protective measures during the operations of clearing and grubbing on the site and during road construction to avoid damaging or destroying trees that have been identified as being required to be preserved.</p> | <p><i>Trees to be preserved</i></p> |
| <p>3. The Contractor shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing. No growing trees shall be destroyed or damaged by the Contractor other than those specified.</p> | <p><i>Trees outside Limits of Work</i></p> |
| <p>4. Any tree remaining within the road reserve but outside the limits of clearing which is, in the opinion of the Council Engineer, unsound and likely to fall upon the roadway shall be cleared and disposed of in accordance with Clause C212.05.</p> | <p><i>Unsound trees in Road Reserve</i></p> |
| <p>5. Any branch, which overhangs the road formation, shall be cut back to within 0.5m of the tree trunk and disposed of in accordance with Clause C212.05.</p> | <p><i>Overhanging branches</i></p> |
| <p>6. Every precaution shall be taken to prevent timber from falling on private property and the Contractor shall dispose of any timber so fallen or produce the written consent of the owner to its remaining there. The cost of disposal of such fallen timber shall be borne by the Contractor.</p> | <p><i>Debris in Private Property</i></p> |
| <p>7. The Contractor shall make good damage of any kind, including damage to fencing, occurring during clearing operations. The cost of making good such damage shall be borne by the Contractor.</p> | <p><i>Damage to Property</i></p> |

CLEARING & GRUBBING

C212.04 GRUBBING

1. All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing. **Extent**
2. Grubbing operations shall be carried out to a depth of 0.5 m below the natural surface or 1.5m below the finished surface level, whichever is the lower. **Depth**
3. Holes remaining after trees and stumps have been grubbed shall be backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground. **Backfill Holes**

C212.05 CHIPPING OF CLEARED VEGETATION

1. The Contractor shall produce wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this Specification. The wood-chip mulch produced shall be stockpiled for subsequent use in accordance with Specification C273 - LANDSCAPING or for use at other locations as appropriate. **Wood-chip Mulch**
2. The wood-chip mulch shall be produced from branches having a maximum diameter of 100 millimetres and the chipped material produced shall not have two orthogonal dimensions exceeding 75mm and 50mm. **Dimensions**

C212.06 DISPOSAL OF MATERIALS

1. Unless otherwise specified elsewhere, all materials cleared and grubbed in accordance with this Specification shall become the property of the Contractor and shall be removed from the site and legally disposed. **Removal from Site**
2. Unless otherwise approved by the Council's Supervising Engineer in writing, disposal of timber and other combustible materials by burning shall not be permitted. Where the Contractor obtains the prior written approval of the Council's Supervising Engineer, the Contractor shall comply with all Statutory requirements applicable to burning off, and any such burning off shall be carried out in such a manner that no damage is done to any trees outside the limits of clearing. Where smoke resulting from such burning off causes a traffic hazard, the burning off shall be ceased and any fire extinguished immediately. **Burning not Permitted**

C212.07 SUMMARY OF APPROVALS & SUBMISSIONS TO COUNCIL'S SUPERVISING ENGINEER

Activity	Notice Required	Spec Clause
Clearing Operations – Clearing and grubbing		C212.03

CONSTRUCTION SPECIFICATION

C213

EARTHWORKS

SPECIFICATION C213 : EARTHWORKS

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SPECIFICATION C213 : EARTHWORKS

GENERAL

C213.01 SCOPE

1. The work to be executed under this Specification consists of:- **Scope**
- (a) Removal of topsoil
 - (b) All activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the Drawings and Specification.
 - (c) Removal and replacement of any unsuitable material,
 - (d) Any spoil or borrow activities associated with earthworks, and
 - (e) Any additional processing of selected material for the selected material zone.

C213.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

(a) Council Specifications

- C201 - Control of Traffic
- C211 - Control of Erosion and Sedimentation
- C212 - Clearing and Grubbing
- C220 - Stormwater Drainage - General
- C273 - Landscaping

(b) Australian Standards

- AS 1289.F1.1 - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.
- AS 1289.3.3.1 - Calculation of the plasticity index of a soil.
- AS 1289.5.1.1 - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
- AS 1289.5.7.1 - Compaction Control Test (Rapid Method).
- AS 2187 Explosives - Storage, transport and use (SAA Explosive Code)
 - Part 1 Storage and land transport
 - Part 2 Use of explosives

(c) RTA Test Methods

- T166 - Determination of Relative Compaction.

(d) Other

EARTHWORKS

- AUSTROADS - Explosives in Roadworks, Users Guide 1982.
- DECC - Environmental Noise Control Manual (originally issued by the EPA)
- DECC - Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage June 2003 (originally issued by Resource NSW)

C213.03 EARTHWORKS MATERIALS

1. The Contractor shall be responsible for any assumptions made by their Contractor(s) in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

Material Characteristics

2. The estimated quantity for general earthworks at any cutting includes all types of materials that may be encountered in the cutting.

3. Where material from excavations is acceptable for use in embankments, but the Contractor elects to:-

Embankment Material Deficiency

- (a) Spoil it, or
- (b) Use it for the Contractor's own purposes, or
- (c) Use it as a source of pavement materials, or
- (d) Construct embankments with dimensions in excess of those specified.

and a deficiency of material for embankment construction is thereby created, the Contractor shall make good that deficiency from sources of material meeting the quality requirements specified in Clause C213.23. The cost of making good such deficiency of material shall be borne by the Contractor.

Contractor's Cost

C213.04 PROTECTION OF EARTHWORKS

1. The Contractor's responsibility for care of the Works shall include the protection of earthworks.

Contractor's Responsibility

2. The Contractor shall install effective erosion and sedimentation control measures in accordance with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION, prior to commencing earthworks, and shall maintain these control measures for the duration of the contract and defects liability or maintenance period.

Erosion and Sedimentation Control

3. Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

Drainage of Working Areas

4. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off with a smooth roller.

Wet Weather Precautions

5. Should insitu or stockpiled material become over wet as a result of not providing adequate protection of earthworks, the material shall not be incorporated into the works until it is dried out.

Wet Material

C213.05 SETTING OUT OF EARTHWORKS

1. Before earthworks operations commence, batter profiles shall be established by the Contractor and the necessary pegs driven at 25 m intervals or at each cross section shown on the Drawings, whichever is the lesser. The chainage/station, offset from control line and slope distance to finished surface level, shall be clearly marked on each peg.

Batter Profiles

- | | |
|--|--|
| 2. The batter profiles shall be repositioned by the Contractor at each change in the slope of the batter and at intervals of not more than 5 m of vertical height. | Profile
Location |
| 3. All pegs and batter profiles shall be maintained in their correct positions. The Contractor on completion of the contract or separable part shall remove them. | Retention and
Removal of
Pegs |
| 4. The foregoing shall be the minimum requirement. Additional pegs and profiles may be required to suit the Contractor. These shall not be painted with the same colours used for the specified setting out pegs and stakes. | Additional
Pegs |
| 5. The position and extent of all transitions from cuttings to embankments and foundations for shallow embankments shall be marked with clearly labelled stakes in accordance with Clauses C213.15 and C213.24. | Transitions
Cuttings/
Embankments |

C213.06 STOCKPILE SITES

- | | |
|--|--|
| 1. The Contractor shall obtain the written consent of the Council's Supervising Engineer to the use of any stockpile site that is not shown on the Drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile and identify all erosion and sediment controls to be implemented and maintained for this work. | Additional
Stockpile Sites |
| 2. Any clearing and grubbing required for these sites shall be carried out in accordance with Specification C212 - CLEARING AND GRUBBING. Temporary erosion and sedimentation control measures shall be taken in accordance with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION. | Clearing and
Grubbing |
| 3. The maximum height of stockpiles shall not exceed 2.0 m and the maximum batter slope shall not exceed 2:1. Stockpile heights greater than 2.0 m must be approved by Council's Supervising Engineer in accordance with C213.06.1 above and must be located at least 100m from existing dwellings. | Maximum
heights |
| 4. Restoration of stockpile sites following completion of the work shall be carried out in accordance with Specification C273 - LANDSCAPING. All surplus stockpile material must be removed from the site. Spreading of surplus material over the site is prohibited. | Restoration
and removal of
surplus. |

REMOVAL OF TOPSOIL

C213.07 SCOPE

- | | |
|---|---|
| 1. Topsoil is surface soil, which is reasonably free from subsoil, refuse, clay lumps and stones. | Definition |
| 2. No topsoil is to be removed from the site unless approved in writing by Council's Supervising Engineer. | Topsoil
Removal
Prohibited |
| 3. Removal of topsoil on any section of the Works shall only commence after erosion and sedimentation controls have been implemented and after clearing, grubbing and disposal of materials have been completed on that section of the Works. Topsoil throughout the length of the work shall be removed and stockpiled separately clear of the work. | Prerequisites |
| 4. The work shall include the following:-
(a) Cuttings | Extent of Work |

EARTHWORKS

Removal of the topsoil to a depth quoted in Annexure C213A or as directed by the Council's Supervising Engineer.

(b) Embankments

Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in Annexure C213A, or as directed by the Council's Supervising Engineer. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in Annexure C213A shall be removed to its full depth as directed by the Council's Supervising Engineer.

(c) Other Locations

Removal of topsoil as directed by the Council's Supervising Engineer.

C213.08 SURVEY AFTER REMOVAL OF TOPSOIL

1. Where payment is on a 'Schedule of Rates' basis, and unless alternative arrangements have been made by the Council's Supervising Engineer, after removing the topsoil the Contractor shall determine the surface levels in each cutting and embankment at sufficient locations to determine the volume of excavation for general earthworks and the volume of compacted fill. A schedule of these surface levels shall be submitted to the Council's Supervising Engineer for concurrence at least three working days before commencement of any work which will alter the ground surface as surveyed. Such work shall only commence with the approval of the Council's Supervising Engineer.

***Establish
Surface Level***

C213.09 TOPSOIL STOCKPILES

1. Topsoil stockpiles must not be located within 5 metres of existing vegetation, watercourse, overland flowpath, road or property boundary. Stockpiles must not be placed on slopes greater than 10% without formation of a stockpile pad and surface flow diversion berm.

Location

2. The maximum height of stockpiles shall not exceed 2.0 m and the maximum batter slope shall not exceed 2:1.

***Height and
Batter***

3. Topsoil stockpiles shall not contain any timber, stones, clay lumps or other rubbish.

***Stockpiles to
be Clean***

4. To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Council's Supervising Engineer as soon as practically possible. Where a stockpile is to be placed for more than 10 days, appropriate E&SC must be installed. Dust control measures must be implemented on all stockpiles.

***Erosion and
Dust Control***

5. Where seeding of stockpiles to encourage vegetation cover is undertaken, such work shall be carried out in accordance with Specification C273 - LANDSCAPING.

***Seeding
Stockpile***

CUTTINGS

C213.10 SCOPE

1. Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

Extent of Work

C213.11 EXCAVATION

1. Materials encountered in cuttings shall be loosened and broken down as required

so that they are acceptable for incorporation in the Works. In this regard, the Contractor's attention is drawn to Clauses C213.23, C213.26, C213.28, C213.29, C213.30 and C213.31.

2. Cuttings shall have batter slopes as shown on the Drawings or as redetermined by the Council's Supervising Engineer on the basis of site inspection and investigation during the excavation. **Batter Slopes**
3. The tops of all cuttings shall be neatly "rounded" so as the area may be maintained and to inhibit erosion and scouring.
4. In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters will generally require progressive flattening at the ends of cuttings due to the presence of less stable material. **Batters to be Even**
5. Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds. **Unstable Material**
6. Where, after the removal of Topsoil as specified in Clause C213.07, material of variable quality or moisture content is encountered, the Contractor shall adjust its excavation methods to ensure blending of the materials, to obtain material meeting the requirements of Clause C213.23. **Blending Material**
7. Where the Council's Supervising Engineer re-determines the batter slope of any section of a cutting after it has been completed in accordance with this Clause, the Contractor shall have no claim upon the Council or its agents as a result of the redetermination of the batter slope. **Variation for Batter Slopes**

C213.12 BATTER TOLERANCES

1. The tolerances for the excavation of batters, measured at right angles to the design grade line, shall be $\pm 300\text{mm}$. **Batter Tolerances**
2. If the Contractor excavates the batter beyond the batter slope line and the tolerance applicable thereto, the Council's Supervising Engineer may authorise a minor change in the general slope of the batter to suit the convenience of the Contractor, but such a change shall not be regarded as a redetermination of the batter slope under Clause C213.11. The cost of any increase in excavation quantities resulting from such change in batter slope shall be borne by the Contractor. Alternatively the Contractor shall submit details of the material and/or methods proposed to restore the specified slope and stability of the batter for the approval of Council's Supervising Engineer. **Excavation beyond Batter Line**
Contractor's Cost
3. For batters steeper than 1:1, if any section of the batter up to a height of 3m above the table drain level has been over excavated beyond the tolerance limit specified, the Council's Supervising Engineer may direct that the batter be restored to the average batter slope using randomly mortared stone. The stone shall be similar to the sound rock in the cutting and the mortar shall be coloured to match the colour of the rock. **Restoration of Batter Slope**
4. The cost of restoring batters shall be borne by the Contractor. **Contractor's Cost**

C213.13 BENCHING IN CUTTINGS

1. Cut batters shall be benched as shown on the Drawings to provide drainage and erosion control on cut batters. Notwithstanding the tolerances permitted under Clause C213.12, bench widths shall not be less than those shown on the Drawings. **Bench Construction**
2. Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Development. **Bench Maintenance**

C213.14 TREATMENT OF FLOORS OF CUTTINGS

1. The floors of cuttings shall be excavated, parallel to the designed grade line, to a designed floor level that shall be at the underside of the selected material zone or where there is no selected material zone, to the underside of the pavement subbase. The floors shall then be trimmed to a level of not more than 50 mm above or below the designed floor level.

Excavation Level

2. The Contractor shall rip or loosen all material in the floor to a minimum depth of 200mm below the designed floor level for the width of the selected material zone (or subbase layer, where no selected material zone). The maximum dimension of any particles in the ripped or loosened zone shall not exceed 150mm.

Floor Material Ripped

3. Prior to ripping or loosening the cutting floor the Contractor shall determine the CBR of the material in the floor by AS 1289.F1.1. Sufficient tests shall be taken to represent all the various materials that may exist in the cutting floor. If material in the floors of cuttings has a CBR value less than the value quoted in Annexure C213A, the Council's Supervising Engineer will direct the action to be taken.

CBR Testing

4. Ripped or loosened material shall be made available for inspection by the Council's Supervising Engineer before re-compaction commences. It shall be re-compacted in accordance with Clause C213.36. No account shall be taken of the volume involved in loosening when measuring the volume of excavations.

Inspection by Supervising Engineer

5. After re-compaction, the floors of cuttings shall be re-trimmed parallel with the finished wearing surface so that their levels do not vary more than 0 mm above or 40 mm below the designed floor levels.

Level Tolerances

C213.15 TRANSITION FROM CUT TO FILL

1. After the removal of topsoil and before the excavation of any cutting commences the Contractor shall survey and mark the position of the intersection line between cutting and embankment occurring at the underside of the selected material zone or pavement subbase.

Intersection Line

2. Following excavation to the cutting floor, a terrace shall be excavated for the width of the selected material zone (or subbase layer, where no selected material zone) to a depth of 600mm below and parallel to the cutting floor, as shown in Figure C213.1.

Terrace Construction

3. The terrace shall extend into the cut to the point where the cutting floor is 600mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser.

Extent of Terrace

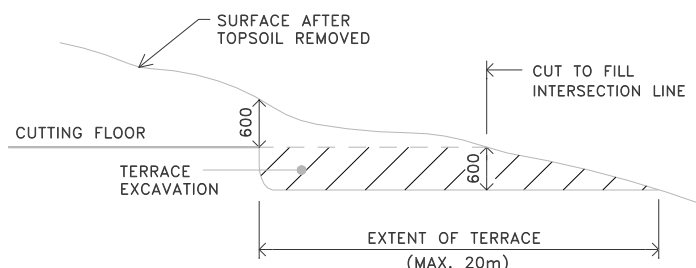


Figure C213.1 - Transition from Cut to Fill

4. The material placed above the terrace shall satisfy the requirements of Clause C213.23 and shall be compacted in accordance with Clause C213.36.

**Quality and
Compaction**

BLASTING

C213.16 GENERAL

1. Blasting is not permitted within areas zoned for urban development (residential, commercial or industrial) where any dwelling is within one kilometre of the proposed site of blasting. When explosives are permitted to be used, the Contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all Government regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187, Parts 1 and 2. The requirements of the Environment Protection Authority (EPA) shall be complied with. Copies of all permits and consents shall be made available to Council's Supervising Engineer on request.

**Prohibited
Locations**

**Contractor to
Obtain
Licences**

2. The Contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

**Contractor's
Responsibility**

3. Before the start of blasting operations, the Contractor, in the presence of the Council's Supervising Engineer, shall conduct a dilapidation survey to determine and record the existing condition of all structures likely to be affected by any blast.

**Pre-blast
Dilapidation
Survey**

4. Structures shall include public utilities. The survey shall include all structures within 500m of any blast but shall be extended where the maximum instantaneous charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site. A written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, shall be submitted to the owner of each structure and to the Council's Supervising Engineer before blasting commences.

**Extent of
Survey**

5. The Contractor shall advise the Council's Supervising Engineer of the proposed maximum instantaneous charge and the Contractor's validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. The Council's Supervising Engineer may direct amendments to the scope of the survey as a result of blast monitoring during the work. All costs associated with the surveys and reports shall be borne by the Contractor.

**Amendment to
Extent of
Survey**

6. A minimum of seven (7) days prior to each blasting operation, the Contractor shall submit to the Council's Supervising Engineer written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and vibration. Monitoring details shall also be provided.

**Proposed
Blasting
Procedure**

7. Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table C213.1:

**Ground
Vibration**

Point of Potential Damage (within 1km of blasting site)	Peak Particle Velocity
Completed and cured bridge structures or sub-structures (eg completed abutment)	25 mm/sec

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Bridgeworks and structural retaining walls under construction.	20 mm/sec
Residential premises, schools, hospitals and other buildings	5 mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance	2 mm/sec

Table C213.1 - Limiting Peak Particle Velocity

8. The Contractor shall advise all residents within a radius of 1km, by letter drop before blasting operations commence, of the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result.

Advice to Residents

9. Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm.

Time Limits

10. When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with Specification C201 - CONTROL OF TRAFFIC. A standard warning procedure such as that given in the AUSTRROADS Explosives in Roadworks, Users Guide 1982 shall be established and observed at all times.

Safety Precautions

C213.17 PRESPLITTING

1. Where presplitting is carried out the spacing of presplit drill holes shall not exceed 750mm centre to centre.

Presplitting

C213.18 BLASTING RECORDS

1. The Contractor shall maintain accurate records of each blast showing the details listed below: -

Records to be Kept

Date and time of blast

Location, number and diameter of holes loaded

Depth of each hole loaded

Inclination of holes

Maximum and minimum burden

Types of explosives used

Charge distribution in each hole

Maximum instantaneous charge

Delay periods and sequence

Total amount of charges in the blast

Length and type of stemming in each hole

Name of Powderman & registered Business Name of his employer

2. The records shall be prepared as holes are loaded and signed by the Powderman. A copy shall be provided to the Council's Supervising Engineer on the day of the blast. **Record Preparation**

C213.19 CONTROL OF AIR BLAST OVER-PRESSURE

1. This Clause shall apply only where a noise sensitive location exists within 1km of the blasting site. **Incidence**
2. The Contractor's attention is drawn to the recommendations given in the EPA Noise Control Manual for the reduction of air blast over-pressure. **Noise Control Manual**
3. The noise emanating from blasting operations shall not exceed an over-pressure level of 115 decibels (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10 per cent of the total number of blasts may exceed this value provided a level of 120 decibels is not exceeded at any time. **Noise Limitations**
4. The Contractor shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. Personnel possessing current NATA registration for such monitoring shall carry out all monitoring. All test results shall be reported on NATA endorsed test certificates, which shall include a clear statement as to compliance or non-compliance with the requirements of this Specification. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Council's Supervising Engineer. **Monitoring of Air Blast Over-Pressure**
5. In the event that the measured air blast over-pressure exceeds the specified limits, all further blasting work shall be suspended until details of proposed additional steps to be taken to eliminate future exceedences are submitted to the Council's Supervising Engineer. Blasting shall not resume until such proposals have been submitted. **Excessive Air Blast Over-Pressure**

C213.20 CONTROL OF GROUND VIBRATION

1. The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table C213.1. Personnel possessing current NATA registration for such monitoring shall carry out all monitoring. All test results shall be reported on NATA endorsed test certificates, which shall include a clear statement as to compliance or non-compliance with the requirements of this Part of the Specification. In general a monitoring location shall be near the perimeter of the structure or building at the point closest to the maximum charge. A copy of the monitoring record is to be submitted to the Council's Supervising Engineer. **Monitoring Vibrations**
2. To minimise the risk of peak particle velocity limits being exceeded, the Contractor shall develop a blasting site relationship between peak particle velocity, distance and blasting charge as set out below. **Blasting Site Relationship**

EARTHWORKS

3. For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula:

**Maximum
Instantaneous
Charge**

$$MIC = 0.5 \left[\frac{D}{\left[\frac{p.p.v.}{1140} \right]^{-0.625}} \right]^2$$

where MIC = Maximum Instantaneous Charge in kilograms

D = Distance in metres from charge to the point of potential damage

PPV = limiting peak particle velocity from Table C213.1

4. A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

5. For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Contractor shall make the regression line plots available to the Council's Supervising Engineer, if so requested.

**Adjustment of
Blast Design**

UNSUITABLE MATERIAL

C213.21 GENERAL

1. Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Council's Supervising Engineer deems to be unsuitable for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings, which the Council's Supervising Engineer deems to be unsuitable for embankment construction.

Definition

2. Such material shall be excavated to the extent directed by the Council's Supervising Engineer. Material removed as unsuitable shall, as directed by the Council's Supervising Engineer, be incorporated in embankments in accordance with Clause C213.23 or spoiled in accordance with Clause C213.34.

**Extent of
Excavation**

3. After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Council's Supervising Engineer for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be compacted in accordance with Clause C213.36.

**Floor
Inspection**

4. The unsuitable material, which has been removed, shall be replaced with material from cuttings, or with material borrowed in accordance with Clause C213.35, of the quality specified in Clause C213.23. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with Clause C213.26 and compacted in accordance with Clause C213.36.

**Replacement
Material**

EMBANKMENT CONSTRUCTION

C213.22 SCOPE

1. Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with Clause C213.21, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified and to the alignment, grading and dimensions shown on the Drawings. It also includes any pretreatment such as breaking down or blending material or drying out material containing excess moisture.

Extent of Work

C213.23 EMBANKMENT MATERIAL

1. Material for embankment construction shall be obtained from the cuttings within the Works, supplemented by borrows in accordance with Clause C213.35 if necessary. Material imported to the site must be characterised as VENM or ENM under the guidelines of the NSW Environmental Protection Authority. A Material Classification Report must be submitted to Council for approval prior to placement of material.

Location and Quality

2. The work shall be programmed so that material of the quality specified in Clause C213.26 and C213.30 for the upper zones of the formation is available when required.

Selection of Material

C213.24 FOUNDATIONS FOR EMBANKMENTS

1. Following removal of topsoil in accordance with Clause C213.07, the embankment foundation area shall be made available for inspection by the Council's Supervising Engineer.

Inspection

2. Where the Council's Supervising Engineer considers that any underlying material is unsuitable, he may direct that it be removed and replaced in accordance with Clause C213.21.

Unsuitable Material

a) Foundations for Shallow Embankments

Shallow Embankments

1. Shallow embankments are those embankments of a depth less than 1.0 metre from the top of pavement to natural surface. After removal of topsoil, the area of shallow embankments shall be calculated.

2. Material in the foundations for shallow embankments that does not meet the requirements specified in Annexure C213A shall be deemed unsuitable in accordance with Clause C213.21 and shall be replaced by material of the specified quality.

Unsuitable Material

3. Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as specified in Clause C213.36. Equipment and techniques to minimise surface heaving or other foundation damage shall be used.

Preparation of Foundations

b) Other Embankments

1. For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in Clause C213.36.

Preparation

2. Where a bridging layer has been specified as a foundation treatment in the Contract

Bridging Layer

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documents, it shall be supplied and placed as part of General Earthworks. The bridging layer shall consist of free-draining granular material, which shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of Clause C213.36 shall not apply to the bridging layer

3. A bridging layer may also be employed, subject to the approval of the Council's Supervising Engineer, where ground water or seepage is encountered in the foundation area or where it is demonstrated that it is impracticable to achieve the degree of compaction specified for the foundation in Clause C213.36. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design.

Seepage from Foundations

C213.25 HILLSIDE EMBANKMENTS

1. Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1 metre in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material.

Horizontal Terraces

2. No account shall be taken of the material removed in terracing when determining the General Earthworks excavated volume.

Excavated Volume

C213.26 PLACING FILL FOR EMBANKMENT CONSTRUCTION

1. The fill material for embankment construction shall be obtained from the cuttings within the work in accordance with Clause C213.11, supplemented by borrows when authorised by the Council's Supervising Engineer in accordance with Clause C213.35.

Source of Material

2. The methods of excavation transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed.

Uniformity of Material

3. The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of Clause C213.36.

Embankment Stability

4. Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with Clause C213.36. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25 per cent by volume of the filling consists of rock with any dimension larger than 150mm, the Council's Supervising Engineer may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in Clause C213.36 is attained.

Layer Thickness

5. The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers.

Maximum Size Rock Pieces

6. Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Council's Supervising Engineer considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material.

Grading of Fill Material

7. Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer.

Reworking Stony Patches

- | | | |
|-----|---|---|
| 8. | In placing embankment layers, equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers shall be used. | <i>Equipment Selection for Placement</i> |
| 9. | After compaction, embankment material in the zone(s) below the selected material zone (or sub-base layer, where no selected material zone) shall have a CBR value not less than that quoted in Annexure C213A for the depth(s) specified in Annexure C213A. | <i>CBR Value</i> |
| 10. | For the purpose of this Clause, the CBR value of the material shall be determined by Test Method AS 1289.F1.1. | <i>Test Methods</i> |
| 11. | The Contractor shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements. | <i>Contractor's Responsibility</i> |

C213.27 EMBANKMENT BATTERS

- | | | |
|----|--|--------------------------------------|
| 1. | The batter slopes shown on the Drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Council's Supervising Engineer according to the Council's Supervising Engineer's assessment of the materials encountered. | <i>Batter Slopes</i> |
| 2. | When completed, the average planes of the batters of embankments shall conform to those shown on the Drawings or as determined by the Council's Supervising Engineer. No point on the completed batter shall vary from the specified slope line by more than $\pm 300\text{mm}$ when measured at right angles to the grade line. However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the Drawings. | <i>Slope Tolerances</i> |
| 3. | Undulations in the general plane of the batter shall not be permitted. | <i>Slope Undulations</i> |
| 4. | Where the Council's Supervising Engineer re-determines the slope of any section of an embankment batter which has been completed in accordance with this Clause the Council's Development Engineer shall order a Variation to the contract for the resetting out and removal or addition of fill material and retrimming of the batter. | <i>Slope Re-determination</i> |

C213.28 ROCK FACING OF EMBANKMENTS

- | | | |
|----|---|------------------------------------|
| 1. | Where shown on the Drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock. | <i>Extent</i> |
| 2. | The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced. | <i>Mechanical Interlock</i> |
| 3. | The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter. | <i>Graded Filter</i> |
| 4. | Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage and /or large rock dislodgement down the batter | <i>Caution in Placement</i> |

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C213.29 TRIMMING TOPS OF EMBANKMENTS

1. The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone.

Levels

2. The tops of embankments at these levels shall be compacted to meet the requirements of Clause C213.36 and trimmed so that they do not vary more than 0 mm above or 50 mm below the levels as calculated above.

Tolerances

C213.30 SELECTED MATERIAL ZONE

1. A selected material zone shall be provided as indicated on the Drawings and in accordance with the following quality requirements:

Dimension and Quality

- (a) It shall be free from stone larger than 100mm maximum dimension
- (b) The fraction passing a 19.0mm AS sieve shall have a CBR value of not less than that quoted in Annexure C213A.

2. The selected material shall be obtained from cuttings excavated or from borrow areas as specified in Clause C213.35. If necessary, the Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this Clause.

Winning Material

3. Any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled, until at least sufficient material is reserved to complete the selected material zone over the whole work.

Selection of Material

4. The Contractor shall have no right to monetary compensation or a claim for damages in respect of any loss the Contractor may claim to have suffered by reason of the Contractor's failure to reserve sufficient selected material or by reason of stockpiling material for the selected material zone.

Cost of Handling

5. The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. Compaction shall be as specified in Clause C213.36.

Layer Thickness

6. After placement the selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material, which does not comply with the specified requirements of this Clause.

Homogeneous Layers

7. The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in Annexure C213A.

Tolerances

C213.31 FILL ADJACENT TO STRUCTURES

1. Supply and placement of fill adjacent to structures shall be deemed to be part of General Earthworks.

Payment

2. For the purpose of this Clause, structures shall include bridges, precast and cast-in-place box culverts and retaining walls. Fill adjacent to other culverts and drainage structures shall be provided in accordance with the particular Specifications for STORMWATER DRAINAGE as appropriate.

Structure Types

3. No filling shall be placed against structures within 21 days after placing concrete in

these structures, unless approved in writing by the Council's Supervising Engineer.

C213.32 TREATMENT AT WEEPHOLES

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:
 - (a) The maximum particle dimension shall not exceed 50mm
 - (b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.

Grading
2. The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.

Extent
3. Alternatively the use of a synthetic membrane of equivalent drainage characteristics may be used. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Council's Supervising Engineer's approval.

Synthetic Membrane

C213.33 SELECTED BACKFILL

1. Selected backfill shall be placed adjacent to structures in accordance with Table C213.2. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by AS 1289.3.3.1, neither less than 2 nor more than 12. Material conforming to Class S Select Fill Material in accordance with the Resource NSW Specification may also be used.

Quality

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Structure Type	Selected Backfill	
	Width	Height
Bridge abutments	2m	H
Cast-in-place Box Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining walls	H/3	H
(Where H = height of structure)		

Table C213.2 - Selected Backfill, Width and Height

2. The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of Clause C213.36. **Placement in Layers**
3. The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1 metre in width, and the selected backfill shall be placed in accordance with Clause C213.26. **Horizontal Terraces**
4. No filling shall be placed against structures within twenty-one days after placing concrete in these structures, unless approved by the Council's Supervising Engineer. **Time of Placement**
5. Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within twenty-one days after placing concrete in the bridge deck, unless approved by the Council's Supervising Engineer. **Adjacent to Concrete Deck**
6. In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by hand placing around or against such structures. **Spill through Abutments**
7. In the case of framed structures, embankments at both ends of the structure shall be brought up simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm. **Framed Structures**

C213.34 SPOIL

1. Spoil is surplus material from excavations under the Contract, which is not required to complete the Works as specified or material from excavations under the Contract whose quality the Council's Supervising Engineer deems to be unacceptable for incorporation in the Works. **Definition**
2. Where there is surplus material the Council's Supervising Engineer may direct that flatter batter slopes be provided on embankments which have not been commenced, and/or direct that the excess material be used in the uniform widening of embankments, the surface of which shall be shaped so as to provide a tidy appearance and effective drainage. The surplus material shall be spread and compacted as specified in Clauses C213.26 and C213.36 for material in embankments. **Use in Embankments**
3. Alternatively, spoil shall be disposed of in the manner and at locations approved by the Council's Supervising Engineer within the specified working area for the Works or be removed and disposed of off site by the Contractor. Surplus material so deposited shall be compacted as specified in Clause C213.36 for material in embankments or to such lesser **Disposal of Spoil**

extent as may be approved by the Council's Supervising Engineer.

C213.35 BORROW

1. Unless provided by the Contract, borrow will only be authorised by the Council's Supervising Engineer if, in constructing cuttings and embankments to the batter slopes specified or directed by the Council's Supervising Engineer or in providing materials of the quality specified, and not by reason of excess widening of embankments or wastage by the Contractor of material of the quality specified in Clauses C213.23, C213.28, C213.29 or C213.31, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.

Borrow to be Authorized

2. Where borrow material is required to complete the Works, the location of borrow sites shall be as approved by the Council's Supervising Engineer, and the quality of material shall be acceptable to the Council's Supervising Engineer in accordance with Clauses C213.23, C213.28 or C213.31 as appropriate. The edges of borrow sites shall be no closer than 3 metres from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Council's Supervising Engineer, cut batter slopes not steeper than 4 to 1, and shall be left by the Contractor in a tidy and safe condition.

Borrow Site Characteristics

3. For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with Specification C212 - CLEARING AND GRUBBING and Clause C213.07. Restoration of borrow sites shall be carried out in accordance with Specification C273 - LANDSCAPING.

Site Preparation and Restoration

4. If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses C213.11, C213.12 and C213.14 as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

Widening of Cutting

5. If borrow has to be obtained from locations outside the specified working area for the Works, such work shall be treated as imported fill. The Contractor shall be responsible for obtaining any permits required for removal of the imported material from its origin. The Contractor shall also comply with any requirements of the Environmental Planning and Assessment Act, the Local Council, land owners, the Rural Lands Protection Board and the NSW Soil Conservation Service, as appropriate.

Imported Fill

COMPACTION AND QUALITY CONTROL

C213.36 COMPACTION AND MOISTURE REQUIREMENTS

1. In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

Trimming and Compaction

2. The following areas shall be compacted to provide a relative compaction, determined by AS 1289.5.7.1 for standard compactive effort, of not less than 100 per cent.

100% Compaction Requirements

- Each layer of material replacing unsuitable material as detailed in Clause C213.21.
- Each layer of material placed in embankments, up to 0.5 metres from the top of the pavement.
- The whole area on the floors of cuttings.
- Fill placed adjacent to structures up to 1.0 metre from the top of pavement.
- Material in unsealed verges and within medians up to the level at which topsoil is placed.

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- Spoil (excluding unsuitable material)
 - All other areas except those where other compaction requirements are specified.
3. Unsuitable material shall be stockpiled and compacted by track rolling. ***Unsuitable Material***
4. The following areas shall be compacted to provide a relative compaction of not less than 98 per cent as determined by AS 1289.5.7.1 for modified compactive effort: ***98% Modified Compaction Requirements***
- Foundations for shallow embankments.
 - Foundations other than shallow embankments.
 - Each layer of the embankment within 0.5 metres from the top of pavement.
 - Each layer of the selected material zone as specified in Clause C213.30.
 - Any areas of material of specified quality, which may be shown on the Drawings, specified elsewhere behind kerbs and/or gutters, or adjacent to rigid pavements.
 - The fill material placed adjacent to structures as specified in Clauses C213.31 and C213.33 in each layer within 1.0 metre from the top of the pavement.
5. At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Council's Supervising Engineer, is within the range set out in Annexure C213A of the optimum moisture content as determined by AS 1289.5.1.1 or AS 1289.5.7.1. Material that becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Council's Supervising Engineer, by the use of hydrated or quick lime. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained. ***Moisture Content***
6. Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage. ***Prompt Compaction***
7. Any material that has been placed that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS 1289.5.7.1, shall be dried out and uniformly re-compacted to the required relative compaction in accordance with this Clause before the next layer of material is placed. ***Moisture Content above Optimum***
- C213.37 TEST LOCATIONS**
1. The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the area shall be worked to ensure uniform moisture content and compaction of all material within the lot. ***Contractor to Prepare Area***
2. The tests then taken shall be considered to represent the total volume of material placed within the lot. ***Test Representation***
3. Where the Council's Supervising Engineer considers that the material that is present has not achieved uniformity required by this Clause or Clause C213.26, he may direct further testing. The Council's Supervising Engineer shall nominate the area represented by the additional testing. ***Further Testing***

4.

C213.38 DEFLECTION MONITORING OR PROOF ROLLING

1. Following completion of the formation to the underside of the selected material zone in accordance with Clause C213.24 and C213.26, and completion of the selected material zone in accordance with Clause C213.30, the work shall be made available in lots, for the Council's Supervising Engineer to carry out deflection monitoring or proof rolling. This action constitutes a **HOLD POINT**. The Council Supervising Engineer's approval to the completed formation following deflection monitoring or proof rolling is required prior to release of the hold point.

**Timing of
Deflection
Monitoring**

HP

2. A lot for deflection testing shall consist of a continuous length of formation, and a single carriageway width, which is generally homogeneous with respect to material and appearance. The boundaries of each lot shall be clearly identified with stakes clearly labelled to the satisfaction of the Council's Supervising Engineer.

Lot Size

C213.39 WIDENING OF FORMATION

1. Road shoulders and formation shall be widened to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the Drawings.

**Provision for
Services**

LIMITS AND TOLERANCES**C213.40 SUMMARY OF TOLERANCES**

1. The tolerances applicable to the various clauses in this Specification are summarized in the Table below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	Batter Slopes a) Excavation	± 300mm	C213.12
	b) Embankment	± 300mm	C213.27
2.	Floors a) Floor of Cutting	Parallel to the designed grade line and ± 50mm of the designed floor level	C213.14
3.	Tops of Embankments Trimming tops of Embankments	Parallel to the designed grade line, +0mm or -50mm of the levels specified	C213.29
4.	Selected Material	Annexure C213A	C213.30

NOTE: Plus (+) is towards the roadway/surface and minus (-) is away from the roadway/surface. Tolerances are measured at right angles to design surfaces.

Table C213.3 - Limits and Tolerances**SPECIAL REQUIREMENTS**

C213.41 RESERVED

C213.42 RESERVED

C213.43 RESERVED

C213.44 RESERVED

C213.45 RESERVED

ANNEXURE C213.A

EARTHWORKS - SUPPLEMENTARY INFORMATION

CLAUSE	DESCRIPTION	VALUE
C213.24	Requirements of material in foundations for shallow embankments: Moisture Content - within the range of +/- 2% of optimum.	
C213.26 and C213.30	Upper Zones of Formation Selected Material Zone Material within each zone shall have a CBR value of not less than the following, under the nominated test conditions:	

Location	Minimum CBR Value	Depth	Nominated Soaking Period (Days)
a. Selected Material Zone			
b. Material below Selected Material Zone to 1.0 metre from top of pavement			

C213.30 Construction tolerances for Selected Material Zone are + 0 mm or - 50 mm of the designed grade and crossfall.

C213.36 Moisture Content of material placed in embankments:

- (a) Material in upper zones of formation: - within the range of +/- 2% of optimum.
- (b) All other embankment material: - within the range of +/- 2% of optimum.

CONSTRUCTION SPECIFICATION

C220

STORMWATER DRAINAGE GENERAL

SPECIFICATION C220 : STORMWATER DRAINAGE - GENERAL**CONTENTS**

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SPECIFICATION C220 : STORMWATER DRAINAGE - GENERAL

GENERAL

C220.01 INTRODUCTION

1. Drainage works shall form a complete system carrying water through and away from the Works. **Purpose**

2. This is the general Specification common and applicable to all types of drainage lines, open drains, kerb and gutter, and drainage structures and shall be read in conjunction with the following drainage Specifications:

C221	-	Pipe Drainage
C222	-	Precast Box Culverts
C223	-	Drainage Structures
C224	-	Open Drains, including Kerb and Gutter

as applicable.

C220.02 SCOPE

1. The work consists of: **Scope**
- (a) Preparation for stormwater drainage construction,
 - (b) Temporary drainage during construction,
 - (c) Siting of pipes, pipe arches and box culverts.
 - (d) All activities and quality requirements associated with excavation, bedding and backfilling,
 - (e) All concrete work associated with stormwater drainage.

C220.03 EXTENT OF WORK

Complete as necessary to adequately describe the extent of the works, in addition to information shown on the drawings.

C220.04 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

(a) Other Council Specifications

C211	-	Control of Erosion and Sedimentation
C213	-	Earthworks
C271	-	Minor Concrete Works
C221		Pipe Drainage
C222		Precast Box Culverts
C223		Drainage Structures

(b) Australian Standards

AS 1289.5.7.1	-	Compaction Control Test (Rapid Method)
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(c) RTA Test Methods

T 166 - Determination of Relative Compaction

(d) NSW Government Legislation

Occupational Health and Safety Act, 2000

C220.05 TEMPORARY DRAINAGE DURING CONSTRUCTION

1. All drainage works carried out by the Contractor shall comply with Specification C211 CONTROL OF EROSION AND SEDIMENTATION. **Control**
2. Adequate provision for runoff flows at drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures shall be made. **Contractor's Responsibility**
3. No proposal to dam up or divert existing watercourses (either temporarily or permanently) is permitted without the prior approval of Council by way of approved Drawings or written instruction. **Limitations**
4. Material and equipment shall be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows. **Location of Equipment**

C220.06 SITING OF CULVERTS

1. Before commencing construction of any culvert, the culvert inlet and outlet positions shall be set out to the location and levels shown on the Drawings. **Set-out**
2. Council's Supervising Engineer may amend the inlet or outlet locations, designed levels or the culvert length to suit actual site conditions. Any activity resulting from such amendments by Council's Supervising Engineer shall be included as part of the works. **Amendments to planned work**
3. Should the Contractor propose changes to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit his construction procedures amended designs and site setout are to be submitted for consideration by Council's Supervising Engineer. No changes shall be made unless the prior written approval of Council's Supervising Engineer is obtained. **Proposed Changes by Contractor**

C220.07 EXCAVATION

1. Before undertaking stormwater drainage excavation, topsoil shall be removed in accordance with Specification C213 EARTHWORKS. **Topsoil**
2. Excavation shall be undertaken in compliance with the Occupational Health and Safety Act 2000. The Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with these Acts. **Safety**
3. Where public utilities exist or are likely to exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority to the method of excavation before commencing excavation and in addition shall make contact with Dial Before You Dig (phone 1100). **Approval by Public Utility Authorities – Dial Before You Dig**

DRAINAGE - GENERAL

4. Excavation by blasting, if permitted by Council, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed culvert of drainage structure does not exceed 25 millimetres per second. The Contractor shall comply with other requirements concerning blasting operations in Specification C213 EARTHWORKS. **Blasting Operation**

5. Trench or foundation excavations for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed. **Excavation Level**

6. Any material at the bottom of the trench or at foundation level which Council's Supervising Engineer deems to be unsuitable shall be removed and disposed in accordance with Specification C213 EARTHWORKS and replaced with backfill material in accordance with the requirements of this Specification and the Specifications for particular culvert types. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level and slope of the culvert. **Unsuitable Material**

7. The excavated material may be used in the construction of embankments backfilling or spoiled in accordance with Specification C213 EARTHWORKS. **Spoil**

C220.08 BACKFILLING

1. Backfilling shall be carried out in accordance with the requirements of the relevant culverts or drainage structures Specifications and to the compaction requirements specified below.

C220.09 COMPACTION

1. Foundations, bedding and backfilling shall be compacted to the following requirements when tested in accordance with Test Method T166. **Standard**

	Relative Compaction
Foundations or trench base to a depth of 150mm below foundation levels	95%
Material replacing unsuitable material	95%
Bedding material	95%
Selected backfill and ordinary backfill material	
• Below 1.5m of finished surface	95%
• Within 1.5m of finished surface	100%
Backfill material within the selected Material zone	100%

2. All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced. **Layers**

3. At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by Council's Supervising Engineer, is neither less than 60 per cent nor more than 90 per cent of the apparent optimum moisture content, as determined by AS 1289.5.7.1. **Moisture Content**

4. When compacting adjacent to culverts or drainage structures, compaction methods are to be adopted that will not cause damage to any culvert or drainage structure. Any damage caused shall be rectified at the Contractor's expense. **Precautions**

C220.10 CONCRETE WORK

1. All concrete work is to comply with Specification C217 - MINOR CONCRETE WORKS in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

Specification

C220.11 SPRAYED CONCRETE

1. If sprayed concrete has been specified, shown on the Drawings or directed by Council's Supervising Engineer, it shall comply with requirements in Specification C217 - MINOR CONCRETE WORKS.

Standard

LIMITS AND TOLERANCES

C220.12 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this specification are summarised in Table C220.1 below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	Excavation by blasting		
	Peak particle velocity	≤ 25 mm/sec	C220.07
2.	Relative Compaction (Standard)		
	(a) Foundations or trench base to a depth of 150mm below foundation levels	95%	C220.09
	(b) Select material replacing unsuitable material	95%	C220.09
	(c) Bedding Material	95%	C220.09
	(d) Selected backfill and ordinary backfill material.		C220.09
	• below 1.5m of finished surface	95%	
	• within 1.5m of finished surface	100%	
	(e) Backfill material within the selected material zone	100%	C220.09
3.	Backfill		
	(a) Layers	≤ 150 mm	C220.09
	(b) Moisture Content	$> 60\%$, $< 95\%$	C220.09

Table C220.1 - Summary of Limits and Tolerances

CONSTRUCTION SPECIFICATION

C221

PIPE DRAINAGE

SPECIFICATION C221 : PIPE DRAINAGE

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PIPE DRAINAGE

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SPECIFICATION C221 : PIPE DRAINAGE

GENERAL

C221.01 SCOPE

1. This Specification covers the supply and installation of pipes and pipe arches for stormwater drainage.
2. This Specification should be read in conjunction with specification C220 - STORMWATER DRAINAGE - GENERAL. **Associated Specifications**
3. The work to be executed under this Specification consists of supply of pipes and pipe arches, bedding, installation and backfilling. **Extent of Work**

C221.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

(a) Council Specifications

- C213 - Earthworks
- C220 - Stormwater Drainage – General
- C223 - Drainage Structures
- C230 - Subsurface Drainage - General
- C271 - Minor Concrete Works

(b) Australian Standards

- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1254 - Unplasticized PVC (UPVC) pipes and fittings for storm or surface water applications.
- AS 1289.3.3.1 - Calculation of the plasticity index of a soil.

- AS 1289.4.3.1 - Determination of the pH value of a soil - Standard method.
- AS 1289.4.4.1 - Determination of the electrical resistivity of sands and granular materials.
- AS 1289.4.6.1 - Compaction control test - Density index method for a cohesionless material.
- AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio
- AS 1397 - Steel sheet and strip - Hot-dipped zinc coated or aluminium/zinc coated.
- AS 1462 - Methods of Test for Plastic Pipes & Fittings
- AS 1646 - Elastomeric seals for waterworks purposes.
- AS 1650 - Hot-dipped galvanised coatings on ferrous articles.
- AS 1761 - Helical lock-seam corrugated steel pipes.
- AS 1762 - Helical lock-seam corrugated steel pipes - Design and installation.
- AS 2032 - Code of practice for installation of UPVC pipe systems.
- AS 2041 - Corrugated steel pipes, pipe arches and arches.
- AS 2042 - Corrugated steel pipes, pipe arches and arches - Design and installation.
- AS 2105 - Inorganic zinc silicate paint.
- AS 3725 - Loads on buried concrete pipes.
- AS 3887 - Paints for steel structures – Coal tar epoxy.
- AS 4058 - Precast concrete pipes
- AS 4139 - Fibre reinforced concrete pipes and fittings.
- AS/NZS 2566.1 - Buried flexible pipelines, structural design.
- AS/NZS 3750.9 - Organic zinc-rich primer.
- AS/NZS 3750.15 - Inorganic zinc silicate paint.
- AS/NZS ISO 9001: 2000 Quality systems – Requirements.

(c) RTA Test Methods

- T102 - Pretreatment of Samples of Road Materials by Compaction.
- T166 - Determination of Relative Compaction.

(d) NSW Government Legislation

Occupational Health and Safety Act, 2000.

(e) Other

- DECC - Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage June 2003 (originally issued by Resource NSW).

GENERAL REQUIREMENTS

C221.03 GENERAL

1. Pipes and/or pipe arches shall not be placed in position until the Contractor has produced documentary evidence if requested by Council’s Supervising Engineer that the manufacture of the products to be used in the works has complied with the manufacturer’s Quality Plan in accordance with ISO 9001:2000. **Compliance with Quality Plan**
2. Documentation shall comprise a conformance certificate to AS 1462, AS 4058 or AS 4139 as appropriate for each batch of pipes or pipe arches to be included in the works **Certification**
3. At the time of manufacture, each unit shall be marked with: **Marking**
 - (a) Class and size
 - (b) Manufacturer’s name

PIPE DRAINAGE

(c) Date of casting/manufacture

4. All necessary steps shall be taken to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction. **Excavation Drainage**

5. Culverts shall be installed within 10mm of the grade line and within 10mm of the horizontal alignment specified on the Drawings. Any culvert that is not within these tolerances shall be re-laid. **Tolerances**

6. At the discharge end of culverts terminating at pits and headwalls a 3m length of 100mm diameter subsurface drain shall be laid in the trench a maximum of 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at a grade that permits free draining into the pit or headwall. The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with Specification C230 - SUBSURFACE DRAINAGE. **Subsurface Drain**

Backfilling for culverts shall be undertaken in accordance with the requirements of the Occupational Health and Safety Act 2000. **Safety**

8. Where it is proposed to travel construction plant in excess of 5 tonnes gross mass over culverts, the Contractor shall design and provide adequate protective measures for the crossings and shall submit the proposals to Council's Supervising Engineer for prior approval. **Construction Plant Movement**

REINFORCED CONCRETE AND FIBRE REINFORCED CONCRETE PIPES

C221.04 PIPES

1. Reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the Drawings. **Reinforced Concrete Pipes**

2. Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the Drawings. **Fibre Reinforced Pipes**

3. Unless specified otherwise, joints shall be of the flexible type and the pipes shall have special sockets incorporating rubber ring joints complying with AS 1646 and as recommended by the manufacture. **Joints**

C221.05 EXCAVATION AND INSTALLATION

1. Unless otherwise indicated on the Drawings or approved by Council's Supervising Engineer, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition. **Formation to Subgrade Level**

2. Installation shall be in accordance with this Specification, AS 3725 and AS 3725 Supplement 1 for Type HS3 support.

3. For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified below. The trench shall not be excavated wider than 1.4 times the external diameter of the pipe plus 300mm. **Normal Trench Conditions**

4. Pipes laid in wide trench conditions will be deemed to be in embankment conditions. Wide trench conditions apply when, for a single pipe, the width of trench, $W \geq D + 1$ metre where D is the pipe diameter. For multi-cell pipes wide trench conditions apply when the width of trench, $W \geq \Sigma D + \Sigma S + 1$ metre where S is the square spacing between the pipelines. **Wide Trench Conditions**

5. Pipes shown on the drawings to be laid in trench conditions shall not be placed under embankment conditions without a design check for compliance of the pipe strength in accordance with AS 3725.

Design Check

6. All trenching shall be benched or supported in accordance with the requirements of Workcover and the relevant Australian Standards

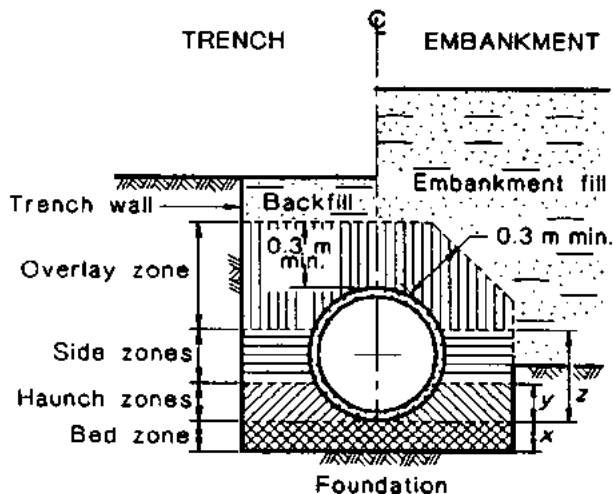
C221.06 BEDDING

1. Unless otherwise shown on the Drawings, the bedding requirements shall be as set out in this clause.

Requirements

2. Figure C221.1 indicates the proportionate dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions.

***Bedding
Dimensions***



where, $Z \geq 0.7D$
 $Y = 0.3D$
 $X = 100$ for $D \leq 1500$
 $X = 150$ for $D > 1500$
 $D =$ External Diameter of Pipe

Figure C221.1
Pipe Installation Conditions

3. Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table C221.2, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6.

Material Requirements

Recycled material complying with DECC specification as Class D10 may also be used as bedding material, with the exception of pipelines covered by AS 3725.

Sieve size mm	Weight passing %	Weight passing %
	Bed and Haunch Zones	Side Zones
75		100
19	100	
9.5		50 – 100
2.36	50 – 100	30 - 100
0.60	20 – 90	15 - 50
0.30	10 – 60	
0.15	0 – 25	
0.075	0 – 10	0 – 25

Table C221.2
Bedding Material Grading Limits

4. The Contractor shall advise Council’s Supervising Engineer of the source of bedding material and test results prior to importing the material.

Source

- | | |
|--|--|
| <p>5. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.</p> | <p>Layers</p> |
| <p>6. At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by Council's Supervising Engineer, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).</p> | <p>Moisture Content</p> |
| <p>7. Bedding material in the bed and haunch zones shall be placed and compacted in layers to a minimum density index of 70 per cent as determined by AS 1289.E6.1. All material shall be compacted in layers not exceeding 150 mm compacted thickness. The top of the bedding material shall be shaped accurately to house the pipe.</p> | <p>Compaction Requirements</p> |
| <p>8. Where the impermeability of the natural ground and the slope of the drainage line are such that erosion of bedding material is considered by Council's Supervising Engineer to be a likely problem, Council's Supervising Engineer may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones.</p> | <p>Cementitious Stabilisation</p> |

C221.07 INSTALLATION

(a) General

- | | |
|--|--------------------------------------|
| <p>1. Pipes shall be laid with the socket end placed upstream. Pipes, which have marks indicating the crown or invert of the pipes, shall be laid strictly in accordance with the markings. Unless specified, no individual length of pipe shall be shorter than 1.2m.</p> | <p>Positioning of Pipes</p> |
| <p>2. In the case of pipes 1,200mm or more in diameter, laid in situations where embankments are to be more than 3m high, measured above the invert of the pipe, pipes shall be stiffened temporarily by the Contractor by interior timber struts, erected before filling is placed. Struts shall be of hardwood measuring at least 100mm by 100mm or 125mm diameter. One strut shall be placed in a vertical position at each pipe joint, thence at a spacing not greater than 1,200mm. Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe. Both the sill and the cap shall be continuous throughout the length of the pipe and they shall be of sawn hardwood, of cross section not less than 100mm by 100mm. Struts shall be made to bear tightly by the use of wedges between the top of the struts and the cap. Struts, sills and caps shall be removed on completion of the embankment, unless removal is ordered earlier.</p> | <p>Stiffening of Culverts</p> |
| <p>3. Lifting holes in all pipes shall be sealed with 3:1 sand: cement mortar before the commencement of backfilling or preferably with a precisely fitting bung supplied by the manufacturer.</p> | <p>Seal Lifting Holes</p> |

(b) Joints in Reinforced Concrete Pipes

(i) Rubber Ringed Joints

- | | |
|--|--------------------------------------|
| <p>1. Before making the joint, the spigot and socket and the rubber ring shall be clean and dry except for any lubricants recommended by the manufacturer.</p> | <p>Clean and Dry Material</p> |
| <p>2. The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted. The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it. The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by Council's Supervising Engineer.</p> | <p>Procedure</p> |
| <p>3. The joint shall be tested to ensure that the rubber ring has rolled evenly into place.</p> | <p>Joint Test</p> |

(ii) Flush or Butt Joints

PIPE DRAINAGE

1. Flush or butt joints shall be used only where required to extend existing culverts. If pipes with flush or butt joints are required, the ends of the pipes shall be butted together. The joints shall be sealed with proprietary rubber sleeves, supplied and installed in accordance with the manufacturer's recommendations.

Joining

(c) Joints in Fibre-Reinforced Cement Pipes

(i) New Pipes

1. Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in Clause C221.07(b). Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions.

Procedure

(ii) Direct Side Connections to Other Pipes

1. Direct side connections to other pipes shall be as detailed on the Drawings.

(d) Concrete Bulkheads

Concrete Bulkheads

1. Concrete bulkheads shall be constructed at intervals of 7.5 metres on stormwater lines with a grade steeper than 20%. For reinforced concrete pipes of 2.44 metres length, concrete bulkheads shall be located at every third joint.

2. The axis of the bulkhead shall be vertical with a minimum top width of 150 mm.

3. The top of the bulkhead shall extend to within 300 mm of the finished surface level or to the subgrade level where the pipeline is within a road pavement. On each side of the pipe at the level of the trench invert, 100 mm diameter pipes shall pass through the bulkhead to allow free draining of the trench. Such pipes shall be filled fibreglass wool or other approved filter material or a capped 1.5 metre length of sub-soil drainage line.

4. Bulkheads shall extend into trench walls and base by a minimum of 300mm.

C221.08 BACKFILL

1. Backfill to the side and overlay zones shall consist of Selected Backfill as defined in Table C221.2, or other material as approved by Council's Supervising Engineer which may include material complying with DECC specification as Class D10. It shall be placed around the pipe to the dimensions shown in Figure C221.1 and compacted in accordance with the requirements in Specification C220 STORMWATER DRAINAGE - GENERAL. The remainder of the trench to the underside of the selected material zone as specified in Specification C213 EARTHWORKS shall be backfilled with material satisfying the requirements for embankment material as defined in Specification 213 EARTHWORKS. Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in Specification 213 EARTHWORKS.

Procedure

2. Backfilling shall be carried out simultaneously on both sides of the culvert and both sides of the wingwalls. Backfilling and compaction shall commence at the pipe or wall and work away from the pipe or wall.

Sequence

3. All backfilling operations shall conform to the requirements in Specification C220 - STORMWATER DRAINAGE - GENERAL.

Associated Specification

STEEL PIPES AND PIPE ARCHES

C221.09 NESTABLE STEEL PIPE AND DRAINAGE UNITS

- | | |
|--|--------------------------------|
| 1. Nestable steel pipes and drainage units shall be supplied in accordance with AS 2041 and AS 2042 and shall be of the class and size as shown on the drawings. | Specification |
| 2. The galvanised steel sheets used in manufacture shall comply with AS 1397 for steel base grade G250 and a minimum coating Class of Z600. | Galvanised Steel Sheets |
| 3. Where specified, the pipes and drainage units shall be given a protective coating over the steel, after assembly of a coal tar epoxy paint or equivalent as approved by Council's Supervising Engineer, to a thickness of 400 microns. | Protective Treatment |
| 4. Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of zinc-rich organic primer complying with AS/NZ 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZ 3750.15 | Field Cuts |

C221.10 HELICAL LOCK-SEAM CORRUGATED STEEL

- | | |
|--|----------------------|
| 1. Helical lock-seam corrugated steel pipe shall be supplied in accordance with AS 1761 and AS 1762 and shall be of the class and size as shown on the drawings. | Specification |
| 2. The galvanised steel sheet used in manufacture shall comply with AS 1397 for steel based grade G250 and a minimum coating Class of Z600. | |
| 3. Unless otherwise approved by Council's Supervising Engineer, no part of the pipe shall incorporate steel strips which have been joined by welding. Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of inorganic zinc silicate paint complying with AS/NZ 3750.15. Pipes and coupling bands shall be given a protective hot-dip coating of bitumen on both sides to AASHTO standard M190 or equivalent as part of the process of manufacturing. | |

C221.11 BOLTED STEEL PIPES, PIPE ARCHES AND SPECIAL SHAPES

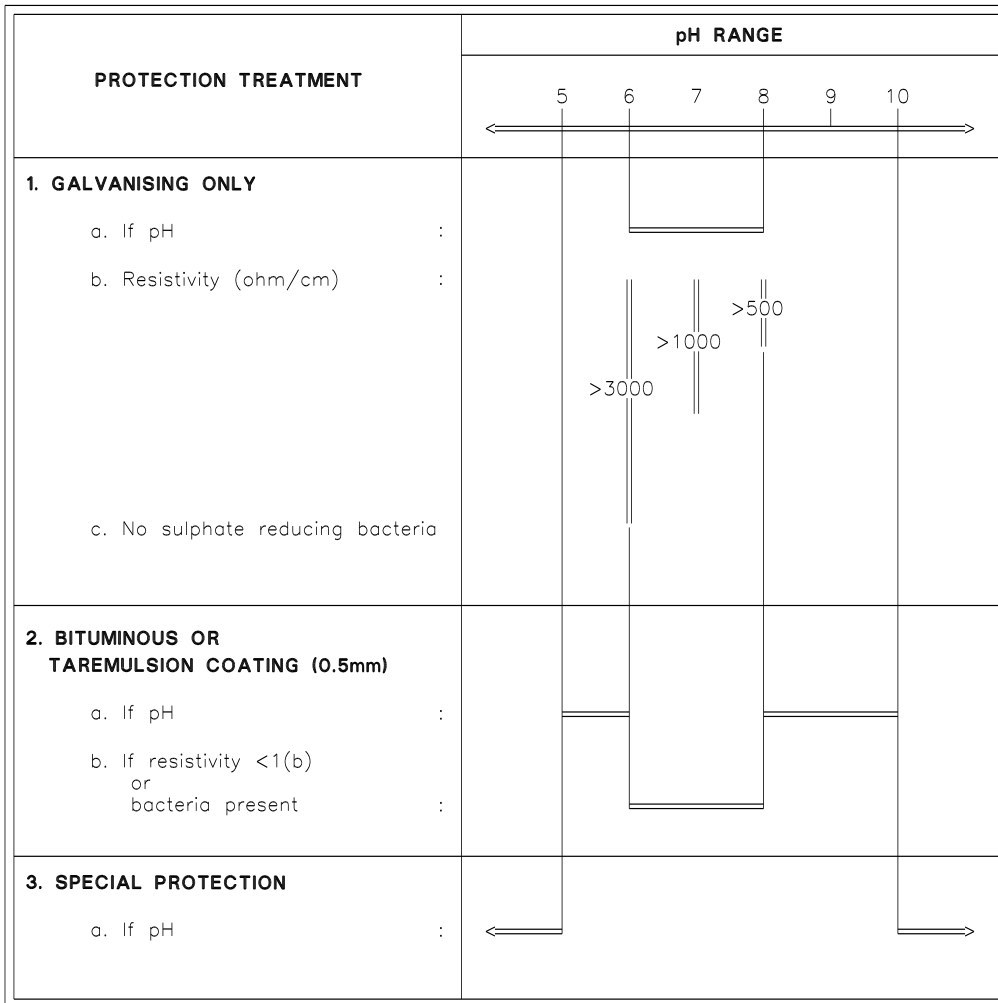
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|---|-----------------------------|
| 1. Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and AS 2042 and shall be of the class and size as shown on the drawings. | Specification |
| 2. Also, after assembly, all bolted steel pipes, pipe arches and special shapes shall be given a protective coating on the outside of the steel plate, of a coal tar epoxy paint complying with AS 3887 or equivalent paint approved by Council's Supervising Engineer. Invert plates shall be coated on the outside before they are placed on the pipe bed. The plate surface shall be cleaned and degreased with a cleaning solution recommended by the protective coating manufacturer. The protective coating shall be applied to give a uniform minimum dry thickness of 400 microns. Any coating damaged shall be recoated by first cleaning any grease, mud or other foreign matter from the affected area. The area shall then be recoated so that the minimum dry thickness of the coating is 400 microns. | Protective Treatment |

C221.12 MATERIALS AND SURFACE TREATMENT OF STEEL PIPES AND PIPE ARCHES

1. All steel pipes and pipe arches will require an Engineer's certification that the pipe materials and surface treatments are adequate to provide for installation and in-service loading as well as corrosion protection for a satisfactory design life of 100 years unless indicated otherwise on the drawings. Such certification shall address the chemistry of the soil, groundwater, stream and backfill material as specified in Clause C221.13.

C221.13 MATERIAL AGAINST STEEL STRUCTURES

1. The severity of corrosive attack on steel structures will depend on the pH value and electrical resistivity of the soil surrounding the structure and the pH value of the water in the stream.
2. Besides meeting the normal requirements of the bedding and Selected backfill materials, as specified for Reinforced Concrete and Fibre Reinforced Concrete Pipes, and the materials used for embankment construction above the steel structures and within a horizontal distance from the structure equal to the height of the filling over the structure, the pH and resistivity limits as shown in Figure C221.2 will determine the level of corrosion protection required.
3. Notwithstanding the height of fill, embankment material within 6m of the structure shall conform to these requirements.
4. The pH and electrical resistivity of the material shall be determined in accordance with AS 1289.D3.1 and AS 1289.D4.1.
5. The Contractor shall nominate the sources of the various materials and submit documentary evidence from a NATA registered laboratory that the representative samples conform to the requirements of this clause and the protective treatment provided. The samples shall be pretreated in accordance with Test Method T102.



**Figure C221.2
CORROSION PROTECTION REQUIREMENTS FOR STEEL STRUCTURES**

C221.14 EXCAVATION AND FOUNDATION PREPARATION

- | | |
|---|-----------------------------------|
| <p>1. Unless otherwise indicated on the drawings or approved by Council's Supervising Engineer, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.</p> | <p>Specification</p> |
| <p>2. The trench shall be excavated to a level 75mm below the design invert and for a minimum width of 600 mm on each side of the structure.</p> | <p>Trench Width</p> |
| <p>3. Where unsuitable material as determined by Council's Supervising Engineer is encountered at the foundation level, it shall be removed to a depth approved by Council's Supervising Engineer. The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 support as specified in Clause C221.06.</p> | <p>Unsuitable Material</p> |
| <p>4. Where rock is encountered at the foundation level, the foundation shall be excavated for an additional depth of 250 mm, or 0.25 times the structure width, whichever is the lesser and for a width equal to the width of the structure. The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in Clause C221.06.</p> | <p>Rock Foundation</p> |

C221.15 BEDDING

- | | |
|--|---------------------|
| <p>1. Bedding shall meet the requirements of Clause C221.06. The thickness of uncompacted bedding material between the foundation and the outer surface of corrugation shall not be less than 75 mm. The uniform blanket of loose material which provides the minimum 75 mm thick bedding shall be placed on the shaped, compacted selected material foundation to allow the corrugations of the structure invert to bed in and become filled with the material.</p> | <p>Depth</p> |
|--|---------------------|

C221.16 INSTALLATION

(a) General

- | | |
|---|--|
| <p>1. The assembly of all corrugated steel pipes and pipe arches as well as helical lock-seam corrugated steel pipes shall be carried out in accordance with the manufacturer's recommendations. These recommendations shall be submitted to Council's Supervising Engineer before assembly or laying of the culverts is commenced.</p> | <p>Manufacturer's Recommendations</p> |
| <p>2. If deemed necessary after consultation with the manufacturer, temporary bracing of corrugated steel pipes or pipe arches shall be carried out in accordance with the manufacturer's recommendations.</p> | <p>Temporary Bracing</p> |

(b) Joints

- | | |
|---|--|
| <p>1. Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2042.</p> | <p>Method</p> |
| <p>2. Where helical-lock seam corrugated steel pipes are to be joined, both ends of the join shall be rerolled with four annular corrugations of pitch 68mm. Coupling of the re-rolled ends shall be made in accordance with AS 1761 by using semi-corrugated bands. Where specified, rubber ring joint seals shall be used in conjunction with the coupling bands.</p> | <p>Ends to be Rerolled</p> |
| <p>3. All joints or lap joints in pipes or pipe arches (excluding rubber ring joint coupling bands) shall be covered with strips of filter fabric material to prevent loss of sand backfill or bedding into the pipe.</p> | <p>Filter Fabric Cover Material</p> |

C221.17 BACKFILL

PIPE DRAINAGE

1. Compaction of the material in the side support and overlay zones shall comply with the requirements of clause 221.06 except that the required relative compaction in the side support and overlay zones shall be 95 per cent (AS 1289.5.4.1 standard compaction). Backfill shall be placed around the steel pipe or structure, to a minimum dimension equal to the pipe width on both sides. Selected backfill material as defined in Specification C213 EARTHWORKS shall be placed around the steel pipe or structure to a minimum width of 500mm and in accordance with the provisions of Clause C221.08 except that the maximum size of any particle shall not exceed 25mm.

Selected Material
 2. All material shall be compacted in layers not exceeding 150 mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Layers
 3. At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by Council's Supervising Engineer, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Moisture Content
 4. The remainder of the trench to the underside of the subgrade, or selected material zone as specified in Specification C213 EARTHWORKS, shall be backfilled with material satisfying the requirements for embankment material as defined in Specification C213 EARTHWORKS. Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in Specification C213 EARTHWORKS.

Trench Backfill
 5. Shape checking of the culvert during backfilling operations is required to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure shall not vary from the manufacturer's specified dimensions by more than plus or minus 2 per cent for pipes and pipe arches.

Distortion of Structure Shape
- C221.18 INVERT PROTECTION OF CORRUGATED STEEL PIPES AND PIPE ARCHES**
1. Where shown on the Drawings, the invert of corrugated steel pipes and pipe arches shall be protected using sprayed concrete.

Sprayed Concrete
 2. The sprayed concrete shall be placed to a thickness of not less than 100mm over the crest of the corrugations and to a width such that the bottom third of the pipe circumference is covered symmetrically about the invert of the pipe.

Depth and Width
 3. All foreign material shall be removed from the surface to be protected. Where corrosion has occurred all loose scale shall be removed.

Scale Removal
 4. The production, application and curing of sprayed concrete shall be in accordance with the Specification for MINOR CONCRETE WORKS.

Associated Specification
 5. The sprayed concrete shall be reinforced with fabric of hard drawn steel wire 4mm diameter with 200mm square mesh. The fabric shall be securely supported at a central location within the sprayed concrete.

Sprayed Concrete Reinforcement
 6. Laps in fabric shall be 300mm and a cover of 50mm of sprayed concrete shall be provided to the fabric at all edges.

Laps in Fabric
 7. Immediately after placement of the sprayed concrete, all free water shall be removed and the surface coated with cement slurry.

Cement Slurry Application
 8. No water shall be allowed to flow over the surface of the sprayed concrete for twenty-four hours after the placement of sprayed concrete.

Water Flow

FLEXIBLE PIPES

C221.19 MATERIALS

1. Flexible pipes shall be UPVC or ribbed Polyethylene pipes covered by Australian Standard AS 2566.1 "Buried Flexible Pipelines Part 1: Structural Design." **Specification**
2. The size/type/class of the flexible pipeline shall be as shown on the Drawings
3. Unplasticised PVC (UPVC) Pipes and Fittings shall be manufactured in accordance with AS 1254. Ribbed Polyethylene pipes and Fittings shall be manufactured in accordance with AS 2566.1. All pipes and fittings shall be of the type and size as shown on the Approved Drawings.
4. Embedment material in the bedding, side support and overlay zones shall be in accordance with bed and haunch zone material in Clause C221.06.
5. Trench backfill material shall satisfy the requirements for embankment material as defined in Specification C213 EARTHWORKS.

C221.20 EXCAVATION AND BEDDING

1. Unless otherwise indicated on the drawings or approved by Council's Supervising Engineer, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition. **Formation to Subgrade Level**
2. Figures C221.3 and Table C221.3 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions, unless otherwise indicated on the drawings. **Bedding Dimensions**

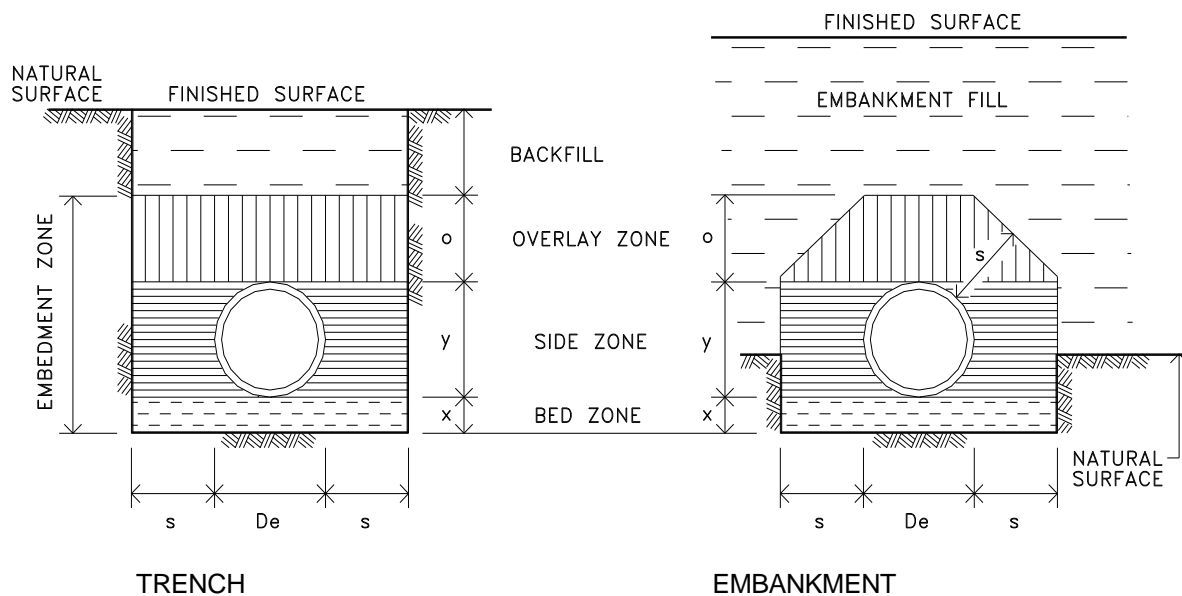


Figure C221.3 - Pipe Installation Conditions

(Figure taken from AS 2566.2)

PIPE DRAINAGE

Extreme External Dia (De)mm	Minimum Dimensions (mm)			
	x	s	o	y
≥75 ≤150	75	100	100	Pipe dia.
>150 ≤300	100	150	150	Pipe dia.
>300 ≤450	100	200	150	Pipe dia.
>450 ≤900	150	300	150	Pipe dia.
>900 ≤1500	150	350	200	Pipe dia.
>1500 ≤4000	150	0.25 De	300	Pipe dia.

NOTE: Where multiple pipes are laid side by side, the minimum distance between the pipes shall be dimension "s" for the larger of adjacent pipes.

Table C221.3 - Trench and Embedment Dimensions

- Bedding zone material shall be placed and compacted in accordance with the requirements in Clause C221.06 except that the required relative compaction in the bedding zone shall be 95 per cent (AS 1289.5.4.1 standard compaction)

C221.21 INSTALLATION

- Embedment of the flexible pipe shall be in accordance with the requirements of AS/NZS 2566.1 and to the dimensions shown in Figure C221.3.
- Pipe laying shall be in accordance with Part 7 of AS 2032 and the manufacturer's specifications. Solvent-cement pipe jointing shall be in accordance with Part 3 of AS 2032. Jointing of UPVC pipes may be performed with the pipes either in the trench or at ground level. Jointing of Ribbed Polyethylene pipes is performed in the trench. All pipes, or jointed pipelines, shall be lowered into the trench without being dropped. Pipelines shall be placed so that joints are not strained.

**Laying and
Jointing**

C221.22 BACKFILL

- Compaction of the material in the side support and overlay zones shall comply with the requirements of clause C221.06 except that the required relative compaction in the side support and overlay zones shall be 95 per cent (AS 1289.5.4.1 standard compaction).
- All material compacted in layers not exceeding 150 mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.
- At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by Council's Supervising Engineer, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction)
- The remainder of the trench to the underside of the subgrade, or selected material zone as specified in Specification C213 EARTHWORKS, shall be backfilled with material satisfying the requirements for embankment material as defined in Specification C213 EARTHWORKS. Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in Specification C213 EARTHWORKS.

**Embedment
Compaction**

Layers

**Moisture
Content**

Trench Backfill

C221.23 RESERVED

C221.24 RESERVED

C221.25 RESERVED

LIMITS AND TOLERANCES

C221.26 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	Culvert Position		
	(a) Grade Line	± 10mm	C221.03
	(b) Horizontal Alignment	± 10mm	C221.03
2.	Bedding		
	(a) Bed and Haunch Zone Compaction	70%	C221.06
3.	Backfill – Concrete Pipes		
	(a) Side and Overlay Zone Compaction	70%	C221.08
4.	Backfill – Steel Pipes		
	(a) Side and Overlay Zone Compaction	95%	C221.17
	(b) Pipe Structure		
	(i) Horizontal and Vertical Variation	< 2% of specified dimensions	C221.17
5.	Sprayed Concrete		
	(a) Over crest of corrugations over bottom third of pipe circumference	➤ 100mm	C221.18
6.	Bedding Zone Compaction	≥ 95%	C221.20
7.	Backfill – Flexible Pipes		
	(a) Side and Overlay Zone Compaction	≥ 95%	C221.21

Table C221.5 - Limits and Tolerances

CONSTRUCTION
SPECIFICATION

C222

PRECAST BOX CULVERTS

SPECIFICATION C222 : PRECAST BOX CULVERTS

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SPECIFICATION C222 : PRECAST BOX CULVERTS

GENERAL

C222.01 SCOPE

Scope

1. This Specification covers the installation of precast concrete box culverts and should be read in conjunction with Specification C220 - STORMWATER DRAINAGE - GENERAL.

2. The work to be executed under this Specification consists of:

Extent of Work

- (a) Preparation of foundations;
- (b) Provision of bedding;
- (c) Construction of base slabs;
- (d) Installation of precast culvert units;
- (e) Headwalls and wingwalls;
- (f) Backfilling against structures;
- (g) Provision and removal of coffer dams;
- (h) Excavation of inlet and outlet channels.

C222.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Other Council Specifications

- C213 - Earthworks
- C220 - Stormwater Drainage - General
- C224 - Open Drains, including Kerb and Gutter
- C242 - Flexible Pavements
- C271 - Minor Concrete Works

(b) Australian Standards

- AS1597.1 - Precast reinforced concrete box culverts - Small culverts
- AS1597.2 - Precast reinforced concrete box culverts - Large culverts
- ISO 9001:2000 - Quality Systems.

MATERIALS

C222.03 CULVERT UNITS, LINK AND BASE SLABS

Supply

1. The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with AS 1597.1 for small culverts not exceeding 1200mm width and 900mm depth, and AS 1597.2 for large culverts from 1500mm span and up to and including 4200mm span and 4200mm height with the following alterations or additional requirements:

- (a) Proof load testing shall be arranged by the Contractor in batches as specified in either AS 1597.1 or AS1597.2 as appropriate.
- (b) Lifting holes, galvanised lifting points or steel lifting eyes shall be provided in the culvert units, link and base slabs.
- (c) The end units shall have factory installed starter bars for headwall and wingwall construction.
- (d) Delivery and unloading shall be the Contractor's responsibility.

2. The Supplier shall implement and maintain a Quality System in accordance with ISO 9001:2000 to ensure materials and manufacture conforms to the appropriate Standards.

3. A conformance certificate for the box culvert units shall be submitted at least 3 working days prior to despatch.

4. Each unit shall be marked at time of manufacture with:

- (a) Type and size
- (b) Casting date
- (c) Manufacturer's name
- (d) Inspection pass and date.

C222.04 CONCRETE

1. The concrete and reinforcement for cast-in-situ base slabs shall comply with Specification C271 - MINOR CONCRETE WORK. **Quality**

C222.05 SELECTED BACKFILL

1. The quality of selected backfill shall comply with the requirements in AS 1597.2. **Quality**

C222.06 ORDINARY BACKFILL

1. Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas, which is in accordance with the requirements for the upper 1.0m of embankment construction as detailed in Specification C213 -EARTHWORKS. **Quality**

CONSTRUCTION

C222.07 COFFER DAMS

1. At some sites it may be expedient for the Contractor to construct a cofferdam. All costs associated with the construction of cofferdams shall be borne by the Contractor. **Contractor's Costs**

2. Cofferdams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation. Cofferdams shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure. **Construction**

PRECAST BOX CULVERTS

3. A cofferdam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete. The details of the cofferdam and formwork, and the clearances proposed shall be subject to the approval of the Council's Supervising Engineer, but the Contractor shall be responsible for the successful construction of the work. **Contractor's Responsibility**
4. Cofferdams that have tilted or have moved laterally during sinking shall be righted or enlarged to provide specified clearances at the Contractor's expense. **Specified Clearances**
5. No timber or bracing shall be left in the concrete or in the backfill of the finished structure. Cofferdams, including temporary piles, shall be removed at least to the level of the invert after completion of the structure. **Removal**

C222.08 EXCAVATION

1. Excavation shall be carried out in accordance with the provisions in Specification C220 - STORMWATER DRAINAGE - GENERAL. **Specification**
2. The trench width shall be the width of the base slab plus 150mm minimum each side. **Trench Width**

C222.09 FOUNDATIONS

1. Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the Drawings. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed. **Rock Foundations**
2. Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material. **Additional Excavation**
3. Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock. **Uniform Surface**
4. Earth foundations shall be finished to line and level to the underside of bedding shown on the Drawings. Care shall be taken to avoid disturbing material below this level. **Line and Level**
5. All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the Council's Supervising Engineer and backfilled in accordance with Specification C220 - STORMWATER DRAINAGE - GENERAL. **Unsuitable Material**

C222.10 BEDDING

(a) In-Situ Base Slabs

1. No bedding material shall be placed until the foundations have been inspected and approved by the Council's Supervising Engineer. **Inspection**
2. Bedding shall be either mass concrete or lightly bound DGB20 in accordance with Specification C242 - FLEXIBLE PAVEMENTS, as shown on the Drawings. **Type**
3. Mass concrete bedding shall be of the same compressive strength as for the base slab and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of ± 10 mm in level and ± 5 mm in line. The bedding shall be finished to a smooth surface. **Mass Concrete**

(b) Precast Base Slabs

- | | |
|---|-----------------------------|
| <p>1. Precast base slabs, U-shaped culvert units and one piece culvert units shall be supported on a bedding zone of selected fill of minimum compacted depth 150mm in accordance with AS 1597.2.</p> | <p>Selected Fill</p> |
|---|-----------------------------|

C222.11 IN-SITU BASE SLABS

- | | |
|--|----------------------------------|
| <p>1. Cast-in-situ base slabs shall be constructed to the dimensions shown on the Drawings and in accordance with the requirements of Specification C271 - MINOR CONCRETE WORKS. The invert levels shall be within -10mm to +10mm, grade 5mm in 2.5m (1 in 500) and plan position ± 50mm.</p> | <p>Construction</p> |
| <p>2. Recesses to accommodate the walls of the precast crown units shall be formed in the base slab to the dimensions shown on the Drawings.</p> | <p>Recesses for Walls</p> |

C222.12 INSTALLATION OF PRECAST UNITS

- | | |
|--|--------------------------------------|
| <p>1. Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa and the Contractor has produced documentary evidence to the Council's Supervising Engineer that proof load testing, as required by AS 1597.1 or AS 1597.2 as appropriate, has been carried out and the representative specimens satisfied the proof load test requirements. The cost of these tests is deemed to be part of the supply and installation Pay Item.</p> | <p>Proof Load Testing</p> |
| <p>2. Precast crown units shall be placed on a bed of mortar in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout.</p> | <p>Mortar Bed in Recess</p> |
| <p>3. Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of precast unit.</p> | <p>Mortar Bed on Supports</p> |
| <p>4. Steel lifting hooks shall be cut flush with the surface of the concrete, cleaned to bright metal and coated with two coats of coal tar epoxy. Alternatively, they shall be cut off 12mm below the surface of the unit and the recess sealed with epoxy mortar.</p> | <p>Lifting Hooks</p> |
| <p>5. In the case of multi-cell culverts, a nominal 15mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout.</p> | <p>Gap Between Cells</p> |
| <p>6. All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.</p> | <p>Curing of Joints</p> |

C222.13 BACKFILL

- | | |
|--|-----------------------------------|
| <p>1. All bracing and formwork shall be removed prior to backfilling.</p> | <p>Removal of Formwork</p> |
| <p>2. Selected fill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with Specification C213 - EARTHWORKS.</p> | <p>Selected Fill</p> |
| <p>3. No fill shall be placed against wingwalls until 21 days after casting.</p> | <p>Wingwalls</p> |
| <p>4. Backfill layers shall be placed simultaneously on both sides of the culvert with a</p> | <p>Sequence</p> |

PRECAST BOX CULVERTS

maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it.

5. Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m before the backfill is placed. **Horizontal Terraces**

C222.14 EXCAVATION OF INLET AND OUTLET CHANNELS

1. Excavation of inlet and outlet channels shall be carried out as shown on the Drawings and shall extend to join the existing stream bed in a regular manner as detailed in Specification C224 - OPEN DRAINS INCLUDING KERB AND GUTTER. **Extent**

C222.15 CONSTRUCTION LOADING ON CULVERTS

1. Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32MPa. **Traffic Over Culvert**
2. Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2. **Loading Restrictions**

LIMITS AND TOLERANCES

C222.16 SUMMARY OF TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarised in the Table below

Item	Activity	Tolerance	Spec Clauses
1.	Mass Concrete Bedding		
	a) Level	± 10mm	C222.10
	b) Line	± 5mm	C222.10
2.	Culvert Location		
	a) Invert Level	±10mm	C222.11
	b) Grade	5mm in 2.5m (1 in 500)	C222.11
	c) Plan Position	±50mm	C222.11

Table C222.1 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C222.19 RESERVED

CONSTRUCTION
SPECIFICATION

C223

DRAINAGE STRUCTURES

SPECIFICATION C223 - DRAINAGE STRUCTURES

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SPECIFICATION C223 : DRAINAGE STRUCTURES

GENERAL

C223.01 SCOPE

1. This Specification covers the construction of drainage structures and shall be read in conjunction with Specification C220 STORMWATER DRAINAGE - GENERAL and other drainage Specifications as applicable:

Associated Specifications

- C221 - Pipe Drainage
- C222 - Precast Box Culverts
- C224 - Open Drains, including Kerb and Gutter

2. The work to be executed under this Specification consists of the construction of headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipators, batter drains and other supplementary structures as shown on the Drawings.

Extent of Work

C223.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Documents Standards Test Methods

(a) Council Specifications

- C213 - Earthworks
- C220 - Stormwater Drainage - General
- C221 - Pipe Drainage
- C222 - Precast Box Culverts
- C224 - Open Drains, including Kerb and Gutter
- C271 - Minor Concrete Works

(b) Australian Standards

- AS 3996 - Metal access covers, road grates and frames

(c) RTA Specifications

- 3204 - Preformed Joint Fillers for Concrete Road Pavements and Structures

CONSTRUCTION

C223.03 GENERAL

1. Drainage structures shall be constructed in concrete and in accordance with Specification C271 - MINOR CONCRETE WORKS.

Concrete Work

2. All structures shall be constructed as soon as practicable and shall be completed not later than 28 days after the construction of the associated culverts, unless otherwise

Time for Completion

approved by Council's Supervising Engineer.

C223.04 ALIGNMENT

1. Unless otherwise shown on the Drawings, headwalls and pits shall be constructed parallel to the road centreline and wingwalls at 135° to the headwall.
2. Where the culvert is laid skew to the road, the wingwalls and headwalls shall be splayed so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall. **Skew Angle**
3. Energy dissipators shall be constructed on the axis of the culvert. **Energy Dissipators**

C223.05 HEADWALLS AND WINGWALLS

1. The wingwalls shall be constructed to retain the batters effectively. Where the dimensioned drawings do not satisfy this requirement Council's Supervising Engineer shall be notified before the headwalls and wingwalls are constructed. Council's Supervising Engineer shall direct the Contractor as to the action to be taken. **Batter Retention**
2. Where rock is encountered at the bottom of excavations for wingwalls and headwalls, the depth of cut-off walls in uniform rock over the full width of the foundations may be reduced to less than that shown in the Drawings, but must be not less than 150mm into sound rock. **Rock Foundations**

C223.06 PITS

1. All new pits, including gully grates and frames complying with AS 3996, shall be constructed to the details shown on the Drawings. Modification of existing pits is only to be carried out if such is shown on the Drawings. **Modification**
2. Where pits and drop structures are deeper than 1.2m the Contractor shall install suitable galvanised step irons at a vertical spacing of 300mm in one wall of the pit, for the full depth of the pit. **Step Irons**

C223.07 PRECAST UNITS

1. Where precast units are provided in the design they shall be handled and installed in accordance with the manufacturer's instructions. **Manufacturer's Instructions**
2. If the Contractor proposes to use precast units, detailed drawings and complete details of installation procedures shall be submitted for the approval of Council's Supervising Engineer. **Contractor's Responsibility**
3. Unless otherwise approved by Council's Supervising Engineer, precast units shall not be delivered to the site before satisfactory documentary evidence has been submitted to Council's Supervising Engineer that quality tests have been carried out. **Delivery**

C223.08 JOINTING

1. Where drainage structures abut concrete paving, kerb and gutter or other concrete structures, a 10mm wide joint shall be provided between the structure and paving, or kerb and gutter or other concrete structures. The joint shall consist of preformed jointing material complying with RTA Specification 3204. **Preformed Jointing Material**

DRAINAGE STRUCTURES

C223.09 MASS CONCRETE BEDDING

1. Mass concrete bedding shall not be placed on earth or rock foundations until the foundations have been inspected and approved by Council's Supervising Engineer. Following such approval, the surface of the foundation shall be dampened and a layer of concrete not less than 50mm thick shall be placed over the excavated surface and shall be finished to a smooth even surface.

***Foundation
Inspection***

2. Unreinforced concrete bases may be cast on earth or rock foundations without the mass concrete bedding.

***Unreinforced
Concrete Base***

C223.10 BACKFILL

1. Backfilling shall not commence until the compressive strength of concrete has reached at least 15MPa unless otherwise approved by Council's Supervising Engineer.

Commencement

2. Selected backfill shall be placed against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure.

Selected Backfill

3. Selected backfill shall consist of a granular material in accordance with the requirements in Specification C213 - EARTHWORKS.

Composition

4. Special care shall be exercised to prevent wedge action against vertical surfaces during the backfilling. Where the sides of the excavation are steeper than 4 horizontally to 1 vertically they shall be cut in the form of successive horizontal terraces at least 600mm in width, as the backfill is placed.

***Horizontal
Terraces***

5. Backfill on both sides of wingwalls up to stream bed level shall be carried up to level simultaneously. Backfilling and compaction shall commence at the wall. Compaction shall be in accordance with Specification C220 - STORMWATER DRAINAGE - GENERAL.

Procedure

SPECIAL REQUIREMENTS

C223.11 RESERVED

C223.12 RESERVED

C223.13 RESERVED

C223.14 RESERVED

CONSTRUCTION SPECIFICATION

C224

OPEN DRAINS INCLUDING KERB & GUTTER

SPECIFICATION C224 : OPEN DRAINS, INCLUDING KERB AND GUTTER
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OPEN DRAINS

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SPECIFICATION C224 : OPEN DRAINS, INCLUDING KERB AND GUTTER

GENERAL

C224.01 SCOPE

1. The work to be executed under this Specification consists of the construction, lining and protection of all types of open drains including the construction of rock filled wire mattresses and gabions. **Scope**
2. This Specification should be read in conjunction with Specification C220 - STORMWATER DRAINAGE - GENERAL, and other drainage Specifications as applicable:

C221	-	Pipe Drainage
C222	-	Precast Box Culverts
C223	-	Drainage Structures

C224.02 DEFINITION

1. Open drains are all drains other than pipe and box culverts and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, gutters and kerbs and gutters. **Definition**

C224.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents
Standards Test
Methods**

(a) Council Specifications

C211	-	Control of Erosion and Sedimentation
C220	-	Stormwater Drainage - General
C221	-	Pipe Drainage
C222	-	Precast Box Culverts
C271	-	Minor Concrete Works
C273	-	Landscaping

(b) Australian Standards

AS 1141.22	-	Wet/dry strength variation
AS 1289.5.4.1	-	Compaction control test – Dry density ratio, moisture Variation and moisture ratio
AS 1289.5.7.1	-	Compaction control test (rapid method)
AS 1650	-	Hot-dipped galvanised coatings on ferrous articles
AS 2876	-	Concrete kerbs and channels (gutters) - Manually or machine placed

(c) RTA Specifications

3204	-	Preformed Joint Fillers for Concrete Road Pavements and Structures
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(d) RTA Test Methods

T166	-	Determination of Relative Compaction
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(e) Other Specifications

AUSTROADS - Guide to Geotextiles

UNLINED OPEN DRAINS

C224.04 GENERAL

1. Unless shown otherwise on the Drawings, drains shall be vee shaped or of trapezoidal cross section and shall not be less than 300mm deep and have a minimum waterway area of 0.2 square metres. **Shape**
2. Open drains shall be graded to ensure free flow of water and, shall not have a grade of less than 1 per cent. **Grade**
3. Where trees exceeding 1m in girth at 500mm above the ground or rock outcrops occur in the line of a drain, the drain may be neatly diverted if approved by Council's Supervising Engineer. **Trees and Rock Outcrops**
4. Open drains shall be extended as necessary to lead the water clear of the work to natural drainage depressions, culverts or pits connected to underground drainage systems. The drains shall follow existing watercourses and depressions in the natural surface, unless other locations are shown on the Drawings **Open Drains**
5. All work shall be undertaken in accordance with the requirements of Specification C211 - CONTROL OF EROSION AND SEDIMENTATION. **Control of Erosion**

C224.05 TYPES

1. Catch drains shall be provided above the tops of cuttings or the toes of embankments where shown on the Drawings before construction of the adjacent roadway. The edges of catch drains shall not be less than 2m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains. **Catch Drains**
2. Minor diversion and contour drains shall be constructed where shown on the Drawings or directed by Council's Supervising Engineer. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain. **Diversion & Contour Drains**
3. Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the Drawings. Their construction is deemed to be part of earthworks. **Table Drains**
4. Inlet, outlet and diversion channels shall be excavated as shown on the Drawings and, unless indicated otherwise, shall extend to join the existing streambed in a regular manner to the satisfaction of Council's Supervising Engineer. The channel shall be excavated to the full width of the structure but the existing streambed shall be preserved as far as possible outside the limits of the excavation. **Channels**

C224.06 CONSTRUCTION

1. Where the drawings permit, material excavated from drains shall be placed on the lower sides of the drains and formed as banks with slopes not steeper than 4:1 on the cross section of the bank. This material shall be compacted in accordance with AS 1289.5.4.1 to not less than 95% standard compactive effort. **Excavated Material**

- | | |
|--|---|
| <p>2. No activities associated with the work shall disturb any watercourse outside the site. Any excavation below the level of the natural channel shall be backfilled with suitable material compacted to a density equal to and compatible with that existing naturally.</p> | <p>Contractor's Responsibility</p> |
| <p>3. The Contractor shall legally and responsibly dispose of any excess material.</p> | <p>Excess Material</p> |
| <p>4. Unlined drains and areas adjacent to open drains shall be revegetated immediately after the drains are complete, in accordance with Specification C273 - LANDSCAPING.</p> | <p>Revegetation</p> |

LINED OPEN DRAINS

C224.07 GENERAL

- | | |
|---|---|
| <p>1. Lined open drains include concrete gutters/channels, and kerb and gutter.</p> | |
| <p>2. Where shown on the Approved Drawings, open drains shall be lined. Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain.</p> | <p>Profile</p> |
| <p>3. Before placing any lining material, the foundation material shall be shaped and compacted to form a firm base for the lining. Other than for kerb and gutter constructed on pavement courses, the relative compaction, as determined by AS 1289.5.7.1 or AS 1289.5.4.1 shall not be less than 95 per cent for standard compactive effort.</p> | <p>Compaction of Foundations</p> |

C224.08 CONCRETE LINING

- | | |
|---|------------------------|
| <p>1. Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed in accordance with Specification C271 - MINOR CONCRETE WORKS. In wet areas weepholes shall be provided in the concrete at intervals as determined by Council's Supervising Engineer.</p> | <p>Method</p> |
| <p>2. Contraction joints in concrete lining, consisting of narrow transverse and vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete at intervals of 5m unless otherwise specified by Council's Supervising Engineer. Expansion joints shall be placed at intervals not more than 15m, shall consist of jointing material complying with RTA Specification 3204 and shall be of sufficient depth to fill the joint.</p> | <p>Jointing</p> |

C224.09 STONE PITCHING

- | | |
|---|--|
| <p>1. Stone Pitching shall consist of sound durable rock not less than 100mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface. The exposed surface of each stone or block shall be approximately flat and not less than 0.05 square metres in area. Spaces between adjacent stones or blocks shall not exceed 20mm in width.</p> | <p>Rock Quality and Placing</p> |
|---|--|

C224.10 BATTER DRAINS

- | | |
|---|----------------------------|
| <p>1. Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the Drawings.</p> | <p>Type</p> |
| <p>2. The units shall be installed in carefully excavated and template controlled trench to produce an even rim line of +0 to -50 from the batter line at the underside of topsoil.</p> | <p>Installation</p> |
| <p>3. Any over excavation and undulations in the batter line shall be backfilled and both</p> | <p>Compaction</p> |

OPEN DRAINS

sides of the drain compacted over the full length to form a firm shoulder against the rim of the trough.

4. When topsoil is placed it shall be tapered over a width of 1m to zero thickness at the rim of the drain. Both sides of the drain shall then be turfed for minimum width of 600mm and pinned down as provided in Specification C273 - LANDSCAPING.

Topsoil and Turfing

C224.11 PROPRIETARY PRODUCTS

1. Unless shown on the Drawings, proprietary products may only be used with the approval of Council's Supervising Engineer. Where specified, they must be used strictly in accordance with the manufacturer's instructions.

Manufacturer's Instructions

C224.12 KERB AND GUTTER

1. Kerb and/or gutters may be constructed in fixed forms, by extrusion or by slip forming, in accordance with AS 2876.

Method

2. The foundation, concrete quality, curing and testing details shall be in accordance AS 2876.

Construction Details

3. The top and face of the finished kerb and gutter shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities.

Finish

4. The level at any point on the surface of the gutters shall be within ± 10 mm of design levels. When a straight edge 3m long is laid on top of or along the face of the kerb or on the surface of gutters, the surface shall not vary more than 5mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring gutter depression.

Tolerances

5. Unless shown otherwise on the Drawings, contraction joints, shall be formed every 3m of gutter length for a minimum of 50 per cent of cross sectional area. The joint shall be tooled 20mm in depth to form a neat groove of 5mm minimum width.

Contraction Joints

6. Unless shown otherwise on the Drawings, expansion joints, 15mm in width for the full depth of the kerb and gutter, shall be constructed at intervals not exceeding 15m and where the gutter abuts against gutter pits, retaining walls and overbridges. Expansion joints shall consist of a joint filler complying with RTA Specification 3204.

Expansion Joints

7. Where kerbs and/or gutters are cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and/or gutter.

Adjacent Concrete Pavement

8. House stormwater outlets shall be provided and/or extended through the kerb for each house that drains to the kerb.

Stormwater Outlets

9. Opposite all driveways, where shown on the Drawings or where directed by Council's Supervising Engineer, vehicular or pedestrian access shall be provided. Such accesses shall be constructed in accordance with the current issue of the Standard Drawings and shall also comply with the requirements for access for persons with disabilities

Vehicular or Pedestrian Access

ROCK FILLED WIRE MATTRESSES AND GABIONS

C224.13 GENERAL

1. Installation shall be in accordance with the manufacturer's instructions. A geotextile shall be placed between the wire cage and the material being protected.

Location and Filter Fabric

C224.14 MATERIALS

For wire mattresses and gabions, the galvanising requirements for wire of circular cross section cited in this clause as "heavily galvanised", shall comply with the coating mass requirements for wire in AS 1650, type A wire.

(a) Gabions

1. The gabions shall be of the sizes shown on the Drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the Drawings. Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100mm. Gabions shall have a nominal mesh size of 80mm x 100mm and body wire shall be a minimum diameter of 2.7 mm heavily galvanised with an additional thickness of 0.4 mm PVC coating where specified on the Drawings. The minimum core diameters of galvanised selvedge wire and lacing wire shall be 3.4 mm and 2.2 mm respectively.

Dimensions**(b) Wire Mattresses**

1. Unless specified otherwise, the wire mattresses shall be supplied in units having dimensions of 6 m x 2 m x 230 mm, and shall be cut to suit areas as shown on the Drawings. Diaphragms shall divide the mattresses into cells of length not exceeding 600mm. Unless otherwise specified, mattresses shall be fabricated of woven heavily galvanised wire and PVC coated where specified on the Drawings.

***Mattress
Dimension***

2. Mattresses shall have a mesh size of 60 mm x 80 mm and body wire shall be a minimum diameter of 2.0 mm heavily galvanised with an additional minimum thickness of 0.4 mm PVC coating where specified on the Drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7 mm and 2.2 mm respectively.

***Wire
Dimensions*****(c) Geotextile**

1. A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square metre, in accordance with AUSTRROADS - Guide to Geotextiles shall be used.

Type

2. Samples, manufacturer's specification and instructions on installation shall be submitted to Council's Supervising Engineer seven days before the intended use of geotextile.

Sample**(d) Rock Fill Material**

1. The rock fill shall consist of clean hard rock with a minimum wet strength of 100 kilonewtons and a maximum wet/dry strength variation of 45 per cent as determined by AS 1141.22.

Rock Quality

2. Rock fill for gabions shall have particle sizes between 100mm and 250mm and preferably not greater than 200mm. Fill material may be placed by hand or mechanically, and shall be tightly packed with a minimum of voids. Fill material shall be levelled off 25mm to 50mm above the top of the mesh to allow for settlement.

For Gabions

3. Rock fill for wire mattresses shall have particle sizes between 75mm and 150mm and preferably not greater than 125mm. When the mattress is on a slope, rock fill material shall be placed into the units starting from the low end. Units shall be filled slightly overfull to allow for settlement and to provide an even tight and smooth surface of the required contour.

***For Wire
Mattresses***

C224.15 ASSEMBLY AND ERECTION

1. Before laying out the gabions or wire mattresses, filter fabric shall be placed on the founding material. The edges of wire mattresses shall be firmly tied to galvanised star pickets driven a minimum of 900mm into the surrounding ground at 1m maximum intervals and the star pickets cut off level with the top of the mattress. The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300mm and filled with rock fill. This edge shall be tied to star pickets.

Procedure

LIMITS AND TOLERANCES

C224.16 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	Open Drains - General		
	(a) Grading	Grade >1%	C224.04
	(b) Depth	>300mm	C224.04
	(c) Waterway Area	>0.2 sq m	C224.04
	(d) Catch Drain Location	>2m from top of cuttings or toes of embankments	C224.05
2.	Open Drains - Lining		
	(a) Compaction of Foundation	>95%	C224.07
3.	Stone Pitching		
	(a) Rock Dimensions	>100mm thickness	C224.09
	(b) Exposed Surface Area	>0.05 sq m	C224.09
	(c) Spaces between Stones	<20mm width	C224.09
4.	Batter Drains		
	(a) Rim line	+0, -50 from batter line	C224.10
5.	Kerb and Gutter		
	(a) Level of gutter surface	Level $\leq \pm 10$ mm of design level	C224.12
	(b) Surface uniformity	Deviation of kerb and gutter surface from 3m straight edge ≤ 5 mm	C224.12
6.	Rock Fill for Gabions and Wire Mattresses		
	(a) Wet Strength	>100kN	C224.14d
	(b) Wet/Dry Strength variation	<45%	C224.14d
	(c) Particle size for Gabions	>100mm <250mm	C224.14d
	(d) Fill Level	>25mm <50mm above top of mesh	C224.14d
	(e) Particle size for Wire Mattresses	>75mm <150mm	C224.14d
7.	Erection of Wire Mattresses		
	(a) Star pickets for ties	Depth in ground >900mm Spacing <1m	C224.15
	(b) Trench Depth for upstream edge	Depth >300mm	C224.15

Table C224.1 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C224.17 RESERVED

C224.18 RESERVED

C224.19 RESERVED

CONSTRUCTION
SPECIFICATION

C230

**SUBSURFACE DRAINAGE
GENERAL**

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

Details are provided below outlining the clauses amended from the Wollondilly Shire Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Plastic pipe specification	C230.10	M	BG	1/3/16
2	Filter material	C230.12	M	BG	1/3/16

SPECIFICATION C230 - SUBSURFACE DRAINAGE-GENERAL

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C230A SLOTTED PIPES FITTED WITH SEAMLESS TUBULAR FILTER FABRIC	

SPECIFICATION C230 : SUBSURFACE DRAINAGE - GENERAL

GENERAL

C230.01 INTRODUCTION

1. This is the general specification common and applicable to all types of subsurface drainage and shall be read in conjunction with subsurface drainage specifications: **Purpose**

- C231 - Subsoil and Foundation Drains
- C232 - Pavement Drains
- C233 - Drainage Mats

as applicable to particular contracts.

C230.02 SCOPE

1. The work to be executed under this Specification consists of:
- (a) Preparation for subsurface drainage construction;
 - (b) Siting of subsurface drainage facilities;
 - (c) The supply of all materials associated with the provision of the subsurface drainage system;
 - (d) All activities and quality requirements associated with the supply, placement and compaction of filter material;
 - (e) The provision of a detailed record of all subsurface drain installations;
 - (f) The marking on the ground of the location of all subsurface drains.

C230.03 EXTENT OF WORK

1. Details of the work are as shown on the Drawings, or as directed by the Council's Supervising Engineer and Geotechnical Engineer.

C230.04 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

- C211 - Control of Erosion and Sedimentation
- C213 - Earthworks
- C271 - Minor Concrete Works

(b) Australian Standards

- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1141.22 - Wet/dry strength variation.
- AS 1289.E5.1 - Determination of minimum and maximum dry density of a cohesionless material.
- AS 1477 - Unplasticised PVC (UPVC) pipes and fittings for pressure applications
- AS 2439.1 - Perforated drainage pipe and associated fittings
- AS 2758.1 - Aggregates and rock for engineering purposes - Concrete aggregates
- ASTM-D2434-68 Test method for permeability of granular soils (constant head)

(c) RMS Specifications

- MR1160 - Supply and Delivery of Seamless Tubular Filter Fabric

(d) RMS Test Methods

- T102 - Pretreatment of Samples of Road Materials by Compaction
- T103 - Pretreatment of Road Materials by Artificial Weathering

(e) Legislation

Occupational Health and Safety Act, 2000

C230.05 TEMPORARY DRAINAGE DURING CONSTRUCTION

1. All drainage works carried out by the Contractor shall comply with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION.

***Erosion
Control***

2. The Contractor shall make adequate provision for runoff flows at subsurface drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities.

***Contractor's
Responsibility***

3. The Contractor's material and equipment shall be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows.

***Location of
Equipment***

SUBSURFACE DRAINAGE

C230.06 SITING OF WORK

1. Before commencing construction of any subsurface drainage activity, the Contractor shall set out on site the position of the work to the location and levels shown on the Drawings. **Set-out**
2. The Council's Supervising Engineer may amend the locations or designed levels or the lengths to suit actual site conditions. **Amendments to Planned Work**
3. Should the Contractor propose changes to the location, length, designed levels, conditions of installation or cover to suit the Contractor's construction procedures, the Contractor shall present the proposed set-out in addition to the designed set-out for consideration by the Council's Supervising Engineer. No changes shall be made unless the prior written approval of the Council's Supervising Engineer is obtained. **Proposed Changes by Contractor**

C230.07 EXCAVATION

1. Excavation shall be undertaken in compliance with all statutory requirements. The Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with these statutory requirements. **Safety**
2. Where public utilities exist or are likely to exist in the vicinity of drainage works the Contractor shall obtain the approval of the relevant authority to the method of excavation before commencing excavation and in addition shall make contact with Dial Before You Dig (phone 1100). **Approval by Public Utility Authorities – Dial Before You Dig**
3. Excavation by blasting, if permitted, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed drainage structure does not exceed 25 millimetres per second. The Contractor shall comply with other requirements concerning blasting operations in Specification C213 - EARTHWORKS. **Blasting Operation**
4. Trenches shall be excavated to the line, grade, width and depth shown on the Drawings or as directed by the Council's Supervising Engineer. The bottom of the trench shall be constructed so that no localised ponding can occur. The Contractor shall remove all loose material. **Excavation Level**
5. Any material at the bottom of the trench or at foundation level which the Council's Supervising Engineer deems to be unsuitable shall be removed and disposed in accordance with Specification C213 - EARTHWORKS by the Contractor and replaced with backfill material in accordance with the requirements of this Specification. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level or grade of the pipe. **Unsuitable Material**

C230.08 BACKFILLING

1. Backfilling shall be carried out in accordance with the requirements of the relevant subsurface drainage structures Specifications. **Detail**

C230.09 OUTLET STRUCTURES FOR SUBSURFACE DRAINAGE

1. Subsurface drainage pipes shall be connected to discharge into gully pits or to outlet structures as shown on the Drawings or as directed by the Council's Supervising Engineer. **Discharge**
2. Outlets shall be spaced at a maximum interval of 80m. **Spacing**
3. Outlets, including those discharging into gully pits, shall be made rodent proof using **Rodent Proof**

galvanised wire netting.

- | | |
|--|-------------------------------|
| 4. The outlet shall be located so that erosion of the adjacent areas does not occur or shall be protected by the placement of selected stone or similar treatment. | Erosion Control |
| 5. Outlet pipes from curtain drains shall be unslotted. At no point shall an outlet pipe be higher than the pipe at the end of the curtain drain. | Outlet Pipe |
| 6. All concrete used in the construction of outlet structures shall conform to the requirements of Specification C271 - MINOR CONCRETE WORKS. | Concrete Specification |

MATERIALS

C230.10 CORRUGATED PLASTIC PIPE

- | | |
|---|----------------------|
| 1. Corrugated plastic pipe shall be Class 400 (SN8 RMS Specification 3552) conforming to the requirements of AS2439.1. Class 1000 (SN20 RMS Specification 3552) shall be used where subject to heavy vehicle traffic loads. | Specification |
| 2. Joints, couplings, elbows, tees and caps shall also comply with AS2439.1 and only the manufacturer's recommended fittings shall be used. | Fittings |
| 3. The Contractor shall obtain from the Manufacturer a Test Certificate demonstrating compliance with AS2439.1. | Compliance |

C230.11 OTHER TYPES OF SUBSURFACE DRAINAGE

- | | |
|---|----------------------------|
| 1. Where a Contractor wishes to use a subsurface drainage pipe other than corrugated plastic pipe, he shall submit full details of the type of pipe, certification from the manufacturer of its suitability and quality and written acceptance by the Council for its use in each particular application. Certification of the suitability of any pipe will address the crushing strength, flexural strength, jointing system and slotting details. | Submit for Approval |
|---|----------------------------|

C230.12 FILTER MATERIAL

(a) General

1. The types of filter material covered by this Specification include Type A and Type B material as specified below. Other material sizes may be used but require prior approval by council Engineer and must comply with RMS Specification 3580.

- (a) Type A filter material for use in most applications
- (b) Type B filter material for use in trench drains and Type B drainage mats

2. All filter material shall consist of clean, hard, tough, durable particles.

(b) Type A Filter Material

1. Type A filter material shall be crushed rock complying with the following requirements:	Grading
--	----------------

SUBSURFACE DRAINAGE

TEST METHOD	PROPERTY	REQUIREMENT
AS 1141.11	Material passing AS sieve	Per cent by mass
	6.7mm	100
	4.75mm	85 to 100
	2.36mm	0 to 40
	1.18mm	0 to 5
	425um	0 to 2

Table C230.1 - Type A Filter Material

(c) Type B Filter Material

1. Type B filter material shall be granular material complying with the following grading requirements: **Grading**

TEST METHOD	PROPERTY	REQUIREMENT
AS 1141.11	Material passing AS sieve	Per cent by mass
	4.75mm	100
	2.36mm	95 to 100
	425um	20 to 80
	300um	0 to 30
	150um	0 to 2
	75um	0 to 0.1

Table C230.2 - Type B Filter Material

2. In addition to the above grading requirements, Type B filter material shall have a coefficient of saturated permeability, when compacted to its maximum dry density as determined by AS 1289.E5.1 and then tested in accordance with Test Method ASTM-D2434-68, of at least 8 metres per day after three hours of flow. **Coefficient of Saturated Permeability**

3. After treatment in accordance with Test Method T103 and five cycles of compaction in accordance with Test Method T102, Type B filter material shall not vary from its original grading before such treatment by more than the following amounts: **Grading Variation**

AS Sieve	Variation From Grading Before Treatment (per cent of mass)
2.36mm	± 3
1.18mm	± 1
425um	± 1
300um	± 1
150um	± 0.5
75um	± 0.1

Table C230.3 - Type B Filter Material Variation

C230.13 GEOTEXTILE

(a) General

1. The geotextile, other than seamless tubular filter fabric, shall consist of a needle-punched felt, which shall be manufactured from synthetic materials other than polyamide. It shall be bio-stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents.

Properties

2. The geotextile shall be resistant to ultra-violet light. No geotextile shall be left exposed to sunlight during storage and construction for a period longer than a total of twenty-one days. If exposure in excess of twenty-one days does occur, the geotextile shall be tested and if its characteristics have deteriorated to or below 90 per cent of the characteristics claimed by the manufacturer or the characteristics determined on unexposed geotextile, whichever is the better, it shall be removed and replaced with a geotextile complying with this Specification.

Ultra Violet Light Resistant

3. The geotextile shall be capable of retaining particles of particle size greater than 100 microns.

Particle Retention

4. The minimum mass of geotextiles for different types of subsurface drainage shall be as follows:

Mass

TYPE OF SUBSURFACE DRAINAGE	MINIMUM MASS OF GEOTEXTILE (Grams per square metre)
Trench Drains and Drainage Mats	250
Curtain Drains	500

Table C230.6 - Geotextile Mass

5. In addition to the above requirements, geotextiles for curtain drains shall consist of polyester, polypropylene or polyethylene. Geotextiles for curtain drains shall have a rate of water transmission not less than 20 litres per hour per metre width of fabric through a 300 mm length of the fabric when subjected to a pressure of 200 kPa applied at right angles to the plane of the fabric, and to a constant head of water no greater than 50 mm applied to the top edge of the fabric.

Water Transmission Rate

(b) Seamless Tubular Filter Fabric

Specification

1. Seamless tubular filter fabric shall be used to enclose all slotted pipes and shall comply with MR Form 1160.

2. Fitting of the seamless tubular filter fabric shall be in accordance with the requirements of Annexure C230A. Filter fabric that is excessively stretched, torn or otherwise damaged during fitting of the fabric, storage, transportation or pipe laying will be removed and replaced so as to eliminate any damaged lengths.

Fitting

RECORDING OF DRAINAGE

C230.14 RECORDING OF SUBSURFACE DRAINAGE INFORMATION

- 1. The Contractor shall keep a detailed record of all subsurface drainage pipes and the completed subsurface drainage systems shall be shown on the work-as-executed plans. **Work As Executed Plans**
- 2. In addition, the Contractor shall prepare a subsurface drainage information sheet or sheets at the completion of construction of each drain or drainage system and shall submit the subsurface drainage sheet or sheets to the Council’s Supervising Engineer within five working days of the completion of the drain or drainage system. **Information Sheet**
- 3. The information to be included in the subsurface drainage information sheets shall include: **Detail**

Date of completion of drain construction:

Drain Number:

Type of Drain:

Pipe Size:

Pipe Type:

Filter Type:

Grade of Drain:

Locations of Cleanouts:

Locations of Outlets:

Geotextile-

Sheet Yes/No

Seamless Tubular Filter Fabric Yes/No

Response Time:

NOTE: Response Time shall be the time taken for water to travel from the inlet end of a drain or from a cleanout leading to a drain to the outlet end of the drain.

SPECIAL REQUIREMENTS

C230.15 RESERVED

C230.16 RESERVED

C230.17 RESERVED

ANNEXURE C230A

SLOTTED PIPES FITTED WITH SEAMLESS TUBULAR FILTER FABRIC

1. PROCEDURE FOR FITTING SEAMLESS TUBULAR FILTER FABRIC TO SLOTTED PIPE

Seamless tubular filter fabric shall be fitted to slotted pipe immediately before the slotted pipe is to be laid in its final position in the work.

The filter fabric shall be initially pulled over and onto a short length of smooth pipe of internal diameter between 20mm and 30mm greater than the external diameter of the slotted pipe to be enclosed by filter fabric. The short, larger diameter pipe shall be referred to as the 'mandrel'.

The pipe to be enclosed by the filter fabric shall be passed through the mandrel. The filter fabric shall be slipped on to the pipe as the pipe emerges from the mandrel leaving enough overhang of the filter fabric to make a suitable joint with the filter fabric on the adjacent pipe. The filter fabric shall be firmly held to the forward end of the pipe so that it cannot slip back along the pipe.

The pipe shall be pulled right through the mandrel allowing the filter fabric to progressively slip over the pipe. The filter fabric shall be restrained from easily slipping off the mandrel thus ensuring the filter fabric is stretch fitted onto the pipe.

When the end of the pipe emerges from the mandrel, the filter fabric shall be clamped to that end of the pipe so that the filter fabric cannot slip down the pipe. The filter fabric shall remain clamped to each end of the pipe to ensure the filter fabric remains stretch fitted onto the pipe when the pipe is placed in its final position in the drain. The filter fabric shall be cut cleanly leaving enough overhang over the end of the pipe to make a fully covered joint with the filter fabric on the adjacent pipe when the pipes are installed in the drain.

2. PRECAUTIONS TO BE TAKEN WHEN USING SLOTTED PIPE FITTED WITH SEAMLESS TUBULAR FILTER FABRIC

Slotted pipe fitted with seamless tubular filter fabric shall not be dragged over the ground. If carried, the pipe shall be lifted clear of the ground and the filter fabric shall be protected from damage at all times.

Seamless tubular filter fabric, which has been so damaged as to affect its filtering properties, shall be removed from the pipe and replaced with undamaged filter fabric.

If at any time during the installation of a slotted pipe it is found that the enclosed filter fabric has become loose on the pipe it shall be restretched to its correct position. If restretching causes any damage to the filter fabric, the damaged filter fabric shall be removed from the pipe and replaced with undamaged filter fabric.

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C231

**SUBSOIL AND
FOUNDATION DRAINS**

SPECIFICATION C231 : SUBSOIL AND FOUNDATION DRAINS

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SPECIFICATION C231 : SUBSOIL AND FOUNDATION DRAINS

GENERAL

C231.01 SCOPE

1. The work to be executed under this Specification covers the excavation, bedding, installation and backfilling of subsoil and foundation drains. **Scope**
2. Subsoil and foundation drains shall be constructed where and as shown on the Drawings or as directed by the Council's Supervising Engineer. **Location**
3. This Specification should be read in conjunction with Specification C230 - SUBSURFACE DRAINAGE - GENERAL. **Associated Specification**

C231.02 TERMINOLOGY

1. Subsoil drains are intended for the drainage of ground water and/or the pavement in cuttings. **Subsoil Drains**
2. Foundation drains are required for the drainage of seepage, springs and wet areas within and adjacent to the foundations. **Foundation Drains**

C231.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

(a) Council Specifications

- C213 - Earthworks
- C230 - Subsurface Drainage - General

(b) RMS Test Method

- T166 - Determination of Relative Compaction

C231.04 ORDER OF CONSTRUCTION

(a) Subsoil Drains

1. Subsoil drains shall be constructed as soon as possible after necessary earthworks are completed in the area of the drain. Where stabilisation of the subgrade is required, subsoil drains shall be constructed after completion of stabilisation except that, where excessive ground water is encountered, they may be constructed prior to stabilisation of the subgrade. **Timing of Work**
2. Where a Selected Material Zone is specified and excessive ground water is encountered, subsoil drains may be installed in two stages as follows: **Two Stage Construction**
 - Stage 1: Standard subsoil drains installed below the base of the cutting prior to placement of select material in the Selected Material Zone.
 - Stage 2: Extension of subsoil drain to the top of the Selected Material Zone after placement of selected material.

(b) Foundation Drains

1. Foundation drains shall be constructed after completion of clearing and stripping operations, and preceding the commencement of embankment construction.

Timing of Construction

CONSTRUCTION

C231.05 SUBSOIL DRAINS

(a) Excavation

Associated Specification

1. Excavation shall be undertaken in accordance with the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL.

2. Trenches for subsoil and foundation drains shall be excavated to the line, grade, width and depth as shown on the Drawings or as directed by the Council's Supervising Engineer.

Dimensions and Grade

3. The bottom of the trench shall be excavated to the same grade as the design pavement surface in the direction of the trench except where the grade of the design pavement surface in the direction of the trench is less than 0.5 per cent. In which case the trench depth shall be increased to provide a minimum grade of fall in the trench of 0.5 per cent. The bottom of the trench shall be excavated so that no localised ponding of water occurs.

Minimum Grade

4. If at any location the trench is excavated below the specified floor level, the trench shall be backfilled with non-porous subgrade material so that when the subgrade material is compacted to a relative compaction, determined by Test Method T166, of at least 100 per cent, the bottom of the trench shall be at the specified floor level.

Over-excavation

5. Where a subsoil drain is constructed in two stages, the excavation for Stage 2 shall be carried out after placement and compaction of the selected material zone or the stabilised subgrade layer. The Stage 2 trench shall be excavated to the same line and width as the Stage 1 trench and to a depth to provide a clean, full contact with the filter material placed in Stage 1. All excavated material shall be disposed to waste or incorporated into fills.

Two Stage Construction

(b) Laying of Pipe

Bedding

1. The 100mm diameter corrugated slotted plastic piping, complying with Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

2. The type of filter material shall comply with Table C230.1.

Filter Material

3. Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap.

Joints and Capping

(c) Backfilling

Filter Material

1. The trench shall be backfilled with filter material to the level specified. The filter material shall be placed and compacted in layers with a maximum compacted thickness of 300mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance to the pipe.

2. The filter material shall be compacted for its full depth to a relative compaction of not less than 100 per cent (standard compaction) as determined by Test Method T166.

Compaction of Filter Material

3. The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with selected backfill material, conforming to the requirements of Specification C213 - EARTHWORKS, compacted for its full depth to a relative compaction

Select Material

SUBSOIL AND FOUNDATION DRAINS

of not less than 100 per cent (standard compaction) as determined by Test Method T166.

4. Where shown on the Drawings or as directed by the Council's Supervising Engineer, a geotextile conforming to the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be provided at the interface between the filter material and adjoining materials. Laps of 500mm shall be provided at joints in the fabric.

Geotextile

(d) Outlets

Pipes and Structures

1. Outlets are to be provided at maximum intervals of 80m. Where possible, subsoil drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

C231.06 FOUNDATION DRAINS

(a) Excavation

1. Excavation shall be undertaken in accordance with the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL and Clause C231.05 of this Specification.

Associated Specification

(b) Laying of Pipe

1. The 100mm diameter corrugated slotted plastic piping, complying with Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

Bedding

2. The type of filter material shall be as shown in Table C230.1.

Filter Material

3. Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap.

Jointing and Capping of Pipe

(c) Backfilling

1. The trench shall be backfilled with filter material in accordance with the provisions of Clause C231.05(c).

Filter Material

2. The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with suitable earth backfill material, compacted for its full depth to a relative compaction of not less than 100 per cent (standard compaction) as determined by Test Method T166.

Earth Backfill and Compaction

3. Where shown on the Drawings or as directed by the Council's Supervising Engineer, a geotextile, conforming to the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be provided at the interface between the filter material and adjoining materials. Laps of 500mm shall be provided at joints in the fabric.

Geotextile

(d) Outlets

1. An outlet structure in accordance with the detail shown on the Drawings and Specification C230 - SUBSURFACE DRAINAGE - GENERAL shall be constructed at the discharge end. The outlet shall be located so that erosion of the adjacent area does not occur or shall be protected by the placement of selected stone in the splash zone of the outlet.

Construction Detail

LIMITS AND TOLERANCES

C231.07 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C231.1 below.

Item	Activity	Tolerances
1.	Excavation Trench Grade	≥0.5%
2.	Subsoil Drain Backfill	
	(a) Layer thickness	300mm max
	(b) Compaction (Relative) Filter and Backfill material	100% standard
3.	Outlet Spacing	80m max
4.	Foundation Drain Backfill	
	(a) Layer thickness	300mm max
	(b) Compaction (Relative) Filter material	100% Standard
	Backfill material	>100% Standard

Table C231.1 - Table of Limits and Tolerances

SPECIAL REQUIREMENTS

C231.08 RESERVED

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PAVEMENT DRAINS

SPECIFICATION C232 - PAVEMENT DRAINS

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SPECIFICATION C232 : PAVEMENT DRAINS

GENERAL

C232.01 SCOPE

1. This Specification covers the installation of Sub-Pavement Drains, Intra-Pavement Drains and Edge Drains. **Scope**
2. Pavement drains shall be constructed where and as shown on the Drawings or as directed by Council's Supervising Engineer. **Location**
3. This Specification should be read in conjunction with Specification C230 - SUBSURFACE DRAINAGE - GENERAL. **Associated Specification**

C232.02 TERMINOLOGY

1. Sub-Pavement Drains are intended for the drainage of the pavement layers where the subbase is not a macadam crushed rock. **Sub-Pavement Drains**
2. Intra-Pavement Drains are intended for the drainage of the pavement layers of a flexible pavement where the subbase material is a macadam crushed rock or open graded asphaltic concrete. **Intra-Pavement Drains**
3. Edge Drains are intended for the drainage of rigid pavements. **Edge Drains**

C232.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

(a) Council Specifications

- C213 - Earthworks
- C230 - Subsurface Drainage - General
- C242 - Flexible Pavements
- C245 - Asphaltic Concrete

(b) Australian Standards

- AS 1289.3.3.1 - Calculation of the plasticity index of a soil.
- AS 1289.5.4.1 - Methods of Testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio
- AS 1477 - Unplasticised PVC (UPVC) pipes and fittings for pressure applications.

(c) RTA Specifications

- 3555 - Slotted Fibre Reinforced Concrete Pipes for Subsurface Drainage.

C232.04 ORDER OF CONSTRUCTION**(a) Sub-Pavement Drains**

1. Sub-pavement drains shall be constructed as soon as possible after necessary earthworks are completed in the area of the drain. Where stabilisation of the subgrade is required, sub-pavement drain shall be constructed after completion of stabilisation except that where excessive ground water is encountered, sub-pavement drains may be constructed prior to stabilisation of the subgrade.

Timing of Construction

2. Where a Selected Material Zone is specified and excessive ground water is encountered, sub-pavement drains may be installed in two stages as follows:

Stage Construction

Stage 1: Standard sub-pavement drains installed below the base of the cutting prior to placement of select material in the Selected Material Zone.

Stage 2: Extension of sub-pavement drain to top of the Selected Material Zone after placement of selected material.

(b) Intra-Pavement Drains

1. Intra-Pavement Drains shall be constructed after the completion of the layer below the crushed rock Macadam or 40mm open graded asphaltic concrete subbase and preceding the construction of the subsequent layers.

Timing of Construction**(c) Edge Drains**

1. Edge Drains shall be constructed after the construction of the rigid pavement and before the placement and compaction of verge material.

Timing of Construction**CONSTRUCTION****C232.05 SUB-PAVEMENT DRAINS****(a) Excavation**

1. Trenches 300mm wide shall be trimmed to the required line and to a depth of 600mm below the bottom of the subbase or below the base of the cutting where two stage construction of the Sub-Pavement Drain is required.

Trench Dimensions

2. The bottom of the trench shall be to the same grade as the design pavement surface except where the grade of the roadway is less than 0.5 per cent, in which case the depth of the trench shall be increased to provide a grade of 0.5 per cent in the trench. The bottom of the trench shall be excavated so that no localised ponding of water occurs.

Trench Grade

3. Where two-stage construction of the sub-pavement is required, excavation for Stage 2 shall be carried out after placement and compaction of the Selected Material Zone. The Stage 2 trench shall be to the same line and width as Stage 1 and to a depth sufficient to provide a clean, full contact with the previously placed filter material. All excavated material shall be disposed to waste or incorporated into fills.

Two-Stage Construction**(b) Laying of Pipe**

1. The 100mm diameter corrugated slotted plastic piping, complying with Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

Filter Bed

PAVEMENT DRAINS

2. The type of filter materials shall be as shown in Table C230.1. **Type**
3. Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap. **Jointing and Capping**

(c) Backfilling

1. The trench shall be backfilled with filter material to the level specified. The type of filter material shall be as shown in Table C230.1. The filter material shall be placed and compacted in layers with a maximum compacted thickness not exceeding 300mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance of the pipe. **Filter Material**
2. The filter material shall be compacted for its full depth to a relative compaction of not less than 100 per cent (standard compaction) as determined by . **Compaction**
3. On the outlet section of pipes discharging through the fill batters the trench shall be backfilled with the nominated filter material to a depth of 50mm above the pipe. The balance of trench shall be backfilled with earth backfill material of maximum particle size of 50mm and shall be compacted for the full depth to a relative compaction of 100 per cent as determined by AS 1289.5.4.1. **Pipe Outlet**
4. In the case of sub-pavement drains of two stage construction when it is not practical to place the Pavement Layers or the Selected Material Zone immediately after the construction of Stage 1, the filter material placed to the top of Stage 1 shall be protected from scour and/or contamination by covering with a 50mm thick plug of compacted select fill material having a maximum particle size of 25mm and Plasticity Index of not more than twelve as determined by AS 1289.3.3.1. This plug, any contaminated filter material and any select material covering shall be removed and replaced with filter material and compacted immediately ahead of the placement of the pavement layer. All excavated material shall be disposed to waste or incorporated in fills. **Temporary Plug over Filter Material**

(e) Outlets

1. Outlets are to be provided at maximum intervals of 80m. Where possible sub-pavement drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the Drawings shall be constructed at the discharge end. **Location**
2. The outlet shall be made rodent proof in accordance with the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL. **Rodent Proof**
3. The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet. **Erosion Control**

C232.06 INTRA-PAVEMENT DRAINS

(a) Excavation

1. A 'V' shaped trench approximately 50mm deep shall be cut to the required line in the pavement layer immediately below the MS75 crushed rock pavement layer. No excavation is required below a 40mm open graded asphaltic concrete subbase layer. **Type**
2. The bottom of the trench is to be to the same grade as the roadway. The bottom of the trench shall be constructed so that localised ponding of water does not occur. **Grade**
3. Where the pipe is to discharge through the fill batter a trench shall be constructed on a grade suitable for the pipe to discharge its contents without scour. After laying the pipe the trench shall be backfilled with fill material and compacted for the full depth to a relative **Discharge Pipe**

compaction of not less than 100 per cent (standard compaction) as determined by AS 1289.5.4.1

(b) Laying of Pipe

- | | |
|--|--|
| <p>1. Thick walled UPVC pressure pipe, complying with AS 1477, and having a nominal diameter of 58 mm and a minimum pipe wall thickness of 6.5 mm, shall be used with crushed rock subbase having not more than 10 per cent of material passing the 9.5 mm AS sieve and having a layer thickness neither less than 150 mm nor more than 200 mm or open graded asphalt subbase having a layer thickness neither less than 80 mm nor greater than 100 mm.</p> | <p>UPVC Pressure Pipe</p> |
| <p>2. Where a crushed rock subbase require pavement drains and has a depth exceeding 200 mm, the type of pavement drain will need to be certified to have adequate crushing strength and the written approval of Council's Supervising Engineer to the proposed pavement drain type will be required. A similar proposal and the approval of Council's Supervising Engineer is required for pavement drains in asphalt subbase greater than 100 mm in depth.</p> | <p>Fibre Reinforced Cement Pipe</p> |
| <p>3. All pipes shall be slotted except where otherwise shown on the Drawings. Details of slot sizes and spacings shall be in accordance with Annexure C232-A for thick walled UPVC pressure pipe.</p> | <p>Slot Size</p> |
| <p>4. Thick walled UPVC pressure pipe shall have square ends and shall be butt jointed.</p> | <p>UPVC Pipe Joints</p> |
| <p>5. Where spigot and socket type pipes are used, the pipes shall be joined with the socket ends facing upstream.</p> | <p>Spigot and Socket Joints</p> |
| <p>6. The pipe shall be laid to the specified line and level. The pipe shall not deviate from the specified line by more than 100mm at any point.</p> | <p>Level</p> |
| <p>7. The inlet ends of all pipes shall be fitted with caps.</p> | <p>Inlet Caps</p> |
| <p>8. All pipes shall be securely held to the layer under the free-draining subbase to prevent movement of the pipes during placement and compaction of the free-draining subbase. At least seven days before commencement of pipe laying the Contractor shall submit details of the proposed method of securing the pipes to the layer under the free-draining subbase for the approval of Council's Supervising Engineer.</p> | <p>Pipe Anchorage</p> |
| <p>9. Notwithstanding the approval of Council's Supervising Engineer to the use of a method of securing the pipes to the layer under the free draining subbase, if such securing method allows movement of the pipes, the method shall be discontinued and the Contractor shall propose an alternative securing method for the approval of Council's Supervising Engineer.</p> | <p>Alternative Securing Method</p> |
| <p>10. The outlet length of pipe from the outside edge of the free-draining subbase to an outlet structure in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with suitable couplings or mastic.</p> | <p>Outlet Length</p> |

(c) Backfilling

- | | |
|--|-----------------------|
| <p>1. Subbase material shall be spread, compacted and trimmed, where appropriate, as follows:</p> | <p>Subbase</p> |
| <p>(a) For crushed rock Macadam subbase, in accordance with Specification C242 - FLEXIBLE PAVEMENTS.</p> | |
| <p>(b) For open graded asphalt subbase, in accordance with Specification C245 - ASPHALTIC CONCRETE.</p> | |

PAVEMENT DRAINS

2. Tipping, spreading and compaction of the subbase shall be undertaken in such a manner as not to damage the intra-pavement drain pipes. If any pipes are damaged as a result of the tipping, spreading and compaction of the subbase, the Contractor shall remove and replace the damaged pipes. **Damage to Pipes**
3. The thickness of the layer of subbase material enclosing the pipe shall be within the limits specified in Clause C232.06 (b) for the type of pipe used in the intra-pavement drain. **Subbase Layer Thickness**

(d) Outlets

1. Outlets are to be provided as shown on the Drawings or at maximum intervals of 80m. Where possible intra-pavement drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, each pipe shall be extended using a 60-degree bend and unslotted pipe to discharge through the fill batter and an outlet structure constructed on the discharge end in accordance with the Drawings. **Location**
2. The outlet shall be made rodent proof in accordance with the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL. **Rodent Proof**
3. The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet. **Erosion Control**

C232.07 EDGE DRAINS

(a) Excavation

1. The verge material shall be trimmed to subgrade level and to the minimum width shown on the Drawings. The bottom of the trench is to be constructed at the same grade as the roadway and in such a manner that localised ponding of water does not occur. **Width and Level**
2. Where the grade of the roadway is less than 0.5 per cent the trench shall be excavated to provide a minimum grade of 0.5 per cent. **Grade**
3. When the pipe is to discharge through the fill batter a suitable trench shall be excavated to provide the required grade. **Discharge Pipe**

(b) Laying of Pipe

1. Generally, 65mm diameter slotted corrugated plastic pipe enclosed in seamless tubular filter fabric, complying with Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be used for edge drains. **Slotted Plastic Pipe**
2. Where any part of a shoulder consists of material other than concrete, slotted thick walled unplasticised PVC pressure pipe, complying with AS 1477 shall be used. Spigot and socket type pipes shall be joined with the socket ends facing upstream and the ends of each pipe shall be securely held against the vertical face of the rigid pavement. At least seven days before commencement of pipe laying the Contractor shall submit details of the proposed method of securing the pipes against the rigid pavement for the approval of Council's Supervising Engineer. **Slotted Fibre Cement Pipe**
3. The pipe shall be laid on a prepared bed to the specified line and level. **Prepared Bed**
4. Joints in the pipe shall be kept to a minimum number and shall be made using an external joint coupling approved by Council's Supervising Engineer. **Jointing**
5. The inlet end of the pipe shall be fitted with a cap. **Inlet Cap**
6. The outlet section of a pipe from the vertical face of the rigid pavement to an outlet in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with mastic. **Outlet Pipe**

(c) Backfilling

1. The pipe shall be covered with Type B filter material as shown in Table C230.2 **Filter Material**
2. Mechanical compaction of this filter material is not required; however after placement of the filter material it shall be soaked with water. Where necessary additional filter material shall be added and soaked to provide the final dimensions shown on the Drawings. **Soaking of Filter Material**
3. Backfilling over the edge drain shall be done in such a manner as to avoid damage or disturbance of the pipe. Backfill material shall be selected material as required for verges and in accordance with the requirements of the Specification EARTHWORKS. Backfilling shall be compacted to a relative compaction of not less than 100 per cent (standard compaction) as determined by AS 1289.5.4.1. **Procedure and Compaction**

(e) Outlets

1. Unless otherwise shown on the Drawings outlets are to be provided at maximum intervals of 80m. Where possible edge drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the Drawings shall be constructed at the discharge end. **Location**
2. The outlet shall be made rodent proof in accordance with the requirements of Specification C230 - SUBSURFACE DRAINAGE – GENERAL. **Rodent Proof**
3. The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet. **Erosion Control**

LIMITS AND TOLERANCES**C232.08 SUMMARY OF LIMITS AND TOLERANCES**

Item	Activity	Tolerances	Spec Clause
1.	Excavation Trench Grade	≥0.5%	C232.05(a) C232.07(a)
2.	Sub-Pavement Drain Backfill		
	(a) Layer Thickness	300 mm max.	C232.05
	(a) Compaction (Relative)		
	Filter Material	100% Standard	C232.05(c)
	Backfill Material	100% Standard	C232.05(c)
4.	Outlet Spacing	80 m max.	C232.05(e) C232.06(d) C232.07(e)
5.	Intra-pavement drain		
	(a) Alignment	Deviation < 100 mm from specified line at any point	C232.06(b)

PAVEMENT DRAINS

Item	Activity	Tolerances	Spec Clause
6.	Edge Drains		
	Compaction (Relative)		
	Backfill material	100% Standard	C232.07(c)

Table C232.1 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C232.09 RESERVED

ANNEXURE C232.A

SLOTTING DETAILS FOR THICK WALLED UNPLASTICISED PVC PLASTIC PIPE

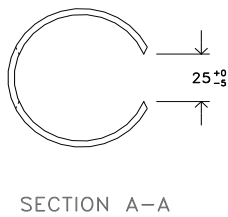
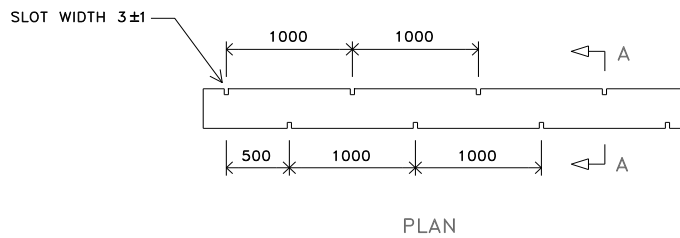


Diagram not to scale
Dimensions are in millimetres

CONSTRUCTION SPECIFICATION

C233

DRAINAGE MATS

SPECIFICATION C233 - DRAINAGE MATS**CONTENTS**

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SPECIFICATION C233 : DRAINAGE MATS

GENERAL

C233.01 SCOPE

1. The work to be executed under this Specification covers the installation of Drainage Mats (Blankets). **Scope**
2. Drainage mats shall be constructed where and as shown on the Drawings or as directed by The Geotechnical Engineer or Council's Supervising Engineer. **Location**
3. This Specification should be read in conjunction with Specification C230 - SUBSURFACE DRAINAGE - GENERAL. **Associated Specification**

C233.02 TERMINOLOGY

1. Type A drainage mats are intended to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. **Type A Mats**
2. Type B drainage mats are constructed to intercept water, which would otherwise enter pavements by capillary action or by other means on fills, and to intercept and control seepage water and springs in the floors of cuttings. **Type B Mats**

C233.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**
 - (a) **Council Specifications**
 - C230 - Subsurface Drainage - General
 - C232 - Pavement Drains
 - (b) **Australian Standards**
 - AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio.

C233.04 ORDER OF CONSTRUCTION

1. Type A drainage mats shall be constructed after the site has been cleared and grubbed and before commencement of embankment construction. **Type A Mats**
2. Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement. **Type B Mats**

CONSTRUCTION

C233.05 TYPE A MATS

1. Type A drainage mats shall be constructed under embankments as and where shown on the Drawings or as directed by The Geotechnical Engineer or Council's Supervising Engineer. **Location**
2. After the embankment foundation has been trimmed and any necessary trench **Placing of**

drains installed, a geotextile complying with the requirement of Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be laid on the embankment foundation. The area of geotextile laid shall be sufficient to cover the area of the Type A drainage mat and an additional amount for enclosing the sides of the drainage mat after the filter material has been placed. Laps of minimum width of 500mm shall be provided at each join in the geotextile.

Geotextile

3. Filter material, as shown on the Drawings or as determined by The Geotechnical Engineer or Council's Supervising Engineer shall be placed on the geotextile and compacted to the satisfaction of The Geotechnical Engineer or Council's Supervising Engineer. The minimum thickness of the compacted filter material shall be 300mm plus an allowance for the expected consolidation of the embankment foundation under the embankment load or 500mm if the amount of the expected total consolidation of the embankment foundation is not known. The filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250mm.

***Placing of
Filter Material***

4. After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing subsequent layers of filter material or earth filling over the drainage mat.

***Securing of
Geotextile***

5. An additional layer of geotextile shall be placed on the drainage mat under the base of any rock facing which may be placed as part of the embankment construction. The additional layer of geotextile shall extend beyond the outside and inside faces of the bottom layer of rock.

***Geotextile
under Rock
Facing***

6. Care shall be taken not to damage the geotextile during the construction of the drainage mat or during placement of subsequent layers of filter material, earth filling or rock facing. Any geotextile so damaged shall be repaired or replaced by the Contractor to the satisfaction of The Geotechnical Engineer or Council's Supervising Engineer. The cost of repairing or replacing such damaged geotextile shall be borne by the Contractor.

***Damaged
Geotextile******Contractor's
Cost***

7. Type A drainage mats shall extend 2m beyond the toes of embankments and such extensions shall be covered by a 300mm thick layer of filter material, as determined by The Geotechnical Engineer or Council's Supervising Engineer. This protective layer shall be placed immediately after completion of construction of each drainage mat.

***Protective
Layer***

8. Outlets from Type A drainage mats may be surface outlets at the toes of embankments or piped outlets connected to other drainage systems. Where piped outlets are constructed they shall conform to the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL.

Outlets

C233.06 TYPE B MATS

1. Type B drainage mats shall be constructed in cuttings as and where shown on the Drawings or as directed by The Geotechnical Engineer or Council's Supervising Engineer. Type B drainage mats shall be constructed for the full width of cuttings and for the pavement width in other locations.

***Location and
Width***

2. After the subgrade material has been compacted and trimmed, a geotextile complying with the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL, shall be laid on the subgrade. Laps of minimum width of 500mm shall be provided at each join in the geotextile.

***Placing of
Geotextile***

3. Slotted thick walled unplasticised PVC pressure complying with As 1477, shall be laid on the geotextile at a distance of 200 mm from and parallel to the longitudinal edges of the drainage blanket as shown on the Drawings. Details of slot sizes and spacings are shown in Specification C233 - PAVEMENT DRAINS.

***UPVC Pressure
Pipe***

4. Filter material complying with the requirements in Table C230.1 shall be placed on the geotextile and compacted to achieve a relative compaction, determined by AS

***Placing and
Compaction of***

DRAINAGE MATS

1289.5.4.1 of at least 100 per cent (standard compaction). Alternatively, The Geotechnical Engineer or Council's Supervising Engineer may approve the use of a coarser filter material having a maximum particle size of 75mm and a maximum D90/D10 ratio of three.

Filter Material

5. The thickness of the compacted filter material shall be as shown on the Drawings or as tabled in this specification. If the required thickness of compacted filter material is greater than 250mm, the filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250mm.

Thickness of Filter Material

6. After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing pavement layers over the drainage mat.

Securing of Geotextile

7. Care shall be taken not to damage the geotextile during the construction of the drainage mat or during placement of subsequent pavement layers. Any geotextile so damaged shall be repaired or replaced by the Contractor to the satisfaction of The Geotechnical Engineer or Council's Supervising Engineer. The cost of repairing or replacing such damaged geotextile shall be borne by the Contractor.

Damaged Geotextile

Contractor's Cost

8. The surface of the completed drainage mat shall be at the design level for the top of the drainage mat with a tolerance of plus zero and minus 40mm.

Surface Level Tolerance

9. Outlet structures where specified, or where directed by The Geotechnical Engineer or Council's Supervising Engineer, shall be in accordance with the requirements of Specification C230 - SUBSURFACE DRAINAGE - GENERAL.

LIMITS AND TOLERANCES

C233.07 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C233.1 below.

Item	Activity	Tolerances	Spec Clause
1.	Filter Material		
	(a) Layer Thickness	250 mm max.	C233.05 C233.06
	(a) Compaction (Relative) Type A filter material	100% Standard	C233.06
2.	Type B Mats		
	Design Level at top of mat	+0, -40 mm	C233.06

Table C233.1 - Table of Limits and Tolerances

SPECIAL REQUIREMENTS

C233.08 RESERVED

CONSTRUCTION SPECIFICATION

C241

STABILISATION

SPECIFICATION C241 : STABILISATION

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SPECIFICATION C241 : STABILISATION

GENERAL

C241.01 SCOPE

1. This specification defines the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

2. The work to be executed under this Specification consists of the supply and incorporation of stabilising binders with material in a nominated pavement course or subgrade materials (including materials for the selected material zone, selected backfill and other subgrade layers), at specified locations in the work and the spreading, compaction, trimming and curing of such materials.

Scope

3. This Specification specifies the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table C241.1.

PAVEMENT COURSE OR SUBGRADE ZONE OR LAYER	STABILISING BINDER
PAVEMENT COURSE Base and Subbase	Blended Stabilising Agent Hydrated Lime (pugmill) Portland Cement (pugmill) Quicklime (in-situ)
SUBGRADE ZONE OR LAYER Selected Material Zone	Blended Stabilising Agent Hydrated Lime (pugmill) Quicklime (in-situ)
Other Subgrade Layers	Blended Stabilising Agent Hydrated Lime (pugmill) Quicklime (in-situ)
Selected Backfill Zone	Hydrated Lime (pugmill)

The type of stabilising agent is to be determined by NATA Registered Geotechnical Laboratories upon investigating the subject pavement.

**Table C241.1
TYPES OF PAVEMENT COURSES, SUBGRADE ZONES
OR LAYERS AND STABILISING BINDER**

4. The pavement course or subgrade zone or layer to be stabilised shall be as specified in Specification C242 - FLEXIBLE PAVEMENTS, or as indicated on the Drawings.

**Associated
Specifications**

C241.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Council Specifications

C201	-	Control of Traffic
C213	-	Earthworks
C220	-	Stormwater Drainage – General
C242	-	Flexible Pavements

(b) Australian Standards

AS 1141.11	-	Particle size distribution by dry sieving.
AS 1289.4.2.1	-	Determination of the sulphate content of an undisturbed soil and the sulphate content of the ground water.
AS 1289.5.7.1	-	Compaction control test (Rapid method)
AS 1289.5.8.1	-	Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode.
AS 1289.6.1.1	-	Determination of the California Bearing Ratio of a soil – Standard laboratory method for a remoulded specimen.
AS 2350.4	-	Setting time of Portland and blended cements.
AS 2350.9	-	Fineness of Portland fly ash cement.
AS 3582.1	-	Fly ash.
AS 3582.2	-	Slag - Ground granulated iron blast furnace.
AS 3583.3	-	Determination of loss on ignition.
AS 3583.6	-	Determination of relative water requirement and relative strength.
AS 3583.12	-	Determination of available alkali
AS 3583.13	-	Determination of chloride ion content.
AS 3583.14	-	Determination of insoluble residue content
AS 3972	-	Portland and blended cements.

(c) RTA Test Methods

T136	-	Rate of Spread of Stabilising Agent
T430	-	Available Calcium Oxide or Calcium Hydroxide in Lime
T432	-	Rate of Slaking of Quicklime
T433	-	Determination of Sieve Residue of Fly Ash and Hydrated Lime
T1004	-	Quantitative Determination of Chloride Ion in Water where Chloride Content is more than 15 p.p.m.

INSPECTION, SAMPLING AND TESTING

C241.03 MATERIALS PROPOSED FOR USE IN THE WORK

1. The Contractor shall provide to Council's Supervising Engineer a certificate from a laboratory with appropriate NATA registration stating that the mix or mixes submitted and the mix constituents comply with the mix nominated in Annexure C241A. It shall also state that the stabilised material meets the requirements of Specification C213 - EARTHWORKS if incorporated into the works as a pavement layer or alternatively Specifications C213 - EARTHWORKS or C220 - STORMWATER DRAINAGE - GENERAL.

**Contractor's
Responsibility**

C241.04 MATERIALS USED IN THE WORK

1. The Contractor shall undertake regular inspection, sampling and testing of pavement and subgrade materials while stabilisation is in progress in accordance with this Specification.

Sampling and Testing

MATERIALS**C241.05 CEMENT**

1. The type of cement used as the stabilising agent or a constituent in a blended stabilising agent shall comply with AS 3972.

Type

2. Cement shall be from a source included in the New South Wales Government Quality Assurance Scheme applicable to the period covered by the Contract.

Quality

3. The Contractor shall nominate the brand and source of all cementitious materials.

Nominated Brand and Source

4. Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Council's Supervising Engineer upon request at any time.

Proof of Quality

5. If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Contractor shall arrange a re-test, to ensure the cement still complies with AS3972, before the cement is used in the work. The cost of retesting cement that has been stored for a period in excess of three months shall be borne by the Contractor. Test results shall be forwarded to the Council's Supervising Engineer for approval at least 2 days in advance of usage of the material.

Storage in Excess of 3 months

C241.06 QUICKLIME

1. Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

Properties

(i) Available Lime The content of calcium oxide, determined by Test Method T430, shall not be less than 85 per cent.

(ii) Slaking Rate The active slaking time shall not be greater than twenty minutes and the temperature rise on slaking, determined from the average of four samples tested in accordance with Test Method T432, shall not be less than 40°C in six minutes.

2. The particle size distribution of the quick lime determined by AS 1141.11 shall comply with the following requirements in Table C241.2.

Particle Size

A. S. SIEVE	PER CENT PASSING
13.2mm	100
9.5mm	96 - 100
4.75mm	70 - 100
2.36mm	0 - 90

Table C241.2
Particle Size Distribution of Quicklime

C241.07 HYDRATED LIME

1. Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties: **Properties**

- (i) Available Lime The content of calcium hydroxide, determined by Test Method T430, shall not be less than 80 per cent.
- (ii) Form The material shall be in powder form.
- (iii) Residue on Sieving (Particle Size) The residue on a 300 micron sieve, determined by Test Method T433, shall not exceed 2 per cent.

2. The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

- (a) Percentage of calcium hydroxide
- (b) Fineness - Percentage by mass passing the 45 micron sieve (AS 2350.9).
- (c) Source.

C241.08 GROUND GRANULATED BLAST FURNACE SLAG

1. The ground granulated blast furnace slag shall conform to AS 3582.2.

2. The properties which characterise the particular ground blast furnace slag to be used in the stabilising agent submitted as part of the mix design are: **Properties**

- (a) Fineness - percentage by mass passing the 45 micron sieve (AS 2350.9).
- (b) Relative strength (28 days) (AS 3583.6).
- (c) Source.

C241.09 FLYASH

1. Flyash shall conform to AS 3582.1.

2. The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are: **Properties**

- (a) Fineness - percentage by mass passing the 45 micron sieve (AS 2350.9).
- (b) Loss on ignition (AS 3583.3).
- (c) Source.

C241.10 BLENDED STABILISING AGENTS

1. A blended stabilising agent may be used. Mill and batch information that will make the blended stabilising agent traceable to the supplier's test results shall be obtained and provided to Council's Supervising Engineer upon request. The handling and storage requirements of the Supplier shall be complied with. Sampling of the agent as required by Council's Supervising Engineer shall also be arranged. **Requirements**

2. The components of the nominated blended stabilising agent shall not vary by more than ± 3 per cent from the blend percentages nominated in the mix design described in Annexure C241A.

3. When a blended stabilising agent is produced from a combined grinding of components the following properties will characterise the particular stabilising agent blend:

Properties

- (a) Source of each component.
- (b) Fineness - percentage by mass passing the 45 micron sieve (AS 2350.9).
- (c) Setting time (AS2350.4).

C241.11 WATER

1. Water shall be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. The water shall not contain more than:

Quality

- (a) 600 parts per million of chloride ion, determined by Test Method T1004.
- (b) 400 parts per million of sulphate ion, determined by AS 1289.D2.1.
- (c) 1 percent by mass of undissolved solids.

2. Water accepted as potable and fit for human consumption will not require testing to confirm suitability.

Potable

STABILISATION PROCESSES

C241.12 GENERAL

1. The Contractor shall submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work to the Council's Supervising Engineer 14 days prior to commencement of the work. This submission, hereafter called the Work Plan, will nominate the sequence of operations, widths of stabilisation passes and provision for traffic if appropriate.

**Proposed
Equipment and
Procedures**

2. Notwithstanding submission to Council's Supervising Engineer of the Contractor's equipment and stabilisation procedures, the work shall meet all the Specification requirements and the Contractor shall perform such tests as specified as the work proceeds, to ensure compliance. Costs of such tests shall be borne by the Contractor.

**Compliance
Contractor's
Cost**

3. Stabilisation of pavement materials shall not proceed during wet weather or if rain is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix.

**Weather
Conditions**

C241.13 APPLICATION OF STABILISING AGENT

(a) Stationary Mixing Plant

1. Application rate of stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by Council's Supervising Engineer.

**Application
Rate**

2. Application rate measured in kilograms per tonne of product shall be monitored and recorded for every 100 tonnes of production.

Measurement

STABILISATION

3. The achieved accuracy of application rate shall be <10 per cent of the nominated rate.

4. The application rate shall not be allowed to exceed the nominated rate by more than 10 per cent.

Over Spread

(b) In-Situ

1. The incorporation of stabilising agent is to follow a process where stabilising agent is spread on the pavement in advance of the specialist mixing equipment.

Application Process

2. Spreading shall be carried out using the mechanical spreader nominated in the Work Plan and subsequently approved by Council's Supervising Engineer. Annexure C241A nominates the spread rate.

Spreading Rate

3. The actual spread rate as determined by Test Method T136 shall be within ± 10 per cent of the nominated rate. The Contractor shall verify this by testing the spread rate for each lot or 500m² (whichever is less) of pavement treated in each application of binder. Spread rate testing shall be performed by weighing the contents of a suitable four sided tray placed on the pavement and between the wheels of the mechanical spreader. The rate of stabilising agent spread shall be calculated by dividing the mass collected (in kgs) by the area of the tray (in m²).

Tolerances

4. Where spreading vehicles are fitted with load cells, the Contractor shall ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run. The Contractor shall record this data for each run and make it available to Council's Supervising Engineer promptly. Such action will not negate the Contractor's obligation to undertake prescribed testing of spread rate if required by Council's Supervising Engineer.

Load Cells

5. The actual spread rate shall not exceed the nominated rate by more than 10 per cent. The stabilising agent spread in excess of the nominated rate shall be at no cost to Council.

Over Spread Contractor's Cost

6. Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property.

Wind

7. Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material until it has been mixed into the layer to be stabilised.

Construction Traffic

8. Any spillage of the stabilising agent on site or at any loading location related to the site shall be removed as soon as possible and in any case within 24 hours of such spillage.

Spillage

C241.14 MIXING

(a) Stationary Mixing Plant

1. The stationary mixing plant shall be purpose built for the process of mixing road making materials. All equipment shall be maintained and calibrated so as to provide a uniformly mixed product without segregation of the aggregate material.

Equipment

2. The plant shall provide for the controlled and metered inclusion of water into the mix.

Control of Water

3. The stationary mixing equipment shall incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements. This performance shall meet the requirements of Council's Supervising Engineer and may be confirmed by monitoring of unconfined compressive strength of production, in accordance with AS 1289.6.1.1, with a pair of test specimens tested for each 400 tonnes of production and at no cost to the Council.

Uniform Mixture

(b) In-situ

- | | |
|---|---------------------------------|
| <p>1. Mixing equipment shall be purpose built for the process of in-situ mixing of road making materials. It shall be capable of mixing to the depth specified for the layer to be stabilised and of distributing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised. A minimum of two passes of the mixing equipment is required. As mixing blades or tynes wear they shall be replaced so as to maintain mixing efficiency consistent with that demonstrated during the trial section. The mixing equipment will be capable of supplying a calibrated amount of water to the mixing bowl in such a manner as to provide a uniformly moist mix to a target moisture content.</p> | <i>Equipment</i> |
| <p>2. The resultant mix shall be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.</p> | <i>Uniform Mixture</i> |
| <p>3. The procedure nominated in the Work Plan shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.</p> | <i>Disturbance</i> |
| <p>4. Council's Supervising Engineer may require that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content. Such additional work shall be carried out at no cost to the Council.</p> | <i>Additional Mixing</i> |

C241.15 FIELD WORKING PERIOD

- | | |
|---|--|
| <p>1. The Field Working Period is nominated as the time period from addition of water during the mixing process until the completion of compaction. This period will vary significantly with variations in the type of stabilising agent.</p> | <i>Definition</i> |
| <p>2. The nominated Field Working Period shall be provided in Annexure C241A for the stabilising agent approved for the works. The Nominated Field Working Period shall be based on laboratory tests determining the time from mixing until such time as the calculated Wet Density for modified compaction procedures decreases by more than 2 percentage points. This testing shall be undertaken utilising AS 1289.5.7.1 and samples of the materials representative of those to be utilised in the works.</p> | <i>Based on Laboratory Tests</i> |
| <p>3. The Contractor will complete the compaction process within the Nominated Field Working Period unless Council's Supervising Engineer provides specific approval to an adjustment for site and seasonal conditions.</p> | <i>Compaction within Field Working Period</i> |

C241.16 TRIMMING AND COMPACTION

- | | |
|--|---|
| <p>1. After mixing the layer shall be trimmed and compacted in accordance with Specification C213 - EARTHWORKS to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the design levels beyond the tolerance for primary trimming specified in Clause C241.18 (a).</p> | <i>Level Tolerance</i> |
| <p>2. Subsequent secondary trimming may be undertaken on one or more occasions in preparation for primer seal and with the objective of meeting shape and level requirements. Secondary trimming shall involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurring will not be accepted. The Contractor's survey control methods as stated in the Work Plan will be adequate to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent such that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified in Clause C241.18 (b). When required by Council's Supervising Engineer survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary trimming. This survey will be at no cost to the Council.</p> | <i>Secondary Trimming</i>

<i>Contractor's Cost</i> |
| <p>3. All trimmed material having been cut to waste shall be used as fill or spoiled as directed by Council's Supervising Engineer.</p> | <i>Trimmed Material</i> |

STABILISATION

4. Measurements with a 3 metre straight edge shall be taken at a minimum of 10 randomly selected stations so as to represent a 200-metre lane length or part thereof. Deviation of the surface from the bottom of a 3 metre straight edge placed in any direction will meet the tolerance shown in Clause C241.18 (a). This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component. **Straight Edge Test**
5. The stabilised layer shall be compacted over the entire area and depth so that the relative compaction determined by AS 1289.5.7.1 is not less than that detailed in Specifications C213 - EARTHWORKS or C220 - STORMWATER DRAINAGE – GENERAL as appropriate. **Compaction**
6. To provide true relative compaction assessments the lots shall be sampled and tested within the nominated field-working period in accordance with AS 1289.5.7.1. **Test Method**
7. The maximum wet density (modified compaction) will be determined by sampling immediately after the determination of field density and testing will be undertaken within 2 hours of sampling. A determination of maximum wet density (modified compaction) is required for each sampling location when calculation of relative compaction is undertaken. **Wet Density**
8. The field density may be determined by in-situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode in accordance with AS 1289.5.8.1. **In-Situ Dry Density**

C241.17 JOINTS

1. Joints are defined in this Specification to comprise interfaces between work episodes that are separated in time by more than the nominal field-working period for the nominated stabilisation mix design. A longitudinal joint shall be considered to be a joint generally parallel to the road centreline. A transverse joint occurs when a length of work is terminated and extended at a later time after a period that exceeds the nominated field-working period. **Joint Type**
2. All longitudinal and transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections. A minimum longitudinal overlap of mixing runs shall be 75mm. Transverse joints shall be overlapped by a minimum of 2 metres. The material disturbed during cutting back shall be remixed at full depth and incorporated into the new work. No longitudinal joints shall be allowed within 0.5 metre of the centreline of a typical wheel path. **Cutting Back**
3. The level and shape of the joints shall be within the limits specified in Clause C241.18. **Finish**

C241.18 TOLERANCES

(a) Levels and Surface Trim

1. The surface level after primary trimming shall be within a tolerance of +30mm and +10mm of the levels shown on the Drawings. **Primary Trimming**
2. The surface level after secondary trimming shall be within a tolerance of +15 mm and –15 mm of the levels shown on the Drawings. **Secondary Trimming**
3. The pavement surface after secondary trimming and immediately prior to sealing shall be of a quality such that deviation under a 3 metre straight edge does not exceed 12mm.

(b) Layer Thickness

1. The final thickness of the stabilised layer at any point shall be within a tolerance of +20mm and -10mm of the nominated layer thickness. **Minimum Thickness**

- | | |
|--|-------------------------------------|
| <p>2. The average thickness of the layer in a lot shall be determined from measurements of six randomly selected locations over any 200m length. The average thickness shall not be less than that required to meet the specified final thickness tolerances after trimming.</p> | <i>Average Thickness</i> |
| <p>3. The layer thickness shall be measured at the edges of the stabilising run before compaction commences. The layer thickness shall be measured relative to the finished design level.</p> | <i>Method of Measurement</i> |

(c) Width

- | | |
|---|-----------------------------|
| <p>1. The width of the stabilised layer measured at any point shall be not less than the specified width as shown in the Drawings by more than 50mm.</p> | <i>Minimum Width</i> |
| <p>2. The average width of the layer determined from measurements at 3 sites selected at random by Council's Supervising Engineer over any 200m shall be not less than the specified width.</p> | <i>Average Width</i> |

C241.19 CURING

- | | |
|---|-----------------------------|
| <p>1. The Work Plan shall contain details of the proposed method of curing and shall be submitted to Council's Supervising Engineer.</p> | <i>Notice</i> |
| <p>2. The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal.</p> | <i>Water Curing</i> |
| <p>3. Water curing shall consist of frequent light uniform spraying that will not produce significant runoff or flooding on sections of the area. Slurrying of the surface or leaching of the stabilising agent shall be avoided.</p> | <i>Caution</i> |
| <p>4. Under this Specification provision for curing up to the period indicated in Annexure C241A shall be the responsibility of the Contractor, at no cost to Council.</p> | <i>Curing Period</i> |

LIMITS AND TOLERANCES**C241.20 SUMMARY OF LIMITS AND TOLERANCES**

1. The tolerances applicable to the various clauses of this Specification are summarised in Table C241.3 below:

Item	Activity	Tolerances	Spec Clause
1.	Quicklime		
	a) Available Lime	>85% Calcium Oxide content (Test Method T430)	C241.06
	b) Slaking Rate	Active Slaking time < twenty minutes, and temperature rise on slaking not less than 40°C in six minutes (for an average of four samples). (Test Method T432)	C241.06
	c) Particle Distribution	Fraction passing AS Sieve: 100% for 13.2mm Sieve 96-100% for 9.5mm Sieve 70-100% for 4.75mm Sieve 0-90% for 2.36mm Sieve	C241.06
2.	Hydrated Lime		
	a) Available Lime	>80% Calcium Hydroxide (Test Method T430)	C241.07
	b) Particle Size	<2% residue on a 300 micron Sieve (Test Method T433)	C241.07
3.	Blended Stabilising Agents	Blend percentages shall not vary by more than $\pm 3\%$ from those nominated in Annexure C241A	C241.10
	a) Portland Cement		C241.10
4.	Water		
	a) Chloride ion content	<600 PPM Chloride ion (Test Method T1004)	C241.11
	b) Sulphate ion content	<400 PPM Sulphate ion (AS 1289.D2.1)	C241.11
	c) Undissolved solids	<1 percent by mass of undissolved solids	C241.11

Item	Activity	Tolerances	Spec Clause
5.	Application of Stabilising Agent		
	a) Spread Rate or Incorporation Rate for in-situ plant.	Actual spread rate shall be within $\pm 10\%$ of the nominated rate (Test Method T136)	C241.13
6.	Trimming and Compaction		
	a) Surface Level	After primary trimming be within +30 mm and +10 mm of levels shown on Drawings After secondary trimming be within ± 15 mm of levels shown on Drawings	C241.18 (a)
	b) Layer Thickness	Final thickness of layers shall not vary more than +20mm and -10mm of required thickness	C241.18 (b)
	c) Shape	Shall not deviate more than 12mm under a 3m straight edge immediately prior to first sealing	C241.18 (a)
7.	Joints		
	a) Longitudinal Overlap	> 75mm overlap of mixing runs	C241.17
	b) Transverse Overlap	> 2m overlap of transverse joints	C241.17
	c) Longitudinal Joints	Shall not be allowed within 0.5m of the centreline of a typical wheel path	C241.17
8.	Width		
	a) Width of Stabilised Layer	At any point, the width shall be not less than 50 mm short of the width shown on the Drawings, with an average width always greater than that shown on the Drawings	C241.18(c)

Table C241.3 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C241.21 RESERVED

C241.22 RESERVED

C241.23 RESERVED

ANNEXURE C241.A

STABILISATION MIX DESIGN

All details are to be determined by the Contractor or its consultant Engineer and submitted to the Council's Supervising Engineer for assessment a minimum of 14 days prior to commencing any work on the site.

Type of Stabilising Agent
.....
.....

Nominal Percentage of Stabilising Agent by Mass %

Spread Rate of Stabilising Agent (kg/m²)

Depth of Compacted Layer to be Stabilised (mm)

Nominated Field Working Period (hrs)

Nominated Target Unconfined
Compressive Strength (UCS)
(7 day accelerated curing) MPa

Nominated Target CBR Value
(4 day soaked) for stabilised
modified subgrade %

Period for Contractor's Curing (days)

Nominated Granular Material(s) (type)

Source of Nominated Granular Material

CONSTRUCTION
SPECIFICATION

C242

FLEXIBLE PAVEMENTS

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Pavement joint	C242.05	A	BG	1/3/16
2	Minimum material quality	C242.07	A	BG	1/3/16
3	CSS75 Material	C242.09	A	BG	1/3/16
4	Material Properties	Table C242.4	A	BG	1/3/16
5	Recycled Materials	C242.09	A	BG	1/3/16
6	Benkelman Beam Testing	C242.20	A	BG	1/3/16

SPECIFICATION C242 : FLEXIBLE PAVEMENTS

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SPECIFICATION 242 : FLEXIBLE PAVEMENTS

GENERAL

C242.01 SCOPE

1. The work to be executed under this Specification consists of the supply, spreading, compaction and trimming of base and subbase courses of flexible pavements to the specified levels and thicknesses as shown on the Drawings. This includes pavements containing bound material layer(s).

C242.02 TERMINOLOGY

- (a) Materials designated as 'base' require the provision of a wearing surface comprising either a sprayed bituminous seal or asphalt up to 100mm thick.
- (b) Materials designated as 'subbase' require a covering course of 'base'. The subbase may consist of one or more layers.
- (c) A flexible pavement consists of a base and a subbase constructed of unbound, modified or bound materials.
- (d) Bound material incorporates a cementitious binder to produce structural stiffness.
- (e) Modified material incorporates small amounts of chemical modifying agent(s) to improve the properties of the material without significantly affecting structural stiffness.

Definitions

C242.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Council Specifications

- C241 - Stabilisation
- C244 - Sprayed Bituminous Surfacing
- C245 - Asphaltic Concrete

(b) Australian Standards

- AS 1141.14 - Particle shape, by proportional calliper.
- AS 1141.22 - Wet/dry strength variation.
- AS 1289.3.1.1 - Determination of the liquid limit of a soil - Four point Casagrande method.
- AS 1289.3.3.1 - Calculation of the plasticity index of a soil.
- AS 1289.5.2.1 - Determination of the dry density/moisture content relation of a soil using modified compactive effort.
- AS 1289.5.8.1 - Determination of field density and field moisture content of a soil using a nuclear surface moisture - density gauge – Direct transmission mode.
- AS 1289.6.1.1 - Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen.

(c) RMS Test Methods

- T106 - Coarse Particle Size Distribution (Sieve Analysis)
- T107 - Fine Particle in Road Materials
- T108 - Liquid Limit of Road Materials
- T114 - Maximum Dry Compressive Strength of Road Materials
- T116 - Unconfined Compressive Strength - Remoulded Material
- T119 - Determination of Density of Road Materials In-Situ using Sand Replacement Method.
- T130 - Dry Density Moisture Relations for Mixtures of Road Materials and Cement.
- T131 - Unconfined Compressive Strength
- T160 - Benkelman Beam Deflection Test
- T166 - Determination of Relative Compaction
- T171 - Modified Texas Triaxial Compression Test

d) AUSTRROADS

APRG Special Report No 21 - A Guide to the design of new pavements for light traffic - 1998
 A Guide to The Structural Design of Road Pavements – 1992

e) Other

- DECC Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage June 2003 (originally issued by Resource NSW).
- DIPNR Department of Infrastructure, Planning and Natural Resources (2003) Guide. Roads and Salinity.

C242.04 SALINITY

1. The Contractor shall comply with the design plans for the treatment of salinity. Treatment may include but not limited to the following:
 - Minimising depth of excavation /disturbance required for road works
 - Minimising infiltration of surface waters by providing adequate sub-soil drainage
 - Provision of adequate drainage for upstream catchments; and
 - Use of appropriate materials in construction of road works.

Salinity and depth of excavation

C242.05 PAVEMENT STRUCTURES

1. Flexible pavement material types and layer thickness shall be as shown on the Drawings or as specified in the approved pavement design.
2. Where a pavement construction joint between a new and existing pavement is proposed each layer shall be “keyed in” a minimum 150mm over the under laying layers. Where a new asphalt wearing surface is placed against an existing wearing surface the interface shall be sealed, unless Council determines it is not required, using a hot or cold applied bituminous crack sealing product.

Materials Types and layer Thickness

Pavement Joint

C242.06 INSPECTION, SAMPLING AND TESTING

1. Inspection, sampling and testing of the pavement shall be undertaken by the Contractor in accordance with the requirements of this Specification before and during the construction of the pavement. Testing shall be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.
2. The Contractor shall provide the Council’s Supervising Engineer with written notice when testing is being carried out and copies of all test reports for approval to proceed.

Contractor's Responsibility

Written Notice

3. Field density tests shall be carried out using Test Method T119 or AS 1289.5.3.1, or, with the concurrence of the Council's Supervising Engineer, a Nuclear Density Meter in accordance with Clause 242.21.

Density Tests

MATERIALS

C242.07 GENERAL

1. The Contractor shall submit details of all constituents of the proposed base and subbase materials, including sources of supply and the proposed type and proportion of any stabilising agent. These details shall be submitted to Council's Supervising Engineer, supported with test results from a nominated NATA registered laboratory confirming that the constituents comply with the requirements of this Specification. If the proposed base or subbase is a bound material, the Contractor shall submit a completed Annexure C241A contained in Specification C241 - STABILISATION.

Details of Proposed Base and Subbase to be Submitted

2. Generally, pavement material quality and compaction shall meet the following minimums:

Minimum material quality

Base course – soaked CBR not less than 80%, PI not greater than 6% and minimum dry density ratio not less than 98% Modified Compaction.

Subbase course - soaked CBR not less than 40%, PI not greater than 12% and minimum dry density ratio not less than 95% Modified Compaction.

Subgrade replacement - soaked CBR not less than 15% and minimum dry density ratio not less than 100% Standard Compaction.

Subgrade - CBR not less than 3%, PI not greater than 34% and minimum dry density ratio not less than 100% Standard Compaction.

3. No material shall be delivered until the Council's Supervising Engineer has approved the source of supply.

Source of Supply

4. If, after the Contractor's proposals have been approved, the Contractor wishes to make changes in any of the material constituents the Contractor shall inform Council's Supervising Engineer in writing of the proposed changes. No delivery of material produced under the altered proposal shall take place without the approval of Council's Supervising Engineer.

Variations by Contractor

5. At least two days before placement of the material on site, the Contractor shall submit a Certificate from a laboratory with appropriate NATA registration demonstrating and stating that the unbound material or the mix and its constituents comply with the requirements of this Specification.

6. Ongoing testing of materials during delivery and construction shall be undertaken on samples taken from the site and at the discretion of the Council.

Sampling on-site

C242.08 TRAFFIC CATEGORY

1. Pavement materials are specified in terms of the Traffic Categories given in Table C242.1 for the calculated design traffic of the pavement.

Pavement Material Traffic Category Drawings

2. The Traffic Category (or Design Traffic) for the pavement materials shall be as shown on the Drawings or as specified in the approved pavement design.

Pavement Material Traffic Category	Description
1	Roads with design traffic equal to or exceeding 10^7 equivalent standard axle (ESA) repetitions.
2a	Roads with design traffic exceeding 4×10^6 ESAs but less than 10^7 ESAs.
2b	Roads with design traffic exceeding 10^6 ESAs but less than or equal to 4×10^6 ESAs.
2c	Roads with design traffic exceeding 10^5 ESAs but less than or equal to 10^6 ESAs.
2d	Roads with design traffic less than or equal to 10^5 ESAs.

Table C242.1 - Pavement Material Traffic Categories

C242.09 UNBOUND BASE AND SUBBASE

1. Unbound materials, including blends of two or more different materials, shall consist of granular material, which does not develop structural stiffness when compacted. Material produced by blending shall be uniform in grading and physical characteristics.

Granular Material

2. Unbound crushed rock materials are designated as follows:

Crushed Rock

- DGB20 20mm nominal sized densely graded base
- DGS20 20mm nominal sized densely graded subbase
- DGS40 40mm nominal sized densely graded subbase
- FCR20 20mm nominal sized fine crushed rock base
- CSS20 20mm nominal sized crushed sandstone base
- FCR40 40mm nominal sized fine crushed rock subbase
- CSS40 40mm nominal sized crushed sandstone subbase
- CSS75 75mm nominal sized crushed sandstone subbase
- R1 20mm nominal sized recycled densely graded base. v
- R2 20mm nominal sized recycled densely graded subbase. v

3. Unbound natural gravel materials are designated as follows:

Natural Gravel

- NGB20-2c 20mm nominal sized natural gravel base for Traffic Category 2c
- NGB20-2d 20mm nominal sized natural gravel base for Traffic Category 2d
- NGS20 20mm nominal sized natural gravel subbase
- NGS40 40mm nominal sized natural gravel subbase

4. The acceptable material types for each Traffic Category are given in Table C242.2.

Material Types

FLEXIBLE PAVEMENTS

Traffic Category	Acceptable Base Material	Acceptable Subbase Material
1	DGB20-1	DGS20, DGS40, R1
2a	DGB20-2a, R1	DGS20, DGS40, R1
2b	DGB20-2b, R1	ANY CONFORMING SUBBASE
2c	DGB20-2c,, NGB20-2c, CCS20-2c, R2	ANY CONFORMING SUBBASE
2d	DGB20-2d, NGB20-2d, FCR20-2d, CCS20-2d, R2	ANY CONFORMING SUBBASE

Table C242.2 - Acceptable Pavement Material Types

5. Base materials shall comply with the requirements of Table C242.3.

Test Method	Description	Base Material Requirements			
		DGB20	R1	NGB20-2c	NGB20-2d
T106	Coarse Particle Size Distribution % passing 75.0mm sieve % passing 53.0mm sieve % passing 37.5mm sieve % passing 26.5mm sieve % passing 19.0mm sieve % passing 13.2mm sieve % passing 9.5mm sieve % passing 6.7mm sieve % passing 4.75mm sieve % passing 2.36mm sieve % passing 0.425mm sieve % passing 0.075mm sieve	- - - 100 95-100 - - 50-70 - 35-55 - -	- - - 100 95-100 70-90 - 50-70 - 35-55 10-30 5-15	- - - 100 93-100 - 71-87 - 47-70 35-56 14-32 6-20	- - - 100 93-100 - 71-87 - 47-70 35-56 14-32 6-20
T107	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36mm sieve) A. Pass 425µm sieve % B. Pass 75µm sieve % Pass 425µm sieve C. Pass 13.5µm sieve % Pass 75µm sieve	35-55 35-55 35-60	- - -	- - -	- - -
T108	Liquid Limit (if non plastic) ▽	max 20	-	max 20	max 20
AS 1289.3.1.1	Plastic Limit (if plastic)	max 20	max 27	max 20	max 20
AS 1289.3.2.1	Plasticity Index ■	max 6	Max 5	max 6	max 6
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve (only applies if Plasticity Index is less than 1)	min 1.7 MPa	min 1.7 MPa	min 1.7 MPa	min 1.7 MPa
AS 1141.14	Particle Shape by Proportional Calliper % mis-shapen (2 : 1)	max 35	max 35	-	-

Test Method	Description	Base Material Requirements			
		DGB20	R1	NGB20-2c	NGB20-2d
AS 1141.22	Aggregate Wet Strength ◊ For category 1 or 2a For category 2b or 2c For category 2d	min 80 min 70 min 60	min 70 min 70 min 70	- - -	- - -
AS 1141.22	Wet/Dry Strength Variation ◊ <u>Dry - Wet %</u> Dry For category 1 or 2a For category 2b or 2c For category 2d	max 35 max 40 max 45	max 35 max 35 max 35	- - -	- - -
AS 1289.F1.1	4 day Soaked CBR (98% Modified Compaction)	-	-	80	60

Table C242.3 - Unbound Base Material Properties

NOTES ON TABLE C242.3:

Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75 per cent of the particles larger than 6.70mm.

- ✓ The maximum value of the Liquid Limit may be increased to 23 for non-plastic material, provided that the value determined is not influenced by the presence of adverse constituents.
- For category 2d base materials the maximum Plasticity Index shall be 8.
 - ◊ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested.
- v Recycled Base and Subbase products must be approved by Council’s Supervising Engineer prior to its use for public roads construction.

FLEXIBLE PAVEMENTS

6. Subbase materials shall comply with the requirements of Table C242.4

Test Method	Description	Subbase Material Requirements						
		DGS20	DGS40	R2	NGS20	CSS40	CSS75	NGS40
T106	Coarse Particle Size Distribution % passing 75.0mm sieve % passing 53.0mm sieve % passing 37.5mm sieve % passing 26.5mm sieve % passing 19.0mm sieve % passing 13.2mm sieve % passing 9.5mm sieve % passing 6.7mm sieve % passing 4.75mm sieve % passing 2.36mm sieve % passing 0.425mm sieve % passing 0.075mm sieve	- - - 100 95-100 - - 50-70 - 35-55 - -	- 100 - - 50-85 - - 30-55 - 25-50 - -	- - - 100 85-100 70-90 - 45-70 - 30-55 10-30 5-15	- - - 100 96-100 - - 65-89 47-80 32-67 14-42 6-26	- - 90-100 80-87 - - 47-62 - 32-48 22-38 8-11 3-11	90-100 75-95 60-90 55-85 50-80 - 37-75 - 27-65 20-55 10-30 5-15	- 100 95-100 80-97 - - 48-85 - 35-73 25-58 10-33 3-21
T107	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36mm sieve) A. Pass 425µm sieve % B. Pass 75µm sieve % Pass 425µm sieve C. Pass 13.5µm sieve % Pass 75µm sieve	35-55 35-55 35-60	35-60 35-60 35-65	- - -	- - -	- - -	- - -	- - -
T108	Liquid Limit (if non plastic)	max 23	max 23	-	max 23	Max 23	Max 23	max 23
AS 1289.3.1.1	Plastic Limit (if plastic)	max 20	max 20	max 27	max 23	Max 20	Max 20	max 23
AS 1289.3.2.1	Plasticity Index	max 12	max 12	max 5	max 12	Max 12	Max 12	max 12
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve (only applies if Plasticity Index is less than 1)	min 1.0 MPa	min 1.0 MPa	min 1.0 MPa	1.0 MPa	-	-	1.0 MPa
AS 1141.14	Particle Shape by Proportional Calliper % mis-shapen (2 : 1)	max 35	max 35	max 35	-	-	-	-
AS 1141.22	Aggregate Wet Strength ♦	min 50kN	min 50kN	min 130kN	-	-	-	-
AS 1141.22	Wet/Dry Strength Variation ♦ Dry - Wet % Dry	max 60	max 60	max 40	-	-	-	-
AS 1289.F1.1	4 day Soaked CBR (98% Modified Compaction)	-	-	-	-	Min 50	Min 50	-

Table C242.4 - Unbound Subbase Material Properties

NOTES ON TABLE C242.4:

Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75 per cent of the particles larger than 6.70mm.

- ♦ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested.

7. Where the proposed unbound base material complies with all of the requirements of Table C242.3 except gradings (T106, T107), the Contractor may propose the use of the material, subject to approval of Council’s Supervising Engineer, if the material complies with the Modified Texas Triaxial Classification Number (T171) requirements specified in Table C242.5, (T171 tested at not less than 85 per cent of Optimum Moisture Content and 100 per cent of Maximum Dry Density as determined by Test Method T112 or AS 1289.5.2.1).

Modified Texas Triaxial Classification

Traffic Category	Modified Texas Triaxial Classification Number (Test Method T171)
1	max 2.0
2a	max 2.2
2b	max 2.5
2c	max 3.0
2d	max 3.0

Table C242.5 - Modified Texas Triaxial Classification Number Requirements

8. In addition to the forgoing, materials designated as R1 or R2 shall in all respects comply with the DECC Recycled Materials specification and be mostly crushed concrete and/or recycled pavement material.

Recycled Materials

The maximum limit by mass of foreign material using RTA T276 test method shall be as follows:

- Type 1 – mortar, metal, glass, asphalt, ceramics and slag: 3%
- Type 2 – plastic film, brick, plaster, clay lumps and other crushable material: 1%
- Type 3 – rubber, lumps of plastic, wood and other vegetable matter: 0.2%

C242.10 MODIFIED BASE AND SUBBASE MATERIALS

1. Modification of unbound base and subbase materials to meet the requirements of Clause C242.08 by the addition of a chemical modifying agent(s) shall be subject to approval by Council’s Supervising Engineer and to the additional requirements of this clause. After modification, the material shall meet the requirements of Clause C242.08.

Modification Of Materials

2. Modification of materials for Traffic Categories 1, 2a and 2b shall only be by use of a chemical modifying agent(s) mixed in a stationary mixing plant at the supplier’s quarry.

Traffic Categories 1, 2a, 2b

3. Modification of materials for Traffic Categories 2c and 2d may be by the use of a chemical modifying agent(s) through a stationary mixing plant or utilising in-situ operations.

Traffic Categories 2c, 2d

4. Material requirements of hydrated lime and quicklime shall be in accordance with Specification C241 - STABILISATION.

Lime

5. The method of incorporating chemical modifying agent(s) through the stationary mixing plant shall ensure that the agent is mixed uniformly through the material.

Incorporation

6. In-situ operations shall be in accordance with Specification C241 -

In-situ

FLEXIBLE PAVEMENTS

STABILISATION.

- | | | |
|-----|--|--|
| 7. | The proportion of modifying agent shall be at the approval of Council. The material prior to treatment shall not contain any added pozzolanic material. | Operations
Proportion |
| 8. | The modified material shall yield an unconfined compressive strength not exceeding 1.0 MPa, when tested in accordance with Test Method T116 commencing within 24 hours of modification. | Unconfined Compressive Strength |
| 9. | For DGB20 material, prior to being modified, the material shall comply with the requirements of DGB20 in Table C242.3, except that the aggregate wet strength shall not be less than 80kN and the wet/dry strength variation shall not exceed 60 per cent. | DGB20 |
| 10. | For DGB20, the modified material shall yield a CBR value of not less than 100 when tested in accordance with AS 1289.F1.1, commencing within 24 hours of modification. | CBR Value |

C242.11 BOUND BASE AND SUBBASE MATERIALS

- | | | |
|----|--|---|
| 1. | Bound materials utilised in pavements for Traffic Categories 1, 2a and 2b shall be supplied as a crushed rock product with the cementitious binder incorporated in a stationary mixing plant (pugmill) at the supplier's quarry. | Traffic Categories 1, 2a, 2b |
| 2. | Bound material for Traffic Categories 2c and 2d may be supplied as a crushed rock product with the cementitious binder incorporated in a pugmill or may be produced by the in-situ stabilisation of natural or blended gravel where stabilisation is undertaken by mobile plant at the site. | Traffic Categories 2c, 2d |
| 3. | Prior to stabilisation, the pavement material shall meet the requirements of Table C242.4 for subbase material for the appropriate Traffic Category. | Material Requirements Prior to Stabilisation |
| 4. | Material requirements for the cementitious binder shall be in accordance with Specification C241 - STABILISATION. | Stabilising Agent |
| 5. | When produced by in-situ stabilisation, the stabilisation process shall meet the requirements of Specification C241 - STABILISATION. | In-situ Stabilisation |
| 6. | The unconfined compressive strength (UCS) of the material after seven days accelerated curing as determined by Test Method T131 shall be not less than 4MPa or more than 10MPa. Sampling and test specimen compaction of the material shall be undertaken within one hour of the incorporation of the cementitious binder. | Unconfined Compressive Strength |

C242.12 UNSEALED PAVEMENT MATERIALS

- | | | |
|----|---|---------------------------|
| 1. | Pavement materials for all unsealed roads shall comply with the requirements of Table C242.6 | Unsealed Pavements |
| 2. | Pavement materials for maintenance and rejuvenation of existing unsealed shoulders shall comply with the requirements of Table C242.6 and shall be subject to the approval of Council | Unsealed Shoulders |

Test Method	Description	Unsealed Pavement Material Requirements
AS 1289.3.6.1	Coarse Particle Size Distribution % passing 75.0mm sieve % passing 53.0mm sieve % passing 37.5mm sieve % passing 26.5mm sieve % passing 19.0mm sieve % passing 13.2mm sieve % passing 9.5mm sieve % passing 6.7mm sieve % passing 4.75mm sieve % passing 2.36mm sieve % passing 0.425mm sieve % passing 0.075mm sieve	- - 100 - 65-95 - 50-80 - - 25-60 15-40 -
AS 1289.3.6.3	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36mm sieve) A. Pass 425µm sieve % B. Pass 75µm sieve % Pass 425µm sieve C. Pass 13.5µm sieve % Pass 75µm sieve	NA NA NA
AS 1289.3.1.1	Liquid Limit (if non plastic)	max 35
AS 1289.3.3.1	Plastic Limit (if plastic)	max 25
AS 1289.3.3.1	Plasticity Index	4-9
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve (only applies if Plasticity Index is less than 1)	NA
AS 1141.14	Particle Shape by Proportional Calliper % mis-shapen (2 : 1)	NA
AS 1141.22	Aggregate Wet Strength ♦	min 50kN
AS 1141.22	Wet/Dry Strength Variation ♦ $\frac{\text{Dry} - \text{Wet}}{\text{Dry}} \%$	max 60kN
T216	Sandstone Crushing Value (in lieu of wet strength and wet/dry strength variation for sandstone materials.)	max 40
AS 1289.F1.1	4 day Soaked CBR (min) (98% Modified Compaction)	60

Table C242.6- Unsealed Pavement Material Properties

DELIVERY, STOCKPILING AND PROCESSING OF PAVEMENT MATERIAL

C242.13 DELIVERY TO SITE

1. Materials shall be supplied sufficiently damp to avoid segregation and loss of fines during transit.

**Damp
Condition**

FLEXIBLE PAVEMENTS

C242.14 STOCKPILING OF UNBOUND MATERIALS

1. Stockpile sites shall be located as shown on the Drawings or as approved by the Council's Supervising Engineer. **Stockpile Sites**
2. Stockpile sites, which shall be cleared of all vegetation and extraneous matter, shall be shaped to form a crown so as to be free draining and compacted over the whole area to provide a relative compaction, determined by Test Method T166 for standard compactive effort, of not less than 95 per cent. **Compacted and Free Draining**
3. Stockpiles and stockpile sites shall be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material. **Stockpile Requirements**
4. The total height of any stockpile shall not exceed 3m. **Height**
5. Stockpiles shall be of uniform shape with side slopes neither steeper than 1.5 to 1 nor flatter than 3 to 1. **Shape**
6. The worked face of any stockpile shall be the full face of the stockpile. The stockpiled material shall be maintained at a moisture content sufficiently damp to avoid loss of fines. **Maintained Damp**
7. At the completion of the works, stockpile sites shall be cleared of all surplus material and left in a clean and tidy condition. **Completion of Work**

C242.15 DELIVERY OF BOUND MATERIALS

1. Bound materials shall be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport, unless otherwise approved by the Council's Supervising Engineer. **Vehicle Deliveries**
2. For bound materials, the time between mixing and conveyance by delivery trucks to the site, shall be such as to allow incorporation into the works including trimming and compaction within the nominated field working period. **Time Limit**
3. Each truck load of crushed rock bound material shall be identified by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck, and such dockets shall be made available to the Council's Supervising Engineer at the point of delivery. **Delivery Dockets**

SPREADING OF PAVEMENT MATERIAL

C242.16 SPREADING PAVEMENT MATERIALS

1. Unbound materials shall not be spread upon an underlying pavement layer which has a moisture content exceeding the laboratory optimum moisture content as determined by AS 1289.5.2.1 or which has become rutted or mixed with foreign matter. The underlying layer shall be corrected to comply with this Specification before spreading of the next layer of pavement. **Underlying Layer Quality**
2. Each layer of material shall be deposited and spread in one operation and, after compaction, the finished surface levels on the base and subbase courses shall be within the permitted tolerances stated in Clause C242.22 (c) without subsequent addition of material. The thickness of each compacted layer shall be neither less than 100 mm or more than 200 mm for all pavement layer types, unless otherwise approved by the Council's Supervising Engineer. **Tolerances**
3. At all work boundaries in bound materials the Contractor shall provide vertical faces to provide for transverse and longitudinal joints. **Joints**

TRIMMING AND COMPACTION

C242.17 GENERAL REQUIREMENTS

- 1. Each layer of the base and subbase courses shall be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction set out in Clauses C242.19 and C242.20.

**Uniform
Compaction**
- 2. On sections of pavement with one-way crossfall, compaction shall begin at the low side of the pavement and progress to the high side. On crowned sections, compaction shall begin at the sides of the pavement and progress towards the crown. Each pass of the rollers shall be parallel with the centreline of the roadway and uniformly overlap each preceding pass. The outer metre of both sides of the pavement shall receive at least two more passes by the compaction plant than the remainder of the pavement.

**Compaction
Procedure**
- 3. At locations where it would be impracticable to use self-propelled compaction plant, the pavement material shall be compacted by alternative hand-operated plant approved by the Council’s Supervising Engineer.

**Hand Operated
Plant**
- 4. Watering and compaction plant shall not be allowed to stand on the pavement being compacted.

**Plant
Movement
Restrictions**
- 5. If any unstable areas develop during rolling, the unstable material shall be rejected. The rejected material shall be removed for the full depth of the layer, disposed of and replaced with fresh material in accordance with Clause C242.24.

Unstable Areas
- 6. The placement of subsequent layers shall not be allowed until the requisite testing has been completed and the Council’s Supervising Engineer has accepted the test results for each layer.

**Placing
Subsequent
Layers**
- 7. Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up shall be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements and level tolerances.

**Excessive
Moisture
Content**
- 8. Each successive layer of the pavement will be tested by proof loading after completion of trimming and compaction of the layer. Council’s Supervising Engineer shall be present during the testing. The testing will involve a visual inspection of the pavement layer as either a fully laden 8-tonne capacity truck or a roller of static weight exceeding 10 tonnes passes over the layer. This inspection will be a **HOLD POINT**. Any unstable areas, including areas showing excessive deflection, shall be rejected. Approval by Council’s Supervising Engineer is required for release of the **HOLD POINT**.

Proof Loading

HP

C242.18 CURING OF BOUND MATERIALS

- 1. The curing of the surface layer of a lot shall commence after compaction is completed.

**Commence-
ment Time**
- 2. The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal.

Water Curing
- 3. Water curing shall consist of frequent light uniform spraying that will not produce significant run off or flooding on sections of the area. Slurrying of the surface or leaching of the stabilising agent shall be avoided.

Caution

ACCEPTANCE OF COMPACTED LAYERS

C242.19 LOTS FOR ACCEPTANCE

1. Acceptance of work shall be based on density testing of the work in lots. A lot shall be nominated by the Contractor, but shall conform to the following:
 - (a) for bound materials, only a single layer of work which has been constructed under uniform conditions in a continuous operation and not crossing any transverse construction joints;
 - (b) for unbound materials, it may comprise the entire layer.

Lot Requirements

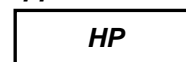
C242.20 COMPACTION ASSESSMENT

1. For residential, commercial and industrial roads, the Contractor shall arrange for testing to assess compaction on the basis of either one test per 50 linear m or per 250 m² (which ever is the greater) with a minimum of two tests in any one length. The results shall be presented to the Council’s Supervising Engineer for approval.
2. For rural roads, the Contractor shall arrange for testing to assess compaction on the basis of either one test per 100 linear m or per 500 m² (which ever is the greater) with a minimum of two tests in any one length. The results shall be presented to the Council’s Supervising Engineer for approval.
3. Acceptance of the final pavement layer shall be determined according to the elastic rebound deflection. The elastic rebound deflection shall be taken as the maximum deflection in accordance with Test Method T160 utilising the Benkelman Beam or equivalent. The average maximum deflection for any lot shall not exceed: 1.4mm (2x10⁴ and 6x10⁴ ESA), 1.3mm (3x10⁵ ESA), 1.1mm (1x10⁶ ESA) and 1.0mm (2x10⁶ ESA) or the limits stated in AUSTROADS. The co-efficient of variation (CV) in recorded deflections shall not exceed 30 per cent. Measurements shall be taken at maximum spacings of 20 metres in alternating wheel paths in each lane, with not less than 4 measurements per any one length of road.
4. The presentation of compaction testing results shall be a **HOLD POINT**. Approval by Council’s Supervising Engineer is required for release of the **HOLD POINT**
5. Proof rolling shall be performed.

Sampling

Benkelman Beam Testing

Approval



Proof Roll Test

C242.21 RELATIVE COMPACTION

1. The relative compaction of pavement material at each location tested for in-situ dry density shall be calculated in accordance with Test Method T166 as follows:

Calculation

$$\text{Relative Compaction (per cent)} = \frac{\text{In-situ dry density}}{\text{Comparative dry density}} \times 100$$

2. In-situ dry density testing shall be carried out by the Contractor using Test Method T119 or, alternatively, the Council’s Supervising Engineer may approve some or all of the in-situ dry density testing to be carried out with a single probe Nuclear Density Meter in the direct transmission mode in accordance with AS 1289.5.8.1.
3. Each day that material is produced for placement in a layer or layers, a sample of the material shall be taken by the Contractor for maximum dry density testing to represent that day’s production.
4. For unbound layers, the sample shall be tested in accordance with AS 1289.5.2.1 to determine the maximum dry density (modified compactive effort) for the material.

In-Situ Dry Density Testing

Daily Samples

Maximum Dry Density

5. For bound layers the sample shall be tested within two hours after the addition of stabilising agent to the mix in accordance with Test Method T130 to determine the maximum dry density (modified compactive effort) for the material. This test method shall also be used to determine the optimum moisture content.

Time for Testing

6. The maximum dry density so determined shall be used as the comparative dry density in relative compaction calculations for all material from that day's production placed in a single layer of work.

Comparative Dry Density

C242.22 COMPACTION REQUIREMENTS AND ACCEPTANCE

1. A lot shall be accepted for compaction if:

Compaction Acceptance Requirements

a) **For sub-base:**

- i. The minimum value of all calculated relative compaction for modified compactive effort is not less than 98 per cent (Modified) within the lot or the area of pavement being assessed.
- ii. Pass proof roll test
- iii. Thickness within tolerance as determined from test pits at locations nominated by the Supervising Engineer.

b) **For base:**

- i. The minimum value of all calculated relative compaction for modified compactive effort is not less than 98 per cent (Modified) within the lot or the area of pavement being assessed.
- ii. Pass proof roll test
- iii. Thickness within tolerance as determined from test pits at locations nominated by the Supervising Engineer.
- iv. Comply with deflection criteria of Benkelman Beam Testing.

c) **For bound layers:**

An area of pavement presented for compaction assessment having within that area a zone or zones with relative compaction less than 98 per cent but equal to or greater than 96 per cent, may be accepted by Council's Supervising Engineer provided such zone or zones shall not comprise more than 5 per cent of the area presented.

2. Lots or areas of pavement not achieving these specified values shall be rejected. Unbound layers may be reworked as provided by Clause C242.22, but the bound materials in rejected layers/courses shall be removed and replaced with fresh materials in accordance with Clause C242.24.

Rejection of Lots

C242.23 REWORKING OF REJECTED UNBOUND LAYERS

1. Lots or areas of pavement that have been rejected in regard to compaction shall be reworked before resubmission for compaction assessment.

Reworking

2. Material that has become degraded, segregated or otherwise reduced in quality by reworking shall be rejected. The rejected material shall be removed, disposed of and replaced with fresh material complying with this Specification in accordance with Clause C242.24. When a lot or area of pavement is resubmitted for compaction assessment, testing shall be carried out in accordance with Clauses C242.18 and C242.19.

Rejected Material

FLEXIBLE PAVEMENTS

3. All costs associated with corrective work carried out before the resubmission of a lot, including rewatering, re-rolling, removal and replacement of material as well as reworking shall be carried out at no cost to the Council. **Contractor's Costs**

C242.24 TOLERANCES

a) General

1. The tolerances stated are the acceptable limits of departure from the dimensions shown on the Drawings. **Tolerances**
2. Areas for assessment of conformity with tolerance requirements shall be divided into lots and presented to the Council's Supervising Engineer together with survey reports covering line and level. **Lots for Assessment of Conformity**

b) Width

1. At any cross section without kerb and/or guttering, and for pavement layers extending under the kerb and/or guttering, the horizontal dimension measured from the design centre line to the edge of the constructed pavement surface shall be neither less than 50mm less than the dimension nor more than 300 mm greater than the dimension shown on the Drawings. **Horizontal Dimensions**
2. The average width of the layer determined from measurements at three sites selected at random by the Council's Supervising Engineer over any 200 metre road length, or part thereof, shall be not less than the specified width. **Average Width**

c) Levels and Surface Trim

1. The levels of the finished surface of the top of the subbase course shall not vary from the design levels by more than ± 10 mm. **Subbase Surface Level**
2. Level tolerances at the top of the base course shall not vary from the design levels by more than 10mm. In addition, where kerb and gutter exists or is being constructed, the level of the top of the base course adjacent to the kerb and gutter shall not vary by more than ± 5 mm from the lip level of the gutter minus the design thickness of the wearing surface. **Base Surface Level**
3. The design level of the top of the subbase course shall be determined from the design level of the finished road surface less the thickness of the base course and the wearing course. **Subbase Design Level**
4. The pavement surface after trimming and immediately prior to sealing shall be of a quality such that the deviation under a 3 metre straight edge placed in any direction does not exceed 12mm. Measurements with the 3 metre straight edge shall be taken at a minimum of 10 randomly selected stations so as to represent a 200-metre lane length or part thereof. **Straight Edge Deviation**

C242.25 ACTION ON REJECTION

(a) Unbound Materials

1. A lot that has not complied with the requirements for width or level tolerance as set out in Clauses C242.22 (b) and C242.22 (c) respectively shall be rejected except as otherwise provided in this Clause. Rejected lots shall be removed, disposed of and replaced with fresh material in accordance with Clause C242.24. **Rejection Criteria**
2. Notwithstanding the above, where the rejected lot can be corrected by further trimming, Council's Supervising Engineer may allow the surface to be corrected without complete removal and replacement with fresh material. Such trimming shall be undertaken **Corrective Action**

in a manner that produces a uniform, hard surface and shall be achieved by cutting only without filling. After any such cutting, the level tolerances in Clause C242.22(c) shall apply.

3. The cost of surface correction or replacement work ordered in accordance with this Clause including removal of material, disposal and supply and transport of replacement material shall be borne by the Contractor. **Contractor's Costs**

(b) Bound Materials

1. An area that has not complied with the requirements for width or level tolerance as set out in Clauses C242.22 (b) and C242.22 (c) respectively shall be rejected except as otherwise provided for in this Clause. Rejected areas shall be removed, disposed of and replaced with fresh material in accordance with Clause C242.24. **Rejection Criteria**

2. The cost of removal and disposal of rejected material and its replacement with fresh material shall be borne by the Contractor. **Contractor's Costs**

3. Notwithstanding the above, Council's Supervising Engineer may allow the Contractor to rectify the area in the following cases: **Corrective Action Circumstances**

(i) Where the cause for rejection is under Clause C242.22 (c), the course is a subbase course and rejection is due to departures from design level being too far below the design level, the Contractor may increase the thickness of the base course to make up such deficiency in thickness.

(ii) Where the cause for rejection is under Clause C242.22(c), the course is a subbase course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course, to allow for its design thickness to be laid, up to a maximum of 20mm above the original design level. Approval by the Council's Supervising Engineer shall be subject to the following requirements:

- The rate of change of grade from the original finished design surface level shall be less than 3 mm per metre.
- The regrading shall not interfere with the proper design functioning of the drainage system.
- The regrading shall not interfere with levels at the property boundary, or increase or decrease footpath or footpath crossover levels or grades beyond Council's allowable design limits.
- The regrading shall not interfere with clearances.

(iii) Where the cause for rejection is under Clause C242.22(c), the course is a base course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course. Approval by Council's Supervising Engineer shall be subject to the requirements of this Clause in (ii) above.

4. The cost associated with surface level corrections required in this Clause shall be borne by the Contractor. **Contractor's Costs**

C242.26 REMOVAL AND REPLACEMENT OF REJECTED COURSES

1. Sections of the work that have been rejected shall be removed from the work and replaced with fresh material. Rejected material shall be removed from site. **Rejected Material**

2. In rejected sections the material shall be removed over the full length of the rejected lot, except that a minimum length of 50 m of pavement layer shall be removed and replaced. Any damage to underlying or abutting layers or structures shall be made good by the Contractor using methods approved by the Council's Supervising Engineer. **Length to be Removed**

FLEXIBLE PAVEMENTS

3. The Council's Supervising Engineer may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Council's Supervising Engineer's satisfaction. In this case, the new longitudinal cold joint shall be formed and located along the centreline of the road pavement. **Superintendent's Discretion**
4. After removal of rejected base or subbase course material, the section shall be presented for inspection by the Council's Supervising Engineer before replacement work is commenced. **Inspection Before Replacement**
5. Materials used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, shall comply with the requirements of this Specification. **Replacement Material**
6. All costs associated with removals, replacements and corrections of base and subbase courses required under this Clause and the extra costs incurred by the Contractor in respect of delays caused by such removals, replacements and corrections shall be borne by the Contractor. **Contractor's Costs**

C242.27 MAINTENANCE BEFORE COMPLETION OF WEARING SURFACE

1. Following the Council Engineer's acceptance of any section of the work, the Contractor shall maintain the prepared surface of the base in the condition specified for acceptance until the wearing surface is completed. The base course of sections of the accepted work shall be covered with a primer seal over the full width of pavement in accordance with the Specification for SPRAYED BITUMINOUS SURFACING within seven days of the date of the acceptance of such sections, unless otherwise approved by the Council's Supervising Engineer. **Primerseal**
2. Should the pavement condition deteriorate before the application of the primer seal and consent to proceed with the bitumen surfacing work is withdrawn by Council's Supervising Engineer, the Contractor shall re-prepare the pavement and re-present the pavement for acceptance by Council's Supervising Engineer. **Contractor's Responsibility**
3. The cost of re-preparing areas of the deteriorated pavement shall be borne by the Contractor. **Contractor's Cost**

OPENING PAVEMENT TO TRAFFIC

C242.28 GENERAL REQUIREMENTS

1. For unbound pavements, construction plant and vehicles not involved in the current construction or testing of the work shall not be permitted to use the pavement until the primer seal has been applied, unless otherwise approved by the Council's Supervising Engineer. **Restrictions on Movement**
2. For bound pavements, construction plant and vehicles not involved in the current construction or testing of the work shall not be permitted to use the pavement until the primer seal has been applied and seven days have elapsed since placement of the base. **Restrictions on Movement of Construction Traffic**
3. For bound pavements, traffic shall not be allowed to use the constructed pavement until a minimum of seven days after completion of the full pavement depth and the primer seal. **Open to Traffic Bound Pavement**

LIMITS AND TOLERANCES

C242.29 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarised in the Table below

Item	Activity	Tolerances	Spec Clause
1.	Stockpile Sites	(i) Relative Compaction > 95% (ii) Stockpile height < 3m (iii) Stockpile batter < 1.5:1 and > 3:1	C242.14 C242.14
2.	Spreading Pavement Materials		
	(i) Compacted Layer Thickness	≥ 100mm, ≤ 200mm	C242.16
3.	Compaction Acceptance		
	Minimum value of all calculated relative compaction results	≥ 98 per cent (modified compactive effort)	C242.22
4.	Width of Pavement		
	(i) Design centre-line to edge of constructed pavement	-50mm to +300mm of dimensions on Drawings	C242.24(b)
	(ii) Average Width	The average width determined from 3 random sites over any 200m road length, or part thereof, shall be not less than the specified width.	C242.24(b)
5.	Surface Level		
	(i) Subbase levels	<± 10mm from design level	C242.24(c)
	(ii) Base levels	<± 10mm from design level	C242.24(c)
	(iii) Base levels adjacent to Kerb and Gutter	<±5mm from the lip levels of adjacent gutter minus design thickness of wearing surface.	C242.24(c)
	(iv) Shape	Deviation from a 3m long straightedge on base surface immediately prior to sealing shall be less than 12mm	C242.24(c)

Table C242.3 - Summary of Limits and Tolerances

C242.30 SUMMARY OF APPROVALS & SUBMISSIONS TO COUNCIL'S SUPERVISING ENGINEER

Activity	Notice Required	Spec Clause
Details of Proposed Base and Subbase to be Submitted		C242.07 1.
Variations by Contractor of Proposed Base and Subbase		C242.07 3.
Modified Texas Triaxial Classification		C242.09 7.
Modification of unbound base and subbase materials		C242.10 1.
Thickness of each compacted layer		C242.16 2.
Proof Loading of each successive layer of the pavement	HOLD POINT	C242.17 8.
The presentation of compaction and deflection testing results	HOLD POINT	C242.20 4.
Correction of rejected lot by further trimming		C242.25 (a) 2.
Correction of rejected lot – bound layer		C242.25 (b) 3.

Table C242.4**SPECIAL REQUIREMENTS****C242.31 RESERVED****C242.32 RESERVED**

CONSTRUCTION
SPECIFICATION

C244

**SPRAYED
BITUMINOUS SURFACING**

SPECIFICATION C244 : SPRAYED BITUMINOUS SURFACING

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SPECIFICATION C244 : SPRAYED BITUMINOUS SURFACING

GENERAL

C244.01 SCOPE

1. The work to be executed under this Specification consists of the supply of all materials and the application of any or all of the following types of sprayed bituminous surfacing:

(i) Prime

Consisting of the application of a primer of field or refinery cutback bitumen without aggregate to provide penetration of the surface (preferably from 5 to 10 mm) and waterproofing.

(ii) Primerseal

Consisting of the application of a primer binder of field or refinery cutback bitumen to provide surface penetration (preferably from 2mm to 5mm), into which aggregate is incorporated to provide a temporary wearing surface prior to the application of the final wearing surface.

(iii) Seal or Reseal

Consisting of the application of a bitumen binder into which aggregate is incorporated to provide a durable wearing surface.

2. The locations and required types of sprayed bituminous surfacing, including types of binders and aggregate sizes, shall be as shown on the Drawings and/or as detailed in Annexure C244.A.

3. For multiple application treatments, the binder and aggregate may be required to be laid in one or more separate applications.

C244.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

C201 - Control of Traffic

(b) Australian Standards

AS 2008 - Residual bitumen for pavements.
 AS 2157 - Cutback bitumen.
 AS 2341.9 - Determination of water content.
 AS 3568 - Oils for Reducing the Viscosity of Bitumen for Pavements
 AS 2758.2 - Aggregate for sprayed bituminous surfacing.

SPRAYED BITUMINOUS SURFACING

(c) RTA Specifications and Forms

- MR466 - Sprayed Bituminous Surfacing Cutback Chart
- 3253 - Bitumen for Pavements
- 3258 - Aggregate Precoating Agents
- 3259 - Bitumen Adhesion Agents
- 3261 - Cutback Bitumen
- RTA Form 23 - Bituminous Surfacing Daily Record

(d) Government Legislation

- Rural Fires Act 1997
- Rural Fires Amendment Act 2000
- Rural Fires and Environmental Assessment Legislation Amendment Act 2002
- Local Government Act, 1993

(e) Other

- AUSTROADS - Design of Sprayed Seals.

MATERIALS

C244.03 BINDERS

(a) Bitumen

Bitumen

1. Bitumen shall be Class 170 conforming to AS2008.

(b) Refinery Cutback Bitumen

**Cutback
Bitumen**

1. Refinery cutback bitumen shall conform to AS 2157.

C244.04 ADDITIVES

(a) Cutter Oil

**Cutter
Specification**

1. Cutter oil shall conform to the requirements of AS3568, displaying an Abel flash point of not less than 38°C and a viscosity at 40°C not greater than 2.0 millipascal seconds, with the following qualifications to the properties for its classification as set down in AS 3568 Table 1:

- (i) Either "Aniline point" or "Aromatic content" is acceptable.
- (ii) There shall be no "Density" requirement.
- (iii) The presence of water, assessed visually as an immiscible phase in any sample of the material, shall be grounds for its rejection. AS2341.9 shall not be demanded as a referee test if more than 0.1% of liquid water is found in any delivery or batch.
- (iv) If the viscosity is calculated by the equation given in Table 1, Note 3 of AS3568, "f" shall be taken to be 0.0009 per °C.

2. Delivery and storage procedures for cutter oil delivered in drums shall ensure that all containers are clean and free from any deleterious material prior to filling with cutter oil, and all drums are stored so as to ensure that entry of water through seals or welds in the drums is prevented.

**Delivery &
Storage**

(b) Adhesion Agent

Adhesion Agent

1. Bitumen adhesion agents shall conform to RTA Specification 3259.

C244.05 AGGREGATE

1. Aggregate shall conform to AS 2758.2.

Specification

2. The Contractor shall obtain test results for each lot/stockpile of aggregate, and certification of compliance with AS 2758.2 from a suitably accredited NATA laboratory, before aggregate from the lot is incorporated in the Works.

Test Results

C244.06 PRECOATING AGENT

1. Aggregate precoating agent(s) shall conform to RTA Specification 3258.

Precoat

C244.07 SAMPLING AND TESTING OF MATERIALS

1. Sampling and testing of materials shall be arranged by the Contractor and carried out by a NATA registered laboratory in accordance with the relevant materials specifications cited in this Specification.

Contractor's Responsibility

DESIGN OF BITUMINOUS SURFACING

C244.08 GENERAL

1. The Contractor shall carry out the design of bituminous surfacing in accordance with the procedure contained in AUSTRROADS Design of Sprayed Seals and shall submit these design details to the Council's Supervising Engineer. Design application rates shall be known as "nominated application rates" and materials as "nominated materials."

AUSTRROADS Design Procedure

2. The following additional details are required:

Additional Information Sought

- (i) Test results for all nominated materials.
- (ii) Aggregates - source, geological type, nominated grading, ALD.
- (iii) Precoating agent and bitumen adhesion agent - types and proportions.
- (iv) Bitumen - refinery source, certification of compliance with AS 2008.
- (v) Cutback bitumen - refinery source of bitumen, source of cutter, certification of compliance with AS 2157.

3. The Contractor shall ensure that the notifications required under Clause 245.04 1 – 5 of Specification C245 ASPHALTIC CONCRETE are carried out.

APPLICATION OF SPRAYED BITUMINOUS SURFACING

C244.09 GENERAL

1. The Contractor shall carry out sprayed bituminous surfacing so as to: **Work Quality**
- (i) provide a uniform application of binder with adequate adhesion to the underlying surface;
 - (ii) provide a complete cover of interlocking aggregate particles, and
 - (iii) achieve effective bond between binder and aggregate.
2. The Contractor shall give the Council's Supervising Engineer two days notice of intention to commence sprayed bituminous surfacing, confirming spray rates, nominal aggregate size and ALD, and shall obtain the Council's Supervising Engineer's approval to proceed.

C244.10 PRECOATING OF AGGREGATE

1. The aggregate precoat agent shall be applied to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading. **Application**
2. Precoating of aggregate shall not be carried out when rain is imminent. If aggregate has been precoated and rain appears imminent, the aggregate shall be adequately covered to prevent the precoating material being washed from the aggregate particles. **Weather Conditions**
3. The Contractor shall take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the precoating agent on the stockpiled aggregate. **Cover for Stockpiles**

C244.11 PLANT

1. A mechanical sprayer shall be used to apply primer, primer binder and binder. The sprayer shall have a current Sprayer Certificate (RTA Form 354) issued by the Roads and Traffic Authority of NSW. **Sprayer Certificate**
2. The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Satisfactory nozzles of similar type shall replace any nozzles, which may be damaged or become unduly worn or defective. A sufficient number of nozzles for this purpose shall be available at all times. **Spray Nozzles**
3. Mechanical spreading equipment shall be used to spread aggregate and shall be capable of achieving a uniform spreading rate. **Aggregate Spreader**
4. Rollers shall be in accordance with Clause C244.20. **Rollers**
5. The Contractor shall remove from the work any plant or equipment not fully operational or not in a satisfactory condition for carrying out work in accordance with this Specification. **Faulty Equipment**

C244.12 PREPARATION OF PAVEMENT SURFACE

1. Before the application of primer, primer binder or binder, the pavement surface shall be swept by the use of a mechanically-operated rotary road broom or suction broom to provide a uniformly clean surface. If necessary, additional sweeping shall be done by hand, using stiff bass or similar brooms. Sweeping shall extend at least 300mm beyond each **Pavement Sweeping**

edge of the area to be sprayed.

2. Adherent patches of foreign material shall be removed from the surface of the pavement.

Foreign Matter on Pavement

3. For the spraying of primer or primer binder, the pavement surface shall be slightly damp so as to impede dust interfering with initial adhesion.

Damp Pavement

C244.13 REVIEW OF NOMINATED APPLICATION RATES

1. The Contractor shall select the locations where each lot of aggregate is to be incorporated in the Works.

Aggregate Lots

2. The Contractor shall review the bituminous surfacing design at each location based on the actual ALD test result for the lot of aggregate instead of the ALD value of the nominated aggregate, and using the AUSTROADS Design of Sprayed Seals. The revised application rates shall be known as “target application rates.”

Target Application Rates

3. The Contractor shall submit details of the aggregate lot and target application rates of each work location to the Council’s Supervising Engineer for approval before commencing sprayed sealing at that location. Approval in accordance with this clause shall constitute a **HOLD POINT**.

Contractor’s Responsibility

HP

C244.14 BINDER TEMPERATURE REQUIREMENTS

1. Bitumen and cutback bitumen shall be within the range shown in Table C244.1 when incorporated with cutter oil.

Mixing Temperature

2. Temperature ranges for spraying of primers, primer binders and binders shall be within the ranges shown in Table C244.1.

Spraying Temperature

3. The Contractor shall measure and record the temperature of the bituminous material, using a suitable means. The thermometer shall be verified as accurate to within 2.5 percent of the correct temperature.

Measurement of Temperature

4. If the temperature of the bituminous material is below the applicable lower limit from Table C244.1, the bituminous material may be heated providing safe heating practices are adopted. Burners shall not be used unless the level of the material in the heating tank is at least 250 mm above the tops of the heating tubes. The Contractor shall comply with the current legislative requirements. Two or more suitable fully-charged pressurised chemical fire extinguishers shall be placed conveniently to the heaters at all times while heating is in progress.

Safe Heating Practices

5. During heating, the temperature of the bituminous material shall not exceed the applicable upper limit from Table C244.1. The temperature of the bituminous material just above the heating tubes shall be checked at regular intervals to ensure that there is no local overheating.

Heating Limits

6. Bituminous materials shall not be held at temperatures within the ranges shown in Tables C244.1 for periods in excess of ten hours.

Max Period of Heating

7. Any bituminous material that has been overheated shall not be used in the work. The Contractor shall record disposal of such material confirming its exclusion from use under this contract.

Overheated Bitumen

C244.15 PAVEMENT TEMPERATURE AND WEATHER CONDITIONS

1. The Contractor shall measure and record pavement temperatures at regular intervals during the course of the work. For this purpose, a spirit or mercury-in-glass

Measurement and Recording

SPRAYED BITUMINOUS SURFACING

thermometer or other suitable type of thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. When a spirit or mercury-in-glass thermometer is used to measure pavement temperature, the bulb of the thermometer shall be covered from direct sunlight with a small heap of grit or similar material.

2. If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded.

Sun and Shade Conditions

3. Spraying primers, primer binders and binders shall be undertaken only if the pavement temperature has been at or above the minimum temperature shown in Table C244.1 for at least one hour before commencement of spraying and does not fall below the specified minimum pavement temperature for spraying during the period of spraying.

Minimum Pavement Temperature

4. Spraying shall not be carried out on a wet pavement, while rain appears imminent or during high winds or dust storms.

Spraying Conditions

TYPE OF MATERIAL	CLASS OR GRADE	EQUIVALENT % CUTTER	MAX HEATING TEMP (°C)	MIN PAVEMENT TEMP (°C)	SPRAYING TEMP (°C)
Bitumen	170		190	10	160 - 190
Cutback Bitumen	AMC 00	56)	30	10	10 - 20
	AMC 0	44)	55	10	35 - 55
	AMC 1	34)	80	10	60 - 80
	AMC 2	27) Conven-	100	10	75 - 100
	AMC 3	21) tional	115	10	95 - 115
	AMC 4	16) Cutter	135	10	110 - 135
	AMC 5	11)	150	10	120 - 150
	AMC 6	7)	160	10	135 - 160
Cutback Bitumen	AMC 7	3)	175	10	150 - 175
	FC2	25)	95	5	70 - 75
	FC3	20) Fast	95	5	80 - 90
	FC4	15) Evapo-	110	5	95 - 110
	FC5	10) rating	140	10	120 - 140
	FC6	7) Cutter	150	10	130 - 150
	FC7	3)	160	10	140 - 160

Table C244.1 - Temperature Limits

C244.16 INCORPORATION OF CUTTER OIL AND ADHESION AGENT

(a) Cutting Back Bitumen

1. The Contractor shall determine and record the proportion of cutter oil required for each sprayer load, using MR Form 466 and based on the measured pavement temperatures.

Contractor's Responsibility

2. The cutter oil, without being previously heated, shall be pumped into the sprayer, followed by the hot bitumen. The full sprayer load of cutback bitumen shall be circulated at a rate of at least 700 litres per minute for twenty minutes to ensure that the mixture is homogeneous.

Mixing Cutter Oil

3. If a part sprayer load of field cutback bitumen is unused on the date of mixing, and needs to be returned to the heater tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter shall be added to the returned cutback bitumen unless the tank is fitted with an effective mechanical mixing system. When the returned cutback bitumen is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned cutback bitumen.

***Unused
Cutback
Bitumen***

(b) Bitumen Adhesion Agent

1. Where bitumen adhesion agent is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres per minute for fifteen minutes before spraying.

***Mixing
Adhesion
Agent***

C244.17 APPLICATION OF PRIMER, PRIMER BINDER AND BINDER

(a) General

***Limit on Spray
Area***

1. The area to be sprayed with primer binder or binder shall be limited to the area that can be covered with aggregate at the target application rate within ten minutes of spraying bitumen or cutback bitumen.

2. Nominated and target application rates and quantities of primer and primer binder shall apply to the whole material, including cutter oil, measured at 15°C.

***Application
Rates***

3. Nominated and target application rates and quantities of binder shall be based on the volumes of bitumen measured at a temperature of 15°C and shall not include any bitumen adhesion agent and/or cutter oil.

***Nominated and
Target Rates***

4. Where bitumen adhesion agent and/or cutter oil have been added to the binder, the application rate of the total binder at 15°C shall be adjusted to allow for the quantities of bitumen adhesion agent and/or cutter oil in the mixture.

***Adjustment of
Application
Rate***

5. The Contractor shall determine the hot application rate of total binder, including bitumen adhesion agent and/or cutter oil, using MR Form 466.

***Calculation of
Hot Application***

6. Where refinery cutback bitumen is used as the binder, the target application rate of binder shall be increased by the Contractor to allow for the percentage cutter oil in the mixture as indicated in Table C244.1.

***Refinery
Cutback
Bitumen
Variation***

(b) Operation of the Sprayer

1. The type of spray nozzles to be used on the spray bar of the sprayer shall be compatible with the nature of the binder to be sprayed and its application rate.

Nozzle Type

2. Where the longitudinal edges of spray runs are not required to overlap, either special type end nozzles or intermediate nozzles set with a jig as end nozzles may be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs shall be 50 mm for special type end nozzles. If intermediate nozzles are to be used to overlap adjacent longitudinal sprays the nozzles shall be set in the normal manner for intermediate nozzles and the overlap shall be 300 mm.

Spray Overlap

3. The spraying of primer, primer binder or binder for each run of the sprayer shall commence on a protective strip of heavy paper weighing not less than 120 grams per square metre laid across and held securely to the pavement surface beforehand. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application is attained at the commencement of spraying.

***Protective
Paper Strip***

4. The sprayer shall maintain a constant road speed throughout the length of each

Road Speed

SPRAYED BITUMINOUS SURFACING

sprayer run.

5. The spraying for each run shall terminate on a protective strip of paper laid across and held securely to the pavement surface beforehand. The width of paper at the commencement and/or termination of each run shall not be less than that endorsed on the Sprayer Certificate.

***Terminating
Paper Strip***

6. Spraying shall cease immediately any defect develops in the spraying equipment and spraying shall not recommence until the fault has been rectified.

***Equipment
Defects***

7. Where any blockage or partial blockage of nozzles occurs, spraying shall cease immediately. If the blockage is due to the condition of the binder being sprayed, that load together with any binder from the same bulk tanker or supply unit shall not be used.

***Nozzle
Blockage***

8. Where a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, such areas shall be sprayed by means of the hand spray equipment attached to the sprayer.

Hand Spraying

9. After each sprayer run, the quantity of binder sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the target application rate is achieved in subsequent runs. If the actual application rate of binder after three runs differs by more than 5 per cent from the target application rate, the sprayer shall not be used until a new Sprayer Certificate has been obtained.

***Application
Rate Checks***

10. Areas not within 5 percent of the target application rate of primer, primer binder or binder shall constitute a 'Non-conformance' under the Contract.

***Non-
conformance***

C244.18 WORK RECORDS

1. Particulars of the work performed shall be recorded by the Contractor on RTA Form 23 - Bituminous Surfacing Daily Record. Details of primer, primer binder, binder and aggregate applied shall be recorded immediately after every sprayer run. The Contractor's representative shall sign each form as a true record of the work performed. The Contractor shall supply to the Council's Supervising Engineer a copy of each completed form.

***Sprayer Run
Records***

C244.19 CONTROL OF TRAFFIC

1. The Contractor shall provide for traffic in accordance with the requirements of Specification C201 - CONTROL OF TRAFFIC while undertaking the work and shall take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate.

***Contractor's
Responsibility***

2. Where early use of the new seal is needed to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no displacement of aggregate occurs. Where necessary, the Contractor shall use pilot vehicles to ensure that traffic travels at an acceptable speed.

Speed Control

3. The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic shall be temporarily diverted while the work is in progress.

***Minimise
Traffic Delays***

4. If facilities for the diversion of traffic are not available, the Contractor may spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway, except during the actual spraying operation when all traffic movement through the work shall cease. Traffic shall not be permitted to encroach upon the edge of the sprayed bituminous material until such time as it is covered with aggregate.

***Part Width
Spraying***

C244.20 APPLICATION AND INCORPORATION OF AGGREGATE

- | | |
|---|--|
| <p>1. The application of aggregate shall proceed after spraying is commenced and shall be completed within ten minutes of spraying bitumen or cutback bitumen.</p> | <p><i>Time for Completion</i></p> |
| <p>2. Wet aggregate shall not be used.</p> | <p><i>Wet Aggregate</i></p> |
| <p>3. The Contractor shall apply the aggregate of the specified nominal size and at the target aggregate application rate. Sufficient loaded and measured trucks of dry aggregate shall be at the site to provide full cover for the area sprayed within the required time frame.</p> | <p><i>Procedure</i></p> |
| <p>4. The aggregate shall be spread uniformly over the sprayed surface by means of suitable mechanical spreading equipment.</p> | <p><i>Uniform Application</i></p> |
| <p>5. Any bare or insufficiently covered areas shall be re-run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Any aggregate spread in excess of the target aggregate application rate shall be removed before rolling is commenced.</p> | <p><i>Deficient or Excess Aggregate</i></p> |
| <p>6. After the aggregate has been applied to each section of the work, initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheel rollers of minimum load of one tonne per tyre and minimum tyre pressure of 550 kPa. Initial rolling shall continue until the aggregate is firmly embedded in the primer binder or binder.</p> | <p><i>Initial Rolling</i></p> |
| <p>7. If the aggregate is not evenly distributed over the surface of the pavement, the surface shall be traversed with a light drag broom or by light hand brooming after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primer binder or binder, the Contractor shall defer or eliminate the drag brooming.</p> | <p><i>Brooming of Surface</i></p> |
| <p>8. Back rolling shall then be carried out for a minimum period of one hour per roller per 1000 square metres sprayed.</p> | <p><i>Back rolling</i></p> |
| <p>9. Where a bituminous surfacing is specified with separate applications of coarse and fine aggregate on a single application of binder, the coarse aggregate shall be applied first, rolled and any necessary brooming carried out as described above, before application of the fine aggregate and its subsequent rolling and brooming. In this case, the time limits for incorporation of aggregate (paragraph 1 above) shall apply only to the application of the coarse aggregate. The application of fine aggregate will proceed in any case as soon as possible after satisfactory application and embedment of the coarse aggregate.</p> | <p><i>Two Aggregate Application</i></p> |
| <p>10. When the aggregate has been evenly spread and embedded in the binder, any remaining loose particles of aggregate shall be removed from the pavement not prior to two days and not later than ten days after sealing.</p> | <p><i>Removal of Loose Particles</i></p> |
| <p>11. During sealing/resealing work, where the aggregate has been evenly spread and embedded in the binder, any remaining loose particles shall be removed from the pavement. The Contractor shall be responsible for the removal of any and all loose aggregate from the pavement prior to the opening of the road to traffic, and also for a period of at least forty eight (48) hours after the completion of the work. The Supervising Engineer may request additional sweeping of the pavement as and when required. The Contractor will be responsible for any windscreen damage to vehicles and tar stains caused to vehicles, driveways and footpaths as a result of the work.</p> | |
| <p>12. Suitable warning signs must be displayed when sweeping of the pavement is being carried out. A "Traffic Control Plan" must be submitted to the Supervising Engineer prior to any sweeping taking place. The Supervising Engineer shall be advised as to when sweeping is taking place so that the work can be monitored.</p> | |
| <p>13. A mechanical suction sweeper is to be used on all urban roads and where there is kerb and gutter. The Council's Supervising Engineer may permit the use of a road broom to remove the loose aggregate from rural roads where the loose aggregate may be broomed to</p> | |

SPRAYED BITUMINOUS SURFACING

the edge of the seal. It shall then be removed by a mechanical suction sweeper. Contractors are to consider the above when tendering for sealing and resealing work.

14. In the event no sweeping or inadequate sweeping has been carried out following reseals/ new seals within the specified time frame, the Supervising Engineer may engage a Sweeping Contractor at the expense of the Resealing/Sealing Contractor.

15. If any sweeping is carried out on a road contrary to the submitted and approved "Traffic Control Plan", the Supervising Engineer shall stop the work immediately.

C244.21 PROTECTION OF SERVICES AND ROAD FIXTURES

1. The Contractor shall take all necessary precautions to prevent primer, primer binder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, kerb and gutter, bridge or culvert decks and other road fixtures.

***Contractor's
Responsibility***

2. The contractor shall also advise residents, businesses and agencies of any temporary "no parking" conditions and possible delays to traffic movements during the work

3. Immediately after aggregate has been spread over the binder, the Contractor shall clean off or remove any sprayed surfacing material and leave the services and road fixtures in a condition equivalent to that existing when the Contractor commenced the sprayed surfacing work.

***Services and
Road Fixtures***

4. The contractor shall supply and erect its own signs during the work and also supply, erect and maintain all necessary signs after work and be responsible for all relevant signs continuously for a period of at least two (2) weeks or until practical completion of the work to the satisfaction of Council's Supervising Engineer. The Council may erect or maintain signs or additional signs as may be necessary and the cost incurred shall be borne by the contractor. A separate "Traffic Control Plan" for each area of work must be submitted at least seven (7) days prior to commencement of work.

5. Stick and stumps shall be placed on the centre line after the completion of work.

NON-CONFORMANCE OF MATERIALS AND WORK

C244.22 GENERAL

1. Non conforming materials and work shall be rejected.

***Replace or
Correct Non-
conformance***

SPECIAL REQUIREMENTS

C244.23 RESERVED

C244.24 RESERVED

C244.25 RESERVED

C244.26 RESERVED

C244.27 RESERVED

C244.28 RESERVED

LIMITS AND TOLERANCES

C244.29 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C244.2 below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	Design of Bituminous Surfacing	Contractor to provide details of design to Council's Supervising Engineer at least seven days before proposed commencement of work	C244.08
2.	Sweeping of Pavement Surface	Sweeping shall extend at least 300mm beyond each edge of the area to be sprayed	C244.12
3.	Bitumen Heating		
	(a) Bitumen Temperature	When incorporated with cutter oil, bitumen shall be in temperature ranges as per Table C244.1.	C244.14
	(b) Refinery Cutback Bitumen Temperature	At the time of spraying shall be in temperature range as per Table C244.1.	C244.14
	(c) Overheating of Bitumen	Bituminous material shall not be heated above the upper temperature limits of Table C244.1. Overheated material shall be rejected.	C244.14
	(d) Retention of Temperature	Bituminous materials shall not be held at temperatures within the ranges of Table C244.1 for periods in excess of 10 hours.	C244.14
4.	Spraying Temperature		
	(a) Pavement Temperature	Bituminous surfacing shall not be undertaken if the pavement temperature has not been at or above temperatures given in Table C244.1 for at least one hour before commencement of spraying.	C244.15
5.	Cutting Back Bitumen	Circulation of hot bitumen and cutter oil mixture in the sprayer shall be at the rate of 700 litres per minute for 20 minutes.	C244.16
6.	Bituminous Adhesion Agent	Circulation of bituminous adhesion agent with hot bitumen shall be at the rate of 700 litres per minute for 15 minutes.	C244.16

Item	Activity	Limits/Tolerances	Spec Clause
7.	Application of Bituminous Material		
	(a) Spray Area	Area to be sprayed shall be limited to area that can be covered by aggregate at target application rate within 10 minutes of spraying.	C244.17
	(b) Application Rates	Application rates and quantities shall apply to a temperature of 15°C.	C244.17
	(c) Non-conformance	Areas not within 5 percent of the target application rate of primer, primer binder or binder shall constitute 'non-conformance' under the Contract.	C244.17
8.	Application of Aggregate		
	(a) Spreading Time	Application of aggregate shall be completed within 10 minutes of spraying bitumen or cutback bitumen on each section.	C244.20
9.	Rolling		
	(a) Roller Numbers and Type	Initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheeled rollers. Minimum load of one tonne per tyre and minimum tyre pressure 550KPa.	C244.20
	(b) Back rolling	Back rolling shall be undertaken for minimum of one hour per roller per 1000 square metres sprayed.	C244.20

Table C244.2 - Summary of Limits and Tolerances

C244.30 SUMMARY OF APPROVALS & SUBMISSIONS TO COUNCIL'S SUPERVISING ENGINEER

Activity	Notice Required	Spec Clause
Notice of Intention to commence surfacing, with details of spray rates, aggregate size and ALD	Two days	C244.09 2.
Approval of the aggregate lot and target application rates	HOLD POINT	C244.13 3.

Table C244.3

ANNEXURE C244A - DETAILS OF WORK

Section		Prime	Primer Seal		Seal or Reseal	
From	To		Binder	Aggregate	Binder	Aggregate

CONSTRUCTION
SPECIFICATION

C245

ASPHALTIC CONCRETE

SPECIFICATION C245 : ASPHALTIC CONCRETE

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C245A ASPHALT WORK RECORD

C245B SCHEDULE OF DETAILS

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GENERAL

C245.01 SCOPE

1. The work to be executed under this Specification consists of the design, production and placing of asphalt including the supply of materials, sampling, testing and any other operations necessary to provide asphalt in accordance with the provisions of the Contract. The extent of the Contractor's work shall include:

Extent of Work

- (a) Notification to residents
- (b) Sampling and testing of materials and the design of asphalt mixes required by the Contract.
- (c) Manufacture of the production mix.
- (d) Provision of a testing laboratory.
- (e) Preparation of the surface on which asphalt is to be placed.
- (f) Transport of asphalt.
- (g) Key in to existing pavement, kerbs and other fixtures
- (h) Placing and compaction of asphalt.
- (i) Sampling and testing.

The asphalt mixes shall be dense graded.

C245.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

C201 - Control of Traffic

(b) Australian Standards

- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1141.14 - Particle shape, by proportional caliper.
- AS 1141.18 - Crushed particles of coarse aggregates.
- AS 1141.22 - Wet/dry strength variation.
- AS 1141.41 - Laboratory polishing of aggregate using the horizontal bed machine.
- AS 1141.50 - Resistance to stripping of cover aggregates from binders.
- AS 1160 - Bitumen emulsions for construction and maintenance of

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	pavements.
AS 1507	- Road tars for pavements.
AS 2008	- Residual bitumen for pavements.
AS 2150	- Hot mix asphalt.
AS 2341.2	- Determination of dynamic viscosity by flow through a capillary tube.
AS 2341.5	- Determination of apparent viscosity by 'Shell' sliding plate micro-viscometer.
AS 2341.7	- Determination of density using a density bottle.
AS 2341.8	- Determination of matter insoluble in toluene.
AS 2341.11	- Determination of ductility.
AS 2341.12	- Determination of penetration.
AS 2341.14	- Determination of flashpoint of residual bitumen.
AS 2341.18	- Determination of softening point (ring and ball method).
AS 2357	- Mineral fillers for asphalt.
AS 2758.5	- Asphalt aggregates.
AS 1742.3	Traffic Control Devices for Work on Roads

(c) RTA Standard Test Methods

T103	- Pretreatment of Road Materials by Artificial Weathering.
T230	- Resistance of Stripping of Cover Aggregates and Binders.
T239	- Fractured Faces of Coarse Aggregate.
T501	- Freedom from Foaming of Bituminous Materials
T600	- Methods of Sampling Materials used in Bituminous Sealing Works
T601	- Compaction of Test Specimens of Dense Graded Bituminous Mixtures - Modified Hubbard-Field Procedure.
T603	- Stability of Dense Graded Bituminous Mixtures - Modified Hubbard-Field Procedure
T606	- Bulk Density of Compacted Dense Graded Bituminous Mixtures
T607	- Bitumen Content and Aggregate Grading of Bituminous Mixtures - Reflux Method.
T731	- Moisture Content of Scrap Rubber
T732	- Metallic Iron Content of Scrap Rubber
T733	- Bulk Density of Scrap Rubber
T734	- Foaming Caused by Scrap Rubber Addition to Bitumen
T735	- Laboratory Preparation of Rubber Bitumen Mixes.
T736	- Flow Test for Rubber Bitumen Mixes
T739	- Torsional Recovery of Polymer Modified Bitumen
T741	- Elastic Recovery of Polymer Modified Bitumens (ARRB Elastometer)
T1180	- Resilience Test for Hot Poured Elastomeric Joint Sealants.

(d) ASTM Test Methods

D5	- Penetration of bituminous materials.
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C245.03 PLANT

1. The Contractor shall provide all the plant and equipment necessary for carrying out the work in accordance with this Specification.

Contractor's Responsibility

2. All plant and equipment used on the work shall be kept in good operating condition. The Contractor shall remove from the work any plant or equipment that Council's Supervising Engineer considers to be unsuitable, not fully operational, or not in a satisfactory condition for carrying out work in accordance with this Specification.

Plant to be Suitable

C245.04 NOTIFICATION AND PROTECTION OF SERVICES AND ROAD FIXTURES

1. Before commencing site operations, the Contractor shall notify all affected

Contractor to

residents, businesses and the Council's Supervising Engineer of the scheduled works.

Notify

2. Such notification shall consist of two parts:

- a. Written notice delivered at least seven days in advance of proposed work; and
- b. A further written or verbal confirmation delivered not less than 24 hours prior to commencement of work.

3. Such notices shall detail:

- intended date of commencement;
- duration of project;
- hours of work;
- name of street(s) affected and limits of work;
- a contact phone number of Contractor's local representative;
- description of work; and
- any precautions to be followed by the public.

4. A sample of the proposed written notification for residents and businesses shall be submitted to the Council's Supervising Engineer for approval prior to use. The contractor shall also advise residents, businesses and agencies of any temporary "no parking" conditions and possible delays to traffic movements during the work.

5. The Contractor shall take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, bridge or culvert decks and other road fixtures. Immediately after the asphalt has been spread the Contractor shall clean off or remove any such material as directed by Council's Supervising Engineer and leave the services and road fixtures in a condition satisfactory to Council's Supervising Engineer.

Contractor's Responsibility

C245.05 PROTECTION OF WORK

1. The Contractor shall provide for traffic in accordance with the requirements of Specification C201 - CONTROL OF TRAFFIC while undertaking the work.

Provision for Traffic

2. The contractor shall supply and erect its own signs during the work and also supply, erect and maintain all necessary signs after work and be responsible for all relevant signs continuously for a period of at least two (2) weeks or until practical completion of the work to the satisfaction of Council's Supervising Engineer. The Council may erect or maintain signs or additional signs as may be necessary and the cost incurred shall be borne by the contractor. A separate "Traffic Control Plan" for each area of work must be submitted at least seven (7) days prior to commencement of work.

Delays

3. Stick and stomps shall be placed on the centre line after the completion of work.

4. The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work.

C245.06 WORK RECORDS

1. Particulars of the work performed shall be recorded by the Contractor on the Asphalt Work Record attached as Annexure C245A. The Contractor shall complete the Asphalt Work Record, which shall be countersigned by Council's Supervising Engineer each day as a true record of the work performed. A copy shall be supplied to Council's Supervising Engineer.

Asphalt Work Record

2. Delivery dockets stating the mass of each truck load of asphalt shall be attached to the Asphalt Work Record.

Delivery Dockets

MATERIALS

C245.07 GENERAL

1. Unless otherwise directed by Council's Supervising Engineer or separately stated in this Specification, materials or mix ingredients shall be sampled in accordance with Test Method T600.

Sampling

C245.08 AGGREGATES

1. Aggregates shall be of uniform quality and grading. Aggregates complying with the requirements of this Clause when combined with the mineral filler shall be capable of achieving the asphalt properties required by this Specification.

Uniformity

(a) Coarse Aggregate

1. Coarse aggregate shall comply with AS 2758.5 and comprises all mineral matter retained on a 4.75mm AS Sieve. Coarse aggregate shall consist of clean, dry, hard, tough and sound crushed rock, metallurgical slag or gravel, be of uniform quality and be free from dust, clay, dirt or other matter deleterious to asphalt.

Quality

2. The grading of the coarse aggregate used in the work shall be determined in accordance with AS 1141.11.

Grading

3. When submitting details of the nominated mix the Contractor shall submit to Council's Supervising Engineer NATA Certified Laboratory Test Reports on the quality and grading of the coarse aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

NATA Reports

4. If the Contractor proposes to blend two or more coarse aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and Council's Supervising Engineer advised of the proportions in which the various sizes and constituents are to be combined. The coarse aggregate from each source and the combined aggregate shall comply with the following requirements:

Test Requirements

(i) Wet Strength - AS 1141.22.

Shall be not less than 100 kN for any fraction.

(ii) Wet/Dry Strength Variation - AS 1141.22

Shall not exceed 35 per cent for any fraction or constituent.

(iii) Particle Shape - AS 1141.14

The proportion of misshapen particles in the fraction retained on the 9.50 mm AS sieve shall not exceed 35 per cent using a caliper ratio of 2:1 and shall not exceed 10 per cent using a caliper ratio of 3:1.

(iv) Fractured (Crushed) Faces of Coarse Aggregate - AS 1141.18

Aggregate which is retained on a 6.70 mm AS sieve shall consist of at least 75 per cent by mass of particles with at least two fractured faces and when used in the wearing course shall have at least 90 per cent by mass of particles with at least one fractured face. The area of each fractured face shall be a significant proportion of the total surface area of the particle.

(v) Resistance to Stripping - AS 1141.50

Stripping of aggregates treated by the addition of a suitable adhesion agent to the binder shall not exceed 10 per cent.

5. When tested in accordance with AS 1141.11 aggregate shall be rejected if the Polishing Aggregate Friction Value (PAFV) for the aggregate is less than 50. Use of the aggregate with a lesser value shall be subject to approval by Council's Supervising Engineer.

Polishing Value

6. Test samples may be pretreated by procedures described in Test Method T103 before commencement of the tests referred to in Clause C245.08 (a).

Pretreatment of Samples

(b) Fine Aggregate

1. Fine aggregate comprises all mineral matter (other than filler) passing the 4.75 mm AS sieve. It shall consist of clean, hard, tough and sound grains, free of coatings or loose particles of clay, silt or other matter deleterious to asphalt. The fine aggregate shall consist of natural sand or a mixture of natural sand and material derived from the crushing of sound stone or gravel.

Soundness

2. When submitting details of the nominated mix the Contractor shall submit to Council's Supervising Engineer a NATA Certified Laboratory Test Report on the quality and grading of the fine aggregate proposed to be used. The grading shall be known as the "Proposed Grading."

NATA Reports

3. If the Contractor proposes to blend two or more fine aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and Council's Supervising Engineer advised of the proportions in which the various sizes and constituents are to be combined. The fine aggregate from each source and the combined aggregate shall comply with the requirements of Clause C245.08 (a).

Test Requirements

(c) Special Aggregates

1. Where special aggregates are required in the asphalt, the aggregates shall be from a source approved by Council's Supervising Engineer.

Approved Source

C245.09 MINERAL FILLER

1. Mineral filler comprises all material passing a 0.75mm AS sieve.

Constituents

2. The mineral filler shall comply in all other respects with the requirements of AS 2357. The voids in the dry compacted filler shall be not less than 40 per cent.

Voids

C245.10 BINDER

1. Unless otherwise directed by Council's Supervising Engineer, the binder supplied and used in the works shall be bitumen complying with Clause C245.10 (a).

Bitumen Quality

2. Where other binders are required they shall comply with the requirements of Clause C245.10 (b).

(a) Bitumen

Qualities

1. The bitumen shall be obtained from processing the residual from the refining of naturally occurring crude petroleum. The residual bitumen shall be homogeneous, contain no inorganic mineral matter other than that naturally occurring and shall be tested and comply with the requirements as shown in Table C245.1.

2. The bitumen used in the works shall be as specified in Annexure C245B.

Specification

Requirements					
Property	Class 170		Class 320		Test Method
	Min	Max	Min	Max	
Viscosity at 60 ^{°C} (Pa.s)	140	200	260	380	AS 2341.2
Viscosity at 135 ^{°C} (Pa.s)	0.25	0.45	0.40	0.65	AS 2008
Penetration at 15 ^{°C} (mm) (200g, 60s)	8	-	6	-	AS 2341.12
Flashpoint (°C)	250	-	250	-	AS 2341.14
Matter insoluble in Toluene (% by mass)	-	1.0	-	1.0	AS 2341.8
Effect of heat and air (Rolling thin film oven test)					AS 2008
(a) Ductility of residue at 15 ^{°C} (mm)	200	-	-	-	AS 2341.11
(b) Viscosity of residue at 60 ^{°C} as percentage of original	-	300	-	300	AS 2341.2
(c) Apparent viscosity of residue at 25 ^{°C} and a shear strain rate of 1 x 10 ⁻² /s as percentage of original (alternative to (b) above)	-	300	-	-	AS 2008 AS 2341.5
The film oven test (1.6mm)					AS 2008
(a) Ductility of residue at 25 ^{°C} (mm)	600	-	-	-	AS 2341.11
Density at 15 ^{°C} (kg/L)	1.00	-	1.01	-	AS 2341.7
Water Content and Foaming at 175 ^{°C}		Nil		Nil	T501

Table C245.1 - Requirements of Residual Bitumen
(b) Other Binders

1. These binders shall be incorporated in the works in accordance with the requirements of this Specification unless otherwise directed by Council's Supervising Engineer.

Incorporated in Works

2. Where other binders are produced by the inclusion of an additive at the time of manufacture of the asphalt, the mixing time required by Clause C245.18 (c) shall be increased by 25 per cent unless otherwise approved by Council's Supervising Engineer.

Mixing Tim

(i) Scrap Rubber Bitumen

1. Scrap Rubber Bitumen shall comprise Class 170 bitumen with scrap rubber either added at the time of mixing or pre-blended in the proportions as directed by Council's Supervising Engineer.

Scrap Rubber

2. When Scrap Rubber Bitumen is pre-blended, the bitumen shall be heated to between 190^{°C} and 200^{°C} and the scrap rubber added in the required proportion. The mixture shall be maintained at between 190^{°C} and 200^{°C} and mixed continuously for one hour to allow for digestion of the scrap rubber in the bitumen.

Heating Temperature

3. A 20 per cent scrap rubber bitumen mixture prepared in accordance with Test Method T735 shall have a minimum recovery of 20 per cent when tested in accordance with Test Method T1180.

Recovery Test

4. Scrap rubber bitumen that has either separated or increased in viscosity to the extent that it is difficult to pump shall be rejected. Scrap rubber shall comply with the requirements of Clause C245.13. **Viscosity**

(ii) Modified Bitumens

1. Polymer modified bitumens containing Styrene Butadiene Styrene (SBS) and Ethylene Vinyl Acetate (EVA) modifiers shall comply with the limits shown in Tables C245.2 and C245.3 as appropriate and the requirements set out below. The polymer modified bitumens shall be supplied in the grades shown in Annexure C245.B. **Polymer Modified**

2. The binder shall be pumped and stored at the manufacturer's recommended temperatures unless Council's Supervising Engineer otherwise specifies the temperatures. **Storage Temperature**

3. For polymer modified bitumens all blending of materials (with the exception of bitumen adhesion agent) shall be carried out in the manufacturer's premises before dispatch. Materials shall not be blended in a road tanker or sprayer. The polymer modifiers shall be compatible with bitumen complying with AS 2008. **Blending**

4. Polymer modifiers may be supplied as powder, pellets or prills provided that, when mixed with bitumen, the resultant modified bitumen complies with Grades 60 or DX of this Specification. For both testing compliance and field use, the Contractor shall advise the required amount of modifier. **Form
Contractor's Responsibility**

Test	Grade 4*	Grade 5*	Grade 6*	Grade 60	Test Method
Elastic Recovery at 60 ^{°C} (%)	-	-	85 min	90 min	T741
Viscosity on ER at 60 ^{°C} (Pa.s)	-	-	5000 min	6000 min	T741
Torsional Recovery at 25 ^{°C} (%)	-	-	60 min	60 min	T739
Flow at 60 ^{°C} (mm)	-	-	10 max	1 max	T736
Viscosity at 135 ^{°C} (Pa.s)	-	-	3 max	5 max	AS 2008
Flash Point (^{°C})	-	-	250 min	250 min	As 2341.14
Softening Point (^{°C})	-	-	75 min	85 min	AS 2341.18
Penetration at 25 ^{°C} (mm/10) (100g. 5 s)	-	-	75 min	50 min	ASTM D5
Other polymers and Mineral Matter	-	-	0.5 max unless disclosed	0.5 max unless disclosed	

* Not applicable to this Specification

NOTE: For the purpose of assessing compliance with this Table samples shall be heated to 135^{°C} without high shear mixing and immediately cast into test moulds.

Table C245.2 - Specified Properties for SBS Modified Bitumens

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Test	Grade A	Grade B	Grade BX	Grade C	Grade DX	Test Method
Elastic Recovery at 45 ^{°C} (%) on heat up	80 min	85 min	40 min	75 min	35 min	T741
Viscosity by Elastomer at 60 ^{°C} (Pa.s)	2500 min	600 min	2500 min	600 min	600 min	T741
Torsional Recovery at 25 ^{°C} (%)	40 min	45 min	16 min	25 min	15 min	T739
Softening Point (°C)	62 min	59 min	64 min	57 min	54 min	AS 2341.18
Viscosity at 135 ^{°C} (Pa.s)	11 max	5.5 max	7 max	2.5 max 0.625 min	1.25 max	AS 2008
Penetration at 25 ^{°C} (mm/10) (100g. 5 s) after overnight cure	30 min	40 min	45 min	40 min	45 min	ASTM D5
Other polymers and Mineral Matter (%)	0.5 max unless disclosed	0.5 max unless disclosed	0.5 max unless disclosed	0.5 max unless disclosed	0.5 max unless disclosed	

Table C245.3 - Specified Properties for EVA Modified Bitumens

C245.11 BITUMEN ADHESION AGENT

1. A bitumen adhesion agent shall be added to the binder. Details of the proposed bitumen adhesion agent shall be submitted for the approval of Council's Supervising Engineer in accordance with Clause C245.15. The bitumen adhesion agent shall be used in a manner compatible with the manufacturer's recommendations. When tested in accordance with Test Method T230, the bitumen adhesion agent shall comply with the requirement in Clause C245.08(a) at a concentration within the range 0.5 per cent to 1.0 per cent by mass of the binder.

Use and Test Requirements

C245.12 BITUMEN EMULSION

1. The bitumen emulsion shall be cationic rapid setting C170 bitumen emulsion complying with the requirements of AS 1160.

Type

C245.13 SCRAP RUBBER

1. Scrap rubber may consist of either natural or synthetic rubber or a mixture of both. The scrap rubber shall be milled to comply with the grading limits shown in Table C245.4.

Composition

Sieve Size (mm)	Per Cent Passing by Mass
1.18	100
0.600	60 min.
0.300	20 max.

Table C245.4 - Required Grading for Scrap Rubber

2. Scrap rubber particles shall be granular in shape with no more than 10 per cent of the particles having a length greater than 7.5 mm and shall comply with the limits shown in Table C245.5.

Particle Shape

Property	Requirements	Test Method
Foaming (%)	50 max.	T734
Moisture Content (%)	1.0 max.	T731
Iron Content (%)	Nil	T732
Bulk Density (kg/m ³)	400 max.	T733

Table C245.5 - Required Properties for Scrap Rubber

3. Scrap rubber shall not contain any metal fragments or other foreign material.

Foreign Matter

4. Cryogenically produced scrap rubber shall not be acceptable unless grinding follows the cryogenic size reduction.

C245.14 GEOTEXTILE

1. Geotextile may be required as an underlay for the drainage layer of asphalt or for other applications as an underlay for wearing or intermediate courses.

Underlay

2. The geotextile used as an underlay for drainage shall be needle punched polyester felt with a mass per square metre of at least 340 grams.

Mass

3. For other applications, geotextile proposed by the Contractor may be approved provided the geotextile is considered by Council's Supervising Engineer to be appropriate to the application and is used in accordance with the manufacturer's specification.

Other Applications

ASPHALT MIX DESIGN

C245.15 NOMINATED MIX

1. The Contractor shall design each asphalt mix, henceforth called the 'nominated mix', within the limits shown in Table C245.6 unless otherwise approved by Council's Supervising Engineer.

Design

2. Each asphalt mix shall include a bitumen adhesion agent in the binder in accordance with Clause C245.11.

Adhesion Agent

3. When asphalt containing special aggregate is specified, the special aggregate shall comprise all coarse and fine aggregates of 5 mm nominal size and greater.

Special Aggregate

4. The Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The Certificate shall confirm that the required testing has been carried out in the twelve-month period before the date of submission to Council's Supervising Engineer.

NATA Laboratory Tests

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5. Details of the nominated mix shall be submitted to Council's Supervising Engineer at least twenty-one days before the placing of asphalt. The nominated mix information shall include combined aggregate grading and binder content, proportions of constituent materials used (including adhesion agent), grading of aggregate and filler, and type and sources of aggregates, filler, binder and adhesion agent.

Submit Details

6. If any revision is necessary, then the costs associated with revision of the Nominated Mix and testing of the revised Nominated Mix in accordance with this clause shall be borne by the Contractor.

***Revised Mix
Contractor's
Cost***

Property	Requirements								
	Classified Roads						Unclassified Roads**		
Aggregate passing AS Sieve (% by mass)	Nominal Size of Asphalt						Type A	Type B	Type R
	5mm (AC5)	10mm (AC10)	14mm (AC14)	20mm (AC20)	28mm (AC28)	40mm (AC40)			
53.0mm						100			
37.5mm					100	85-98			
26.5mm				100	85-98				
19.0mm			100	90-98					
13.2mm		100	85-98	70-90	57-75	55-75	100	100	
9.50mm		90-98					95-100	90-100	
6.70mm	100	70-90	60-75	40-70	45-60	40-55	80-95	65-85	100
4.75mm	85-98						65-80	60-80	85-100
2.36mm	55-75	40-60	35-47	25-55	25-37	25-40	45-60	55-75	55-80
1.18mm							35-50	45-65	38-60
0.600mm	26-43	23-38	15-30	15-27	15-27	14-24	25-40	30-50	25-43
0.300mm							15-25	20-30	15-30
0.150mm							7-15	10-18	8-20
0.075mm	4.5-11	4.5-10	3-7	3-7	3-6	3-6	3-10	5-11	5-12
Binder content (% by mass of total asphalt mix)*	5.6-6.8	5.1-6.4	4.8-6.2	4.6-6.1	4.2-5.8	3.5-5.5	6.0-7.0	5.8-6.8	6.5-7.5
Stability of the compacted asphalt mix (kN) Test Methods T601 and T603 (Modified Hubbard Field Procedure) Min as per Marshall Method (at 35 blows)	22-34	22-34	22-34	22-34	22-34	22-34	4.0	4.0	3.5
Voids in compacted asphalt mix (% of voids in volume of mix) Test Methods T601, AS1507 and T606 (modified Hubbard Field Procedures) As per Marshall Method (at 35 blows)	4-7	4-7	4-7	4-7	4-7	4-7	3-5	3-5	3-5
Voids filled by binder (% voids in the total mineral aggregate to be filled by binder) Test Method T606	65-80	65-80	65-80	65-80	65-80	65-80			
Flow (mm) of compacted mix (35 blow Marshall)							2-5	2-5	2-5
<p>NOTE: * Some increase beyond these ranges of binder content may be permitted for aggregates having unusually high absorption characteristics.</p> <p>** Type A and B are suitable for residential streets, car parks and commercial driveways carrying light traffic. Type R is suitable for footpaths, cycleways and recreation areas.</p>									

Table C245.6
Limits for Design of Nominated Mix - Dense Graded Asphalt (AC)

C245.16 APPROVED MIX

1. When Council's Supervising Engineer has approved a nominated mix, it shall be known as the 'approved mix'. Work shall not commence until an asphalt mix has been approved. Release of the mix approval shall constitute a **HOLD POINT**.

Approval

Hold Point

2. The Contractor shall not make any changes to the approved mix, its method of production or constituent materials without the prior written approval of Council's Supervising Engineer. If any such change is proposed, then the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C245.15.

Changes to Approved Mix

3. If the Contractor's nominated mix has received prior approval under a separate contract with the Principal within twelve months before the proposed date of initial delivery under this contract, then provided that:

Prior Approval

- (a) the Contractor produces documentary evidence and full details of the previously approved mix supplied under a specification which required the same standard of materials and product as this Specification;
- (b) the constituent materials and their quality remain unchanged from that previously approved; and
- (c) the in-service performance of the asphalt incorporating the nominated mix has proved acceptable to the Principal;

Council's Supervising Engineer may approve the nominated mix without requiring the prior-testing of samples by the Contractor at a NATA registered laboratory, but may require samples to be tested in accordance with Clause 241.15 at any time during the course of the contract.

4. Notwithstanding any approval given by Council's Supervising Engineer to a proposed asphalt mix, the Contractor shall be responsible for producing asphalt that satisfies all requirements of the Specification.

Contractor's Responsibility

C245.17 REQUIREMENTS OF PRODUCTION MIX

1. Asphalt produced in the plant and delivered to the site shall be known as the 'production mix'.

(a) Dense Graded Asphalt

Dense graded asphalt shall comply with the requirements shown in Table C245.7 unless otherwise approved by Council's Supervising Engineer.

Production Mix Properties	Allowable Variations from Approved Mix *	
Nominated Mix Type (see Table C245.6)	AC5, AC10, AC14, AC20, AC28, AC40	A, B, R
Grading - Test Method T607 Passing 4.75mm AS sieve and larger Passing 2.36mm and 1.18mm Passing 0.600mm and 0.300mm Passing 0.150mm Passing 0.075mm Binder Content - Test Method T607 Voids in compacted mix - Test Methods T601, AS1507 and T606 Voids in compacted mix - Marshall method (at 35 blows) Voids filled by binder - Test Method T606 Flow of compacted mix - (35 blow Marshall)	±7% ±5% ±4% ±2.5% ±1.5% ±0.3% 4 - 7% - 65 - 80% -	±7% ±5% ±4% ±2.5% ±1.5% ±0.3% - 3 - 5% - 2 - 5mm

* Notwithstanding, these allowable variations shall not fall outside the limits for design of nominal mix as shown in Table C245.6.

**Table C245.7
Dense Graded Asphalt - Requirements for Production Mix**

PRODUCTION

C245.18 MIXING PROCEDURE

(a) Plant

1. Mixing shall be undertaken in an approved batch pugmill, continuous pugmill or drum mixing plant, capable of uniformly mixing coarse and fine aggregate, filler, and binder to meet the requirements specified in this Specification at all times.

Characteristics

(b) Temperature

1. Plant temperatures shall be maintained in a range sufficient to ensure homogeneous asphalt without causing deleterious effects to the binder through overheating. Temperatures shall be in the ranges shown in Table C245.8. For asphalt made with other binders complying with Clause C245.10 (b), the temperatures shall be in accordance with manufacturer's recommendation.

Temperatures

2. In special cases, Council's Supervising Engineer may permit a lower temperature for manufacture, but in no circumstances shall the temperature of the asphalt at the time of laying be less than the minimum value specified in Clause C245.26 (c) for the appropriate road surface temperature and layer thickness.

Limits

ASPHALTIC CONCRETE

3. The asphalt temperature shall be measured as the asphalt leaves the pugmill, drum and/or the hot storage bin(s). **Measurement**

4. The asphalt shall have a moisture content not greater than 0.5 per cent by mass when tested in accordance with AS 2150. **Moisture Content**

DENSE GRADED ASPHALT			
Type of Binder	Class 170	Class 320	SBS Modified Class 170
Min Binder Temp	140 ^{°C}	140 ^{°C}	180 ^{°C}
Max Binder Temp	165 ^{°C}	170 ^{°C}	190 ^{°C}
Min Asphalt Temp	140 ^{°C}	140 ^{°C}	180 ^{°C}
Max Asphalt Temp	165 ^{°C}	170 ^{°C}	190 ^{°C}

Table C245.8
Temperatures for Manufacture of the Asphalt

(c) Mixing Time **Uniform Coating**

1. Mixing time shall be such that all particles of aggregate are uniformly coated with binder.

(d) Storage of Asphalt **Limitations**

1. Asphalt may be stored in an insulated storage bin prior to delivery. Asphalt that has been stored for more than twenty-four hours or is below the minimum temperature specified in Clause C245.26 (c) shall not be used.

(e) Contractor's Laboratory

1. The Contractor shall maintain and operate a testing laboratory at or near the mixing plant to control the quality of the asphalt produced. **Quality Control**

C245.19 SAMPLING AND TESTING OF PRODUCTION MIX

(a) Responsibility for Sampling

1. The Contractor shall be responsible for taking samples and shall supply all facilities, equipment and labour for that purpose. The Contractor shall take the samples. The costs associated with taking samples of production mix shall be borne by the Contractor. **Contractor's Responsibility and Costs**

(b) Frequency of Sampling

1. For the purpose of testing production mix, samples shall be taken at the rate of one sample for each 50 tonnes of asphalt or part thereof. Unless otherwise directed by Council's Supervising Engineer the sample shall be taken at the point of delivery from trucks spaced to represent each 50 tonnes of asphalt or part thereof. **Sampling Rate**

(c) Method of Sampling

1. Each sample shall comprise two increments taken from separate sites distributed over the area of the truckload. Each increment shall represent half the truckload. The **Sampling Points**

sampling point shall be at least 500 mm from any side of the truck body. Surface material shall be removed for a depth of approximately 100 mm and the sample taken from the exposed surface by a deep-sided sampling scoop of such a shape as to prevent the inclusion of material falling in from the sides.

2. A sample of at least 5 kilograms shall be taken.

Size of Sample

(d) Containers

1. Each sample or sample portion as appropriate shall be placed in an airtight metal container, suitably labelled for identification and delivered to the Contractor's nominated NATA registered Laboratory. The label shall be affixed to the body and the lid of the metal container. A suitable label is as follows:

- Date
- Contract No
- Type of Material
- Quantity delivered
- Sample No.
- Supplier
- Delivery Docket No.
- Delivery Vehicle Regd. No.
- Location and Lot Number

(e) Testing

1. The Contractor shall arrange testing required by this Clause at a NATA registered laboratory.

Registered Laboratory

2. The cost of such testing shall be borne by the Contractor.

Contractor's Costs

(f) Inspection of Mixing Plant

1. Council's Supervising Engineer shall have access at all times to all parts of the mixing plant for checking masses or proportions, the nature of materials, temperature measurements or the general operation of the plant and may direct action to be taken to correct any deficiencies. Council's Supervising Engineer shall advise the asphalt supplier or the supplier's representative of the inspection on or before arrival at the plant.

Access

TRANSPORT

C245.20 GENERAL

1. The bodies of haulage trucks shall be kept clean and coated with a thin film of an approved release agent to prevent asphalt sticking to the body of the truck. Any surplus release agent shall be removed before loading.

Release Agent

2. During transport asphalt shall be covered with a canvas or other suitable cover, which is securely held down.

Cover of Load

3. When mix is to be transported over long distances or in cold conditions, the mix shall be covered with a heavy-duty canvas or similar waterproof cover, which shall overlap the sides of the truck body by at least 250 mm and shall be securely tied down. The bodies of all trucks shall be suitably insulated.

Long Distance

4. Delivery of the asphalt shall be at a uniform rate within the capacity of the spreading and compacting equipment. Transport shall be as expeditious as possible to minimise cooling of the asphaltic concrete.

Delivery Rate

5. Unless Council's Supervising Engineer approves another means of measurement, the mass of all truckloads of asphalt shall be measured on a weighbridge certified by the Department of Fair Trading.

Weighbridge

PLACING

C245.21 GENERAL

1. The type and size of asphalt and the surface levels and thickness for each layer of asphalt shall be as shown in the Drawings, or as specified by Council's Supervising Engineer.

Layers

2. Placing of asphalt shall not be permitted when the surface of the road is wet or while rain appears imminent, or when cold winds chill the asphalt to such an extent that, in the opinion of Council's Supervising Engineer, spreading and compaction will be adversely affected.

**Weather
Conditions**

C245.22 PREPARATION OF PAVEMENT

(a) Cleaning of Surface

1. The existing surface shall be dry, clean and free from any loose stones, dirt and foreign matter. The surface shall be swept beyond the edge of the proposed asphalt layer by at least 300 mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of Council's Supervising Engineer.

Requirement

(b) Rectification of Pavement Surface

1. The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's cleaning activities. Affected areas designated by Council's Supervising Engineer shall be removed and reinstated with fresh asphalt compacted to the degree specified in Clause C245.31 and the cost of repairing such damage shall be borne by the Contractor.

**Contractor's
Responsibility**

**Contractor's
Cost**

2. Council's Supervising Engineer may direct that specific surface depressions of greater depth than twice the permissible tolerance (specified in Clause C245.32 (d)) of the layer to be placed be tack coated and squared where necessary, filled with fresh asphalt of appropriate nominal size in accordance with Table C245.12 and compacted before the main course is placed. The asphalt in these patches shall be compacted in accordance with Clause C245.31 to the general level of the existing surface.

**Correction
Courses**

3. No placing of asphalt shall be undertaken until the pavement has been prepared to the satisfaction of Council's Supervising Engineer. The Supervising Engineer's approval shall constitute a **HOLD POINT**

**Asphalt
Placement**

Hold Point

4. Key-in to existing kerbs and fixtures shall be such that the total asphalt cover is not less than the pavement being surfaced

Key-in

5. Where an existing pavement is being overlaid, transverse Key-in joints shall be provided at the start and finish of the overlay such that: -

a. the compacted thickness of new asphalt at the joint is not less than 2.0 to 3.0 times the nominal size of aggregate in the mix for a minimum of 40mm depth.

b. transition from the existing to new pavements shall be smooth and at a grade that does not depart from the overall pavement grade by more than 3%

- c. the length of the transverse key is to be not less than 3.0 metres

C245.23 LAYING OF GEOTEXTILES

(a) Geotextile for Drainage Layer

- | | |
|--|-----------------------------------|
| <p>1. Where a geotextile as specified in Clause C245.14 is to be applied, the surface shall be prepared in accordance with Clause C245.22.</p> | <p>Surface Preparation</p> |
| <p>2. The geotextile shall be neatly cut to fit and at all joins of the geotextile it shall be lapped a minimum of 300 mm with the overlap in the direction of paving. Joins shall be kept to a minimum.</p> | <p>Cutting and Joining</p> |
| <p>3. The geotextile shall be pinned by means of 'U' shaped wire staples of suitable leg length and a wire diameter of 3mm minimum or other rapid fastening system approved by Council's Supervising Engineer.</p> | <p>Staples</p> |
| <p>4. The geotextile shall be pinned through each join and the centre of any length at intervals not exceeding 2 m, and also at all ends and edges. The pinning shall prevent movement of the geotextile before and during the paving operation.</p> | <p>Pinning Locations</p> |

C245.24 PAVEMENT DRAIN

1. Where a pavement drain or an edge drain is specified or shown on the Drawings, Council's Supervising Engineer will direct the sequence of operations.

C245.25 TACK COAT

- | | |
|---|--|
| <p>1. Unless otherwise directed by Council's Supervising Engineer, the whole of the area to be sheeted with asphalt shall be tack coated with a light and even coat of bitumen emulsion that shall meet the requirements of Clause C245.12. Where multiple courses are to be applied a tack coat shall be used between each course unless directed otherwise by Council's Supervising Engineer.</p> | |
| <p>2. The application rate of undiluted bitumen emulsion shall be neither less than 0.15 litres per square metre nor more than 0.50 litres per square metre.</p> | <p>Application Rate</p> |
| <p>3. Where a geotextile is used as specified in Clause C245.23 (a) no tack coat shall be applied.</p> | <p>Excluded with Geotextile</p> |
| <p>4. The bitumen emulsion shall be applied by a mechanical sprayer with spray bar. Where the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, such areas shall be tack coated by hand spraying or brushing.</p> | <p>Mechanical Sprayer</p> |
| <p>5. The bitumen emulsion may be warmed or diluted with water to facilitate spraying of a light uniform application. Adequate time shall be allowed for the emulsion to break before asphalt is laid. Over application of tack coat due to surface depressions shall be removed or dispersed by brushing.</p> | <p>Application</p> |
| <p>6. All contact surfaces of kerbs and other structures and all cold joints shall be coated with a thin uniform application of tack coat.</p> | <p>Contact Surfaces</p> |
| <p>7. Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat any services or exposed fixtures including concrete kerbs, guardrail or bridge handrails. Any such spray or coating shall be removed in accordance with Clause C245.04.</p> | <p>Surface Protection</p> |

ASPHALTIC CONCRETE

8. When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, Council's Supervising Engineer may require that the finished surfaces be blinded with limestone dust or similar material to protect them from carryover of bituminous material.

***Truck
Movements***

9. Proprietary tack coats may be approved by Council's Supervising Engineer in special circumstances.

***Proprietary
Tack Coats***

C245.26 LAYING

(a) Paver

1. The paver(s) shall have a minimum spreading capacity of 50 tonnes of asphalt per hour and capable of spreading a width of at least 3.7m to the requirements of this Specification. It shall have automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam and an automatic crossfall control.

(b) Laying Operations

***Joints to be
Minimised***

1. The work shall be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum.

2. The paver shall operate at a uniform speed and the delivery of asphalt shall match the output of the paver such that continuous laying of asphalt is achieved.

***Continuous
Laying***

3. When laying asphalt in echelon the distance between pavers shall be such that the temperature of the asphalt at the edge of the asphalt laid by the advance paver is not less than 80°C by the time the following paver matches the longitudinal joint.

***Laying in
Echelon***

4. In the event of faulty operation of the paver causing irregularities in the spread asphalt, work shall cease until the fault is rectified.

***Irregularities in
Laying***

5. Unless otherwise approved by Council's Supervising Engineer, asphalt shall not be spread by hand behind the paver. Workers shall not stand or walk on the hot surface until compaction has been completed except where necessary for correction of the surface.

Worker Control

6. Council's Supervising Engineer may approve spreading asphalt by hand for minor correction of the existing surface and in areas inaccessible to mechanical pavers. Asphalt so placed, shall be spread so as to produce a smooth even surface with uniform density to the correct level.

***Hand
Spreading***

(c) Laying Temperature

1. For asphalts made with Class 170 or 320 bitumens, the minimum asphalt temperatures at the time of discharge into the paver shall be as shown in Table C245.9.

Limits

2. For asphalt made with other binders complying with Clause C245.10 (b), the minimum asphalt temperature for laying shall be as directed by Council's Supervising Engineer.

Other Binders

3. Council's Supervising Engineer may allow asphalt to be laid outside the specified limits for wind velocities if the Contractor supplies at least an additional roller above the minimum number of rollers specified in Clause C245.28 and can demonstrate that the level of compaction specified in Clause C245.31 can be achieved.

***Outside
Specified Wind
Velocities***

4. Council's Supervising Engineer may reject that part of any truckload that contains lumps of cooled asphalt that are liable to affect the quality of the finished surface.

***Cooled Asphalt
in Truck***

5. The laying temperature shall be measured in the truck just prior to discharging into

Temperature

the paver hopper. A suitable stem type thermometer readable and accurate to within plus or minus 2°C with a range from at least 0°C to 200°C shall be used. The stem shall be inserted into the asphalt to a depth of approximately 200 mm at a location at least 300 mm from the side of the truck body. The average of two readings shall be adopted as the temperature of the mix. The Contractor in the presence of Council's Supervising Engineer shall make any necessary measurements of asphalt and road surface temperatures and wind velocity to comply with this Clause.

Determination

Binder Type	Road Surface Temperature in Shade (°C)	Asphalt Temperatures (°C)			
		Layer Thickness Less than 30mm	Layer Thickness 30mm to 45mm	Layer Thickness 45mm to 100mm	Layer Thickness over 100mm
Class 170	5-10	*	*	145	130-155
&	10-15	150#	145##	140	125-150
Class 320	15-25	145#	140##	135	120-145
Bitumen	over 25	140	135	130	115-140
SBS polymer	15-25		160	155	
modified bitumen **	over 25		150	150	
<p>NOTE: * Layers thinner than 45mm shall not be placed when the pavement temperature is below 10°C for dense graded asphalt and 15°C for open graded asphalt.</p> <p>** For other polymers the minimum temperatures are as directed by Council's Supervising Engineer.</p> <p># Laying not permitted if wind velocity across the pavement exceeds 5 km/hr.</p> <p>## Laying not permitted if wind velocity across the pavement exceeds 15 km/h.</p>					

**Table C245.9
Minimum Asphalt Temperatures for Laying**

(d) Level Control

1. The minimum controls for level set out below shall be used. Additional controls may be necessary to obtain the required finished pavement properties. **Minimum**
2. Corrective courses shall be automatically controlled from fixed wire or stringline level controls and, as required by Council's Supervising Engineer, a joint matching shoe. Where the correction is only minor, Council's Supervising Engineer may allow the use of levelling beams at least 10m long. **Corrective Course**
3. Intermediate courses shall be automatically controlled from fixed wire or stringline level controls and, as required by Council's Supervising Engineer, a joint matching shoe. **Intermediate Course**
4. The wearing course shall be controlled by levelling beams at least 10 m long and, as required by Council's Supervising Engineer, a joint matching shoe. **Wearing Course**

(e) Layer Thickness

1. The compacted thickness of each course shall be as shown on the Drawings, or as directed by Council’s Supervising Engineer at any location. A course may comprise one or more layers. The nominal compacted layer thickness shall be in accordance with Table C245.10.

Nominated Layer Thickness

Nominal Size of Asphalt (mm)	Compacted Layer Thickness (mm)	Type of Work
5*	15 to 25	Wearing course
10	25 to 40	Wearing course
14	35 to 50	Wearing course
10	25 to 40	Intermediate course
14	35 to 50	Intermediate course
20	40 to 80	Intermediate course
28	75 to 120	Intermediate course
40	100 to 160	Intermediate course

NOTE: *Special purpose asphalt

Table C245.10 - Course and Layer Thickness

C245.27 JOINTS

(a) General

1. The density of the asphalt and surface finish at joints shall be similar to those of the remainder of the layer.

Density & Finish

(b) Longitudinal Joints

1. Unless otherwise directed by Council’s Supervising Engineer, an automatically controlled joint matching device shall be used to control the levels of adjacent runs. Care shall be taken to provide positive bond between adjoining runs. Unless otherwise directed by Council’s Supervising Engineer, longitudinal joints shall be:

Joint Matching Device

- continuous and parallel
- coincident with 150mm of line of change in crossfall
- offset by at least 150mm from joints in underlying layers
- located away from traffic wheel paths
- located beneath proposed traffic line markings in the case of a wearing course.

2. Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

Overnight Exposure

3. When pavers are laying asphalt in echelon, the hot joint so produced shall be constructed by leaving an uncompacted strip approximately 150 mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

Paving in Echelon

4. In the case of cold longitudinal joints, the edge or edges of the first paver run shall be butted and slightly elevated while hot using hand lutes. **Cold**
5. If the edges of joints are left exposed overnight or longer, the edge shall be trimmed to a straight vertical face by cutting disc, rotary saw or pneumatic spade and lightly coated with tack coat material by brushing. The adjoining run shall be placed against the prepared edge with an overlap of 25 mm to 50 mm. The overlap shall be pushed back using lutes, immediately after placing, to form a slight ridge along the joint which the roller shall compress adjacent to the edge of the previously placed run. Any excess, overlapping or segregated material shall be discarded and not incorporated in the mat. **Treatment of Exposed Joints**
6. The compaction of asphalt at a longitudinal joint shall be carried out immediately behind the paver using either a static steel wheeled roller or a vibratory steel wheeled roller operated in a static mode. Compaction shall commence with the roller travelling on the cold lane with a 150 mm overlap on the hot lane for the first forward and reverse pass. The second pass shall be made on the hot lane with 150 mm overlap on the cold lane. **Compaction**
7. When thin layers are to be compacted, Council's Supervising Engineer may allow the use of a vibratory steel wheeled roller operated in the vibratory mode. In this instance, the first forward and reverse pass shall be made with the roller travelling on the hot lane and with a 150 mm overlap on the cold lane. **Thin Layers**
8. Rolling shall continue until the joint is smooth and dense. **Rolling**
- (c) Transverse Joints**
1. When the end of the asphalt layer has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed. **Location**
2. Transverse joints shall be at right angles to the direction of laying. They shall be staggered by at least 1 m between successive layers and between adjacent runs.
3. Runs shall end either against a timber bulkhead to ensure a straight vertical, well-compacted edge or by feathering out and compacting. In the latter case, before continuing the run the feathered material shall be cut back to a line where the full thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut. The end of the previous run shall be lightly tack coated before the laying of the next run proceeds. **Feathered Edge**
4. At the start of the run, care shall be taken to set the screed level with sufficient allowance for compaction so that just the correct thickness of asphalt is placed. The screed shall be heated to the asphalt temperature. **Setting of Screed**
5. When the paver has moved a sufficient distance from the joint, a steel roller shall compact the joint in several transverse passes. The roller shall project about 150 mm further onto the fresh asphalt in each pass. If a vibratory roller is used, it shall be operated in the static mode. At locations where it is difficult to roll the joint transversely, Council's Supervising Engineer may approve an alternative procedure. **Rolling**
6. Boards shall be used for off pavement movement of the roller to prevent rounding the edge of the mat. **Off Pavement Movement**
7. The joint shall then be rolled longitudinally.
8. When the asphalt layer is required to join and match the level of an existing pavement surface, bridge deck or other fixture, sufficient of the existing material shall be cut out to achieve the minimum layer thicknesses as set out in Table C245.10. **Matching Existing Surface**

COMPACTION

C245.28 PLANT AND EQUIPMENT

- | | |
|--|-------------------------|
| 1. The proposed compaction fleet and rolling pattern shall be adequate to achieve the specified compaction and finish. | Compaction Fleet |
| 2. The minimum number of rollers used for compaction of asphalt laid at various rates shall be as shown in Table C245.11. | Minimum Plant |
| 3. For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to Council’s Supervising Engineer shall be used. | Confined Areas |
| 4. Rollers shall travel at a uniform speed not exceeding 5 kilometres per hour for steel rollers and 10 kilometres per hour for both vibratory steel and pneumatic tyred rollers. | Roller Speed |
| 5. Lateral changes in the direction of rolling shall be made on previously compacted asphalt. Sharp turns shall be avoided and any changes from forward to reverse shall be made smoothly. Vibrating rollers shall not be stopped or reversed while in the vibrating mode. | Direction Change |

ASPHALT OUTPUT	ALTERNATIVE ROLLER COMBINATION		
	Dense Graded Asphalt		
Tonnes per hour per paver	Static Steel	Steel Vibrating	Pneumatic Tyred
Up to 45	1	-	1
	-	1	1
45 to 85	1	-	2
	-	1	1
85 to 120	1	-	3
	2	-	2
	-	2	1
Above 120	As for 85 to 120 plus additional rollers as determined by Compaction Trials		
<p>NOTES: 1. At the discretion of Council's Supervising Engineer, the minimum number of rollers may be decreased for layer thicknesses in excess of 60mm.</p> <p>2. Additional pneumatic tyred rollers to those specified may be required for backrolling asphalt.</p>			

Table C245.11 - Minimum Roller Combinations for Compaction

C245.29 DENSE GRADED ASPHALT

(a) Initial Rolling

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the first pass. On deep lift **Roller Type**

asphalt, pneumatic tyred rollers may be used.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver.

Commencing Time

The transverse and longitudinal joints and edges shall be compacted first as specified in Clause C245.27.

Priority

Initial rolling shall be completed before the bitumen asphalt temperature falls below 105^{°C}, or 120^{°C} for polymer-modified asphalt.

Temperature Level

(b) Secondary Rolling

Secondary rolling shall immediately follow initial rolling. Vibratory steel rollers, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers shall be between 500 kilopascals and 600 kilopascals. Rolling shall commence at the longitudinal joint side of the run.

Roller Types and Tyre Pressures

Secondary rolling shall be completed before the mix temperature falls below 80^{°C}.

Temperature Level

(c) Final Rolling

A pneumatic tyred roller shall carry out final rolling with tyre pressures between 600 kilopascals and 700 kilopascals to eliminate all roller marks and to produce a uniform finish. If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling instead of the pneumatic tyred roller specified.

Tyre Pressures

Final rolling shall be completed before the asphalt temperature falls below 60^{°C}.

C245.30 OPEN GRADED ASPHALT

1. All rolling of open graded asphalt shall be with static steel rollers. The minimum number of rollers shall be in accordance with Table C245.11. Only initial and final rolling shall be required.

Roller Type

2. Compaction methods shall be in accordance with AS 2734, Section 8.

Number of Passes

3. All rolling shall be completed while the asphalt temperature is neither less than 90^{°C} nor more than 110^{°C}.

Rolling Temperature

C245.31 ACCEPTANCE CRITERIA FOR COMPACTION

1. The acceptance for compaction shall be on a lot-by-lot basis where each day's work is generally one lot. Any defective areas that show cracking or bony or fatty material shall be excluded from the lot and shall be rectified by the Contractor before being tested.

Statistical Basis

2. The Contractor shall arrange for the determination of the relative compaction of the lot by either of the following methods:

Relative Compaction

Cores

The cores shall be taken on a random basis or in any locations as directed by the Council's Supervising Engineer and have density tests performed on the cores in accordance with Test Method T606. The layer thickness shall be deemed to be the mean thickness of the cores. The testing shall be undertaken at a NATA registered laboratory.

Nuclear Density Meter

The type of nuclear density meter shall be appropriate to the depth of the layer being measured and shall be calibrated for each type of asphalt.

The Contractor shall arrange for a nuclear density meter (backscatter mode) to measure density in situ and shall determine the acceptable compaction level, in terms of the nuclear density meter, from compaction trials or by correlation with cores taken from a compacted layer. The layer thickness shall be deemed to be the nominal layer thickness. The proposed correlation shall be submitted to Council's Supervising Engineer for approval.

- 3. Relative compaction of the core is the ratio of the field bulk density of the core and the mean laboratory density of the lot, determined by Test Methods T601 and T606, and reported as a percentage of the mean laboratory density. **Relative Compaction**
- 4. No cores or nuclear density measurements shall be taken within 150 mm of a joint or free edge. Unless directed by Council's Supervising Engineer, layers less than 30 mm in thickness shall not be cored. **Curing Limitations**
- 5. The minimum Relative Compaction of all values within a lot shall be 95 per cent for a layer of thickness less than 50 mm or 96 per cent for a layer of thickness of 50 mm or greater. **Minimum Relative Compaction**

C245.32 FINISHED PAVEMENT PROPERTIES

(a) General

- 1. Each course of asphalt shall be finished parallel to the finished surface of the wearing course. **Parallel to Finished Course**

(b) Thickness

- 1. The thickness of asphalt, which for each layer shall not be less than the compacted thickness as shown in Table C245.10, shall be specified and/or measured in one of the following ways: **Measurement**

(i) No Finished Surface Levels Specified

No corrective course required

When asphalt is placed over an existing pavement in one or more courses and no corrective course is applied, the calculated average compacted thickness of each course shall be in accordance with the course thickness specified in the Drawings and tolerances indicated in Table C245.12. **Calculated Average Compacted Thickness**

Nominal Size of Asphalt (mm)	Tolerance (mm)
5	+5 0
10	+5 - 0
14	+5 - 0
20	+10 - 5
28	+10 5
40	+10 -10

**Table C245.12
Tolerance for Course Thickness**

(ii) Finished Surface Levels Specified

When asphalt is placed in more than one course (excluding a corrective course) to specified levels over a pavement built by others, each course shall be placed in accordance with this clause provided that the thickness of the wearing course shall be not less than 90 per cent of that specified and the level of the wearing course shall comply with the limits shown in Table C245.13.

When the Contractor also constructs the underlying pavement, the level and thickness of the asphalt shall comply with the requirements of Clauses C245.26 (d) and C245.32 (c).

(c) Level

1. The top surface of any course after final compaction shall be parallel with the final wearing surface and the levels of the surface of the nominated course shall not vary from the levels determined from the Drawings or as determined by Council's Supervising Engineer by more than the limits shown in Table C245.13.

Nominated Course	Below Nominated Course Level (mm)	Above Nominated Course Level (mm)
Wearing Course	0	10
Top of Intermediate Course	5	10
Other Intermediate Course	10	10
Corrective Course	10	10

Table C245.13 - Tolerance for Course Levels

2. Surface irregularities exceeding the tolerances given in this Clause shall be corrected to the satisfaction of Council's Supervising Engineer before a subsequent course is placed.

Surface Irregularities

(d) Shape

1. The surface shall not deviate from the bottom of a 3 m long straightedge laid in any direction by more than the tolerances shown in Table C245.14.

Tolerances

Course	Unclassified Roads (mm)
Corrective Course	15
Intermediate Course	10
Wearing Course	10

Table C245.14 - Deviation from 3m Straightedge

2. Surface irregularities exceeding the tolerances given in Table C245.14 for a particular course shall be corrected to the satisfaction of Council's Supervising Engineer before a subsequent course is placed. When the Contractor is required to provide a new wearing course in a single layer operation over a pavement built by others, the tolerance for the wearing course shown in Table C245.12 shall apply provided the deviations of the existing surface from a 3 metre straightedge do not exceed the tolerance specified in Table C245.14 for an intermediate course.

Surface Irregularities

(e) Riding Quality

1. The finished surface shall have a smooth longitudinal profile.

(f) Voids

1. For asphalt mixes having voids outside the limits specified in Table C245.7, the requirements in Clause C245.39 (a) shall apply.

Limits on Voids

(g) Sampling and Testing of Finished Pavement

1. The Council's Supervising Engineer may take core samples at any locations for the purpose of verifying the thickness of asphalt layers, density void ratio, bitumen content and such other tests as the Council's Supervising Engineer considers to be reasonable under the circumstances. The Council's Supervising Engineer may direct that the core samples be tested at the Contractor's nominated NATA registered laboratory at no cost to the Council and the results made available for the inspection of the Council's Supervising Engineer.

Core Sampling and Testing

2. Any work found to not be in accordance with the specification as a result of testing carried out in accordance with this Clause shall be remedied at no cost to the Council.

(h) Work Record

The Contractor shall keep a record of the details of delivery, laying and compaction on the form "Asphalt Work Record" in Annexure C245A and shall cause a signed copy of the fully completed form to be submitted to the Council's Supervising Engineer.

Submission of Paving Record

LIMITS AND TOLERANCES

C245.33 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses of this Specification are summarised in Table C245.17 below:

Item	Activity	Tolerances	Spec Clause
1.	Coarse Aggregate		
	(a) Wet Strength	>100kN for any fraction other than the 40mm open graded asphalt where wet strength is to be >150kN (Test Method T215)	C245.08
	(b) Wet/Dry Strength Variation	<35% (Test Method T215)	C245.08
	(c) Particle Shape	Fraction retained on 9.50mm AS sieve: <35% for caliper ratio 2:1 <10% for caliper ratio 3:1 (Test Method T213)	C245.08
	(d) Fractured Faces	Fraction retained on 6.70mm AS sieve: >75% of mass with at least two fractured faces. When used as a wearing course shall have at least 90% by mass with at least one fractured face. (Test Method T239)	C245.08
	(f) Polished Aggregate Friction Value (PAFV)	> minimum value specified in Annexure C245. (Test Method T233)	C245.08
2.	Fine Aggregate	Shall meet the requirements as specified for Coarse Aggregate (Item 1) above.	C245.08
3.	Mineral Filler		
	(a) Voids	Dry compacted filler voids > 40%	C245.09
4.	Bitumen		
	(a) Property Requirements	As Table C245.1	C245.10

ASPHALTIC CONCRETE

Item	Activity	Tolerance	Spec Clause
5.	Scrap Rubber Bitumen	A 20% scrap rubber bitumen mixture prepared as for Test Method T735 shall have a minimum recovery of 20% when tested in accordance with Test Method T1180	C245.10
6.	Scrap Rubber		
	(a) Grading	As Table C245.4	C245.13
	(b) Length	< 10% of particles having a length greater than 7.50mm	C245.13
7.	SBS Modified Bitumens		
	(a) Specified Properties	As per Table C245.2	C245.10
8.	EVA Modified Bitumens		
	(a) Specified Properties	As per Table C245.3	C245.10
9.	Design of Nominated Mix		
	(a) Dense Graded Limits	As per Table C245.6	C245.15
10.	Production Mix Variation		
	(a) Dense Graded Asphalt	As per Table C245.7	C245.17
11.	Temperatures for Manufacture of Asphalt		
	(a) Binder Temperature	As per Table C245.8	C245.18
	(b) Asphalt Temperature	As per Table C245.8	C245.18
12.	Asphalt		
	(a) Moisture Content	< 0.5% by mass	C245.18
13.	Laying of Geotextiles		
	(a) Lapping at joins	Lap to be > 300mm	C245.23
	(b) Wire Staples	Wire diameter > 3mm	C245.23
	(c) Pinning	Intervals < 2m	C245.23
14.	Tack Coat		
	(a) Bitumen Emulsion	Application Rate > 0.15 and < 0.50 litres per square metre	C245.25

Item	Activity	Tolerance	Spec Clause
15.	Laying		
	(a) Paver Capacity	>50 tonnes asphalt per hour	C245.26
	(b) Laying Depth	Adjustment between 10mm and 150mm	C245.26
	(c) Laying in Echelon	Distance between pavers is such that temperature of asphalt at edge (or laid by leading paver) is >80°C when following paver matches the longitudinal joint.	C245.26
	(d) Faulty Operation of Paver	Thin layer spread by hand to correct irregularity if surface temperature >115°C for dense graded.	C245.26
	(e) Laying Temperature	As per Table C245.9.	C245.26
	(f) Course and Layer Thickness	Nominal size mix and compacted layer thickness as per Table C245.10.	C245.26
16.	Level Control		
	(a) Levelling Beam for Corrective Course	>10m length	C245.26
	(b) Levelling Beam for Wearing Course	>10m length	C245.26
17.	Longitudinal Jointing		
	(a) Change in Crossfall	Within 150mm of line of change.	C245.27
	(b) Where Underlying Layers	Offset at least 150mm from joints in underlying layers.	C245.27
18.	Transverse Jointing		
	(a) Where Underlying Layers	Stagger to be >1m between successive layers and adjacent runs.	C245.27
19.	Compaction		
	(a) Dense Graded Asphalt		
	(i) Roller Speed	Steel Rollers <5km per hr Vibratory Pneumatic <10km per hr.	C245.29 C245.29

ASPHALTIC CONCRETE

Item	Activity	Tolerance	Spec Clause
19.	Compaction (Cont'd) (a) Dense Graded Asphalt (ii) Rolling	Initial Rolling: To be completed before asphalt temperature falls below 105 ^{°C} Secondary Rolling: Tyre pressures on pneumatic rollers to be 500kP to 600kP. Rolling to be completed before the asphalt temperature falls below 80 ^{°C} . Final Rolling: Tyre pressures on pneumatic rollers to be between 600kP and 700kP. Rolling to be completed before asphalt temperature falls below 60 ^{°C} .	C245.29 C245.29 C245.29
	(b) Acceptance Criteria for Compaction	Minimum Relative Compaction of all values within a lot >95% for layer of thickness <50mm and >96% for layer thickness >50mm.	C245.31
20.	Finished Pavement (a) Thickness	Max compacted thickness as for Table C245.12 Where finished surface levels are specified, thickness shall be >90% of specified and level shall comply with requirements of Table C245.13	C245.32
	(b) Shape	Shall not deviate from bottom of 3m straight edge by more than tolerance in Table C245.14	C245.32

Table C245.15 - Summary of Limits & Tolerances

SPECIAL REQUIREMENTS

C245.34 RESERVED

C245.35 RESERVED

C245.36 RESERVED

C245.37 RESERVED

C245.38 RESERVED

**WOLLONDILLY SHIRE COUNCIL
ASPHALT WORK RECORD**

ANNEXURE C245A

Date: _____ Contract No: _____ Work Location: _____ km to _____ km

DO/WO: _____ Supplier: _____ From _____ towards _____

Road No: _____ Job No: _____ Road Loc: [____ / ____ / ____] to [____ / ____ / ____]

Plan No: _____ Mix Type: _____ New Surfacing Resurfacing Existing Surface Type

Delivery								Paving								Remarks			
Load No.	Time			Truck Rego No	Docket No.	Nett Mass (t)	Mix Temperature		Chainage		Paved Width (m)	Direction With or Against Ch	Dist from Left (m)	Thick-ness (mm)	Layer			Sample No. & tonnes sampled	Weather, Work Stoppages, Start & Finish etc
	Depot Plant	Arrive Job	Depart Job				Ex Plant	Ex Truck	From	To					1st	2nd	3rd		

Remarks: _____

Penciller: _____ Sampling by: _____ Council's Representative: _____ Contractor's Representative: _____

Affiliation: _____ Affiliation: _____ (Signature) (Signature)

ANNEXURE C245B

SCHEDULE OF DETAILS

Pavement Type _____
 Location _____

Sheet No. _____
 of _____ Sheets

Course	Type and Nom Size of Asphalt	Type of Binder	Grade of Binder and/or % by Wt of Additive	Compacted thickness of course (mm)	Minimum Delivery Rate (per hr)	Delivery Trucks to be Insulated*	Pavers in Echelon	Fixed Wire String Line with Support Intervals (m)	Level Control Device			Clause C245.39 Voids Deduction Requirement**
									Levelling Beam	Joint Matching Shoe	Automatic Crossfall Control	
Wearing												
Intermediate 1												
Intermediate 2												
Intermediate 3												
Intermediate 4												
Correction 1												
Correction 2												
Drainage Layer												

NAASRA Roughness Count of Existing Surface (Clause C245.32 (e)) Section _____ Counts/km

Section _____ Counts/km

* Delivery Trucks to be insulated unless otherwise shown (Clause C245.20) Section _____ Counts/km

** Requirement A to apply unless otherwise shown PAFV of Aggregate 50 minimum. (Test Method T233)

(TO BE ISSUED BY COUNCIL FOR EACH SEPARABLE PART)

CONSTRUCTION
SPECIFICATION

C247

MASS CONCRETE SUBBASE

SPECIFICATION C247 : MASS CONCRETE SUBBASE

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MASS CONCRETE SUBBASE

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SPECIFICATION C247 : MASS CONCRETE SUBBASE

GENERAL

C247.01 SCOPE

1. The work to be executed under this Specification consists of the construction, by mechanical or hand placement of mass concrete subbase including trial sections and subgrade beams to the dimensions and levels shown on the Drawings and in accordance with the provisions of the Contract.

C247.02 THICKNESS AND LEVELS OF SUBBASE

1. The subbase thickness and levels shall be as shown on the Drawings.

Levels

C247.03 PROVISION FOR BASE SLAB ANCHORS

1. During construction of the subbase, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the Drawings. Excavation of material, trimming of trenches, compacting the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with Specification C248 - PLAIN OR REINFORCED CONCRETE BASE as part of the concrete base construction.

**Base Slab
Anchors**

C247.04 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Council Specifications

- C248 - Plain or Reinforced Concrete Base
- C271 - Minor Concrete Works

(b) Australian Standards

- AS 1012.1 - Sampling of fresh concrete.
- AS 1012.3 - Determination of properties related to the consistence of concrete.
- AS 1012.4 - Determination of air content of freshly mixed concrete.
- AS 1012.8 - Making and curing concrete compression, indirect tensile and flexure test specimens, in the laboratory or in the field.
- AS 1012.9 - Determination of the compressive strength of concrete specimens.
- AS 1012.14 - Securing and testing cores from hardened concrete for compressive strength.
- AS 1141.11 - Particle size distribution by sieving.
- AS 1141.14 - Particle shape, by proportional caliper.
- AS 1141.22 - Wet/dry strength variation.
- AS 1160 - Bitumen emulsion for construction and maintenance of pavements.
- AS 1379 - The specification and manufacture of concrete.
- AS 1478 - Chemical admixtures in concrete.
- AS 2758.1 - Concrete aggregates.
- AS 3582.1 - Supplementary cementitious materials for use with portland cement - Flyash.
- AS 3799 - Liquid membrane - forming curing compounds for concrete.

AS 3972 - Portland and blended cements.

(c) RMS Test Methods

T 321 - Dry Shrinkage of 100 x 100 x 280mm Concrete Prisms.

MATERIALS FOR CONCRETE

C247.05 CEMENT

- | | |
|---|---|
| <p>1. Cement shall be Type GP Portland cement or Type GB blended cement complying with AS 3972. Cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.</p> | Quality |
| <p>2. When submitting details of the nominated mix in accordance with Clause C247.15 the Contractor shall nominate the brand and source (including works) of the cement. On approval of a nominated mix by Council's Supervising Engineer, the Contractor shall use only the nominated cement in the work.</p> | Nominated Brand and Source |
| <p>3. The Contractor shall upon request furnish documentary evidence of the quality and source of the cement to Council's Supervising Engineer at any stage of the work.</p> | Proof of Quality |
| <p>4. If the Contractor proposes to use cement, which has been stored for a period in excess of three months from the time of manufacture, Council's Supervising Engineer may require a retest to ensure the cement complies with AS 3972 before the cement is used in the work. The cost of retesting cement shall be borne by the Contractor.</p> | Storage Time
Contractor's Cost |
| <p>5. Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.</p> | Transport and Storage |

C247.06 FLYASH

- | | |
|--|-----------------------------|
| <p>1. Flyash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. The use and the quality of flyash shall comply with AS 3582.1.</p> | Quality |
| <p>2. When submitting details of the nominated mix in accordance with Clause C247.15, the Contractor shall nominate the powerhouse source of the flyash. On approval of a nominated mix by Council's Supervising Engineer, the Contractor shall use only flyash from the nominated powerhouse.</p> | Source |
| <p>3. The Contractor shall upon request furnish documentary evidence of the quality and source of the flyash to Council's Supervising Engineer at any stage of the work.</p> | Documentary Evidence |

C247.07 WATER

- | | |
|---|----------------|
| <p>1. Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.</p> | Quality |
|---|----------------|

C247.08 ADMIXTURES

- | | |
|--|----------------|
| <p>1. Chemical admixtures and their uses shall comply with AS 1478. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used. An air-entraining agent may be included in the mix. If an air-entrainer is used, the air content of the fresh concrete shall comply with Clause C247.14.</p> | Quality |
|--|----------------|

MASS CONCRETE SUBBASE

2. Fresh concrete with air content not complying with Clause C247.14 shall be rejected. **Excess Air Content**
3. During the warm season (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WR Re) approved by Council's Supervising Engineer shall be used to control slump within the limits stated in Clause C247.13. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS 1478 for Type Re or Type WR Re shall be submitted to Council's Supervising Engineer, together with the proposed 'dosage chart' in accordance with Clause C247.15. **Retarder for Warm Season**
4. During the cool season (April to September inclusive), only a lignin or lignin-based set retarding admixture containing not more than 6 per cent reducing sugars (Type WR Re complying with AS 1478) may be used in the mix or, alternatively, omitted altogether. If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause C247.16. **Retarder for Cool Season**
5. When submitting details of the nominated mix in accordance with Clause C247.15, the Contractor shall nominate the proprietary source, type and name of each admixture to be used. The Contractor shall furnish documentary evidence of the quality to Council's Supervising Engineer upon request at any stage of the work. **Source and Type**

C247.09 AGGREGATES

(a) General

1. When submitting details of the nominated mix in accordance with Clause C247.15, the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate. **Source and Type**
2. Aggregates shall all pass the 37.5 mm AS sieve and shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent), and material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS 1141.14 shall not exceed 35 per cent. **Quality**
3. When submitting details of the nominated mix, the Contractor shall submit to Council's Supervising Engineer a NATA Certified Laboratory Test Report on the quality and grading of the aggregate proposed to be used. The grading shall be known as the "Proposed Grading." **Proposed Grading**
- If the Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and Council's Supervising Engineer advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause. **Blending of Aggregates**
5. All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

(b) Grading

1. The grading of the combined aggregate used in the work, determined by AS 1141.11, shall not deviate from that of the Proposed Grading by more than the amounts shown in Table C247.1.

Australian Standard Sieve	Maximum Deviation Per Cent Passing by Mass of Total Sample
37.5 mm	-5
19.0 mm	+ or -10
4.75 mm	+ or -10
1.18 mm	+ or -5
600 µm	+ or -5
150 µm	+ or -2

Table C247.1 - Aggregate Grading Deviation Limits

(c) Durability

1. Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements: -

Tolerances

- (i) Wet Strength - AS 1141.22 - Shall not be less than 50 kN.
- (ii) 10 per cent Fines Wet/Dry Variation - AS 1141.22 - Shall not exceed 35 per cent.

(d) Storage

1. Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

Facilities Required

2. The area surrounding the storage facilities and mixing plant shall be constructed so that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of Council’s Supervising Engineer, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of Council’s Supervising Engineer.

Introduction of Foreign Matter

QUALITY REQUIREMENTS OF CONCRETE

C247.10 CEMENT AND FLYASH CONTENT

1. When a cement and flyash blend is nominated the minimum Portland cement content shall be 90 kilograms per yielded cubic metre of concrete and the minimum flyash content shall be 100 kilograms per yielded cubic metre of concrete.

Minimum Content

C247.11 COMPRESSIVE STRENGTH

1. The compressive strength of concrete shall be determined in accordance with AS1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28-day shrinkage less than 400 microstrains, then concrete achieving a strength less than 20MPa shall be accepted.

Compressive Strength

C247.12 SHRINKAGE

1. The drying shrinkage of the nominated mix, determined by Test Method T321 shall not exceed 450 microstrain after three weeks air-drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with AS

Shrinkage Limit

MASS CONCRETE SUBBASE

1012.13.

C247.13 CONSISTENCY

1. The Contractor's nominated slump, determined in accordance with AS 1012.3, Method 1, shall be neither less than 25 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 50 mm nor more than 65 mm for hand placed concrete.

**Slump
Tolerances**

C247.14 AIR CONTENT

1. If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS 1012.4, Method 2, shall be neither less than 3 per cent nor more than 7 per cent when discharged from the transport vehicle ready for placement.

**Air Content
Tolerances**

DESIGN AND CONTROL OF CONCRETE MIXES

C247.15 GENERAL

1. The Contractor shall submit, for approval by Council's Supervising Engineer, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including the nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a 'nominated mix'.

Nominated Mix

2. Also, the Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve-month period before the date of submission to Council's Supervising Engineer.

**Certificate of
Compliance
with
Specification**

3. In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1.0 MPa of the median.

**Compressive
Strength
Determination**

4. These details shall be submitted at least 21 days before using the nominated mix in the work.

**Submission of
Details**

C247.16 VARIATIONS TO APPROVED MIXES

1. The Contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of Council's Supervising Engineer.

**Approval
required to
vary mix**

2. Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C247.15. If the variations to the quantities of the constituents in the approved mix are less than 10 kilograms for Portland cement, 20 kilograms for other cementitious material and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, Council's Supervising Engineer may approve the changes without new trials being carried out.

**Contractor's
Responsibility**

3. Notwithstanding these tolerances, the minimum cement content shall be 90 kilograms per yielded cubic metre of concrete; the minimum flyash content shall be 100 kilograms per yielded cubic metre of concrete.

**Minimum
Constituent
Quantities**

CONFORMANCE FOR CONCRETE STRENGTH AND THICKNESS

C247.17 CONCRETE CYLINDERS

(a) Test Specimens

1. Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this Clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to Council’s Supervising Engineer. **Contractor's Responsibility**

2. Samples of concrete for testing shall be taken in accordance with AS 1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable. **Sampling**

3. The method of making and curing specimens shall be in accordance with AS 1012.8 with compaction by internal vibration.

4. The Contractor shall mark the specimens for identification purposes. **Marking**

(b) Frequency of Moulding of Test Specimens

1. Test specimens shall be moulded as follows: - **Moulding of Cylinders**

(i) For the determination of the compressive strength at twenty-eight days.

For each lot of up to 50 cubic metres of concrete placed at the one time: One pair of specimens

(ii) For the determination of the compressive strength at seven days.

For each lot of up to 50 cubic metres of concrete placed at the one time: One pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor.

For each lot of up to 50 cubic metres of concrete placed at the one time: One pair of specimens

2. A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase. **Lot Size**

(c) Inspection, Capping and Crushing of Specimens

1. Specimens required by this Specification shall be tested at the NATA registered laboratory nominated by the Contractor. The cost of such testing shall be borne by the Contractor. **Contractor's Cost**

2. Specimens shall be inspected, capped and crushed in accordance with AS 1012.8 and AS 1012.9. **Standards**

C247.18 COMPRESSIVE STRENGTH OF CONCRETE

(a) General

1. The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens.

Determination of Strength

2. At the time of approving the mix design, Council’s Supervising Engineer shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

(b) Adjustment of Test Compressive Strength for Age of Specimen

1. Should any specimen be tested more than 28 days after moulding the equivalent 28-day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table C247.2. For intermediate ages the factor shall be determined on a pro-rata basis.

Strength Age Factor

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

Table C247.2 - Concrete Age Conversion Factors

(c) Conformance for Compressive Strength

1. If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause C247.11, the lot represented by the test cylinders shall be removed and replaced.

Limits

2. In case of non-conformance the Contractor may elect to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by Council’s Supervising Engineer. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request and the cost of the Contractor. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

Non-conformance and Coring

C247.19 SPECIMENS CUT FROM THE WORK

1. Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete.

Test Specimens

2. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012. 14 with the following amendments: -

Specimen Characteristics

- (a) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened

enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.

- (b) The preferred dimension for cores shall be 100 mm diameter but in no case shall the diameter be less than 75 mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.
- (c) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5 mm from the mean diameter.
- (d) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table C247.3.

Length/Diameter Ratio of Core	Adjustment Factor
1 :1	0.89
1.5:1	0.965
2 :1	1.00

NOTE:

For intermediate form ratios, the factor shall be determined on a pro-rata basis.

Table C247.3 - Core Strength Factor

- (e) Wet Conditioning only shall be used.

3. Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by Council’s Supervising Engineer. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Contractor at the time of sampling and duly recorded prior to testing.

Frequency of Coring

4. Cores shall be dispatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores.

Curing of Cores

5. Council’s Supervising Engineer shall approve the method of restoration.

Approval

6. The cost of core preparation for testing, curing and testing shall be borne by the Contractor.

Testing Contractor’s Cost

C247.20 ACCEPTANCE OF CORED CONCRETE FOR COMPRESSIVE STRENGTH

1. Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement.

Strength Requirement

2. If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed.

Core Strength

3. No payment shall be made for the rejected concrete nor any bond breaker placed.

Rejected Concrete

4. The cost of removal of rejected concrete, including its legal and responsible disposal from the site, shall be borne by the Contractor.

Contractor’s Cost

MASS CONCRETE SUBBASE

C247.21 CONFORMANCE FOR THICKNESS

(a) General

1. No thickness measurements will be carried out if the surface of the subbase is within the tolerances as specified in Clause C247.32(b). **Conforming Tolerances**
2. If scabbling is required to achieve these, Council's Supervising Engineer may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5m grid on the plan area. Alternatively, Council's Supervising Engineer may authorise coring and measurement at the edges of the layer. **Thickness Measurement**
3. Thickness measurements shall be rounded off to the nearest 5mm.

(b) Thickness Below Specification

1. After making due allowance for the tolerances, subbase which is more than 20mm below the theoretical thickness shall be rejected and removed from the site. The cost of removal and disposal from the site shall be borne by the Contractor. **Remove and Replace**
2. Subbase which is 20mm or less below the theoretical thickness may be accepted by Council's Supervising Engineer providing that it represents isolated sections within a lot and such sections comprise less than 10 per cent of the area of the lot. **Acceptance**

PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

C247.22 PRODUCTION AND TRANSPORT OF CONCRETE

1. At least four weeks before commencing work under this Specification, the Contractor shall submit, for the information of Council's Supervising Engineer, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport. **Contractor's Responsibility**

C247.23 HANDLING, STORAGE AND BATCHING MATERIALS

1. The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements: - **Methods**
 - (a) Certificates of Calibration issued by a recognised authority shall be made available for inspection by Council's Supervising Engineer, as evidence of the accuracy of the scales.
 - (b) Cementitious material shall be weighed in an individual hopper, with the cement weighed first.
 - (c) The moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.
 - (d) Where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by Council's Supervising Engineer, except for liquids that may be measured by volume or flow rate meter.

C247.24 MIXERS AND AGITATION EQUIPMENT

1. Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS 1379, with the following additional requirement that in **Requirements**

Appendix A of AS 1379 the maximum permissible difference in slump shall be 10mm.

C247.25 MIXING AND TRANSPORT

1. Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:- **Methods**

- (a) The mixer shall be charged in accordance with the manufacturer's instructions.
- (b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray.
- (c) For truck-mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten minutes of completion of batching and within 200m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water/cement ratio be exceeded. Mixing of the concrete shall be completed at that location.
- (d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within: -
 - (i) One and a half hours, where transported by truck mixer or agitator
 - (ii) One hour, where transported by non-agitating trucks

Means of verification satisfactory to Council's Supervising Engineer of the times of addition of the cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if Council's Supervising Engineer considers the prevailing weather, mix type, or materials being used warrant such a change.

- (e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 per cent of the gross volume of the drum of the mixer.

C247.26 MAXIMUM MIXING TIME

1. Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes except for split drum mixers where the maximum shall be five minutes. **Batch in Mixer**

2. For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded. **Long Delays**

C247.27 CONSISTENCY

1. The consistency of the concrete shall be such as to allow the production of a dense, non-segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by Council's Supervising Engineer. The edge produced shall maintain its shape and shall not sag or tear. **Requirements**

2. The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of Council's Supervising Engineer. The cost **Contractor's Obligations**

MASS CONCRETE SUBBASE

of consistency testing shall be borne by the Contractor.

3. The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3, Method 1. The test shall be made on concrete samples obtained in accordance with AS 1012.1. **Test Method**

4. Check tests shall be done on each truckload of concrete. **Check Tests**

PLACING AND FINISHING CONCRETE SUBBASE

C247.28 GENERAL

1. At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of Council's Supervising Engineer, full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs. **Contractor's Responsibility**

2. The Contractor shall give Council's Supervising Engineer seven days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause C247.49). **Written Notice**

3. The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition. **Surface Conditions**

4. Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C. **Air Temperature Limits**

5. The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C. **Concrete Temperature Limits**

C247.29 RATE OF EVAPORATION

1. When the value of Rate of Evaporation, determined from the graph in Figure C247.1, exceeds 0.50 kilograms per square metre per hour the Contractor shall take precautionary measures, satisfactory to Council's Supervising Engineer, for the prevention of excessive moisture loss. If, in the opinion of Council's Supervising Engineer, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour. **Evaporation Limit**

2. The cost of such precautionary measures shall be borne by the Contractor. **Contractor's Cost**

3. Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull-floating, are complete. **Use of Retarder**

4. The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity daily, at the site throughout the course of the work. The Contractor shall provide and maintain all equipment, and shall provide suitable personnel necessary for all such measuring and recording. **Contractor's Responsibility**

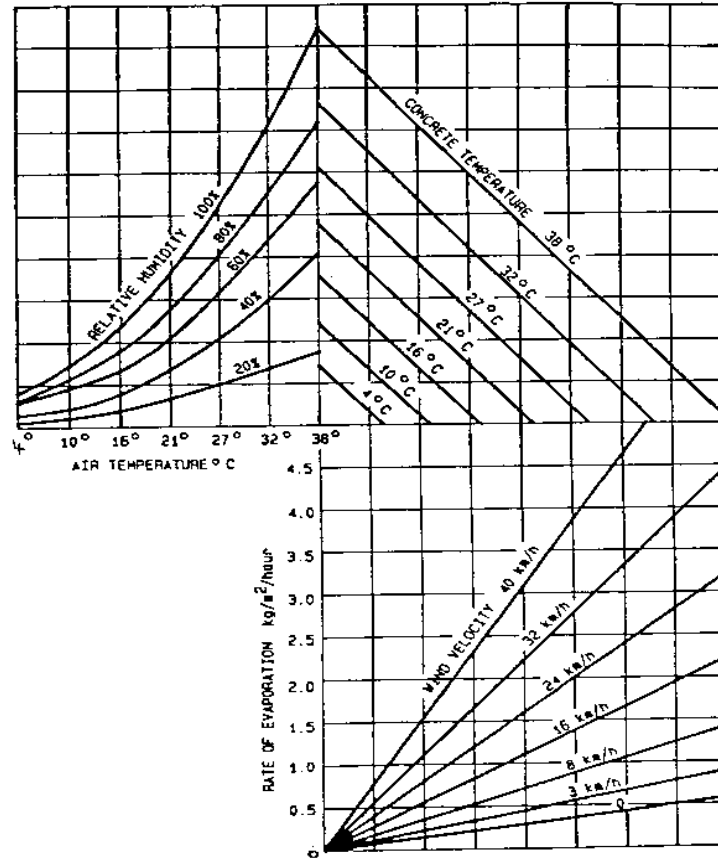


Figure C247.1 - Rate of Evaporation

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27°C
- with relative humidity at 40%
- with concrete temperature at 27°C
- with a wind velocity of 26km/h the rate of evaporation would be 1.6 kg/m²/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27°C. Move vertically down to the respective wind velocity curve - in this case interpolating for 26km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

C247.30 MECHANICAL PAVING

1. The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:-

***Paving
Machine
Requirements***

- (a) An automatic control system with a sensing device to control line and level to the specified tolerances.
- (b) Means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components.
- (c) Internal vibrators capable of compacting the full depth of the concrete.
- (d) Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- (e) Capability of paving the slab widths or combination of slab widths and slab depths shown on the Drawings.

2. The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

***Concrete
Finish***

3. Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

4. The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

***Supporting
Surface***

5. Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, Council's Supervising Engineer may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

***Continuity of
Paving
Operation***

***Contractor's
Cost***

C247.31 HAND PLACING

1. Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non-adhesion of concrete to the forms.

Formwork

2. Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand-guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

***Placing in
Forms***

3. If disruptions occur for any reason, Council's Supervising Engineer may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

***Disruption,
Contractor's
Cost***

4. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

***Concrete
Finish***

5. Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

C247.32 ALIGNMENT AND SURFACE TOLERANCES

(a) Horizontal Alignment Tolerance

1. The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of ± 25 mm.

Outer Edge Location

2. Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal alignment tolerances shall comply with Clause C247.36

Longitudinal Construction Joint

(b) Surface Tolerances

1. The level at any point on the top of the subbase shall not vary by more than 0 mm above or 20 mm below that shown on the Drawings or as directed by Council's Supervising Engineer. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete.

Surface Levels

2. The top surface of the subbase shall also not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.

Surface Levels

C247.33 CURING

1. The subbase shall be cured by the use of one of the following:

Curing Compounds

- (a) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt base is used, or
- (b) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if a concrete base is used, or
- (c) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt or concrete base.

2. The Contractor shall submit, for the information of Council's Supervising Engineer, a current Certificate of Compliance from an Australian Laboratory, approved by Council's Supervising Engineer, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.

Efficiency Index

3. The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres per square metre. When applied with a hand lance the rates should be increased by 25 per cent.

Application

4. The average application rate shall be checked by the Contractor and certified to Council's Supervising Engineer by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by Council's Supervising Engineer.

Application Rate

5. The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

Curing Period

6. The cost of making good such damaged curing membrane shall be borne by the Contractor.

Contractor's Cost

MASS CONCRETE SUBBASE

7. Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

Equipment on Site

C247.34 PROTECTION OF WORK

1. The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first twenty-four hours after placing. The Contractor shall provide, for the information of Council's Supervising Engineer, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5°C and if, in the opinion of Council's Supervising Engineer, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

Temperature Control

2. The Contractor shall protect the work from rain damage and shall provide, for the information of Council's Supervising Engineer, detailed proposals for procedures and equipment to be used for such protection.

Rain Protection

3. Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4.0 MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:-

Traffic Restrictions

- (a) Bond-breaker and spall treatment and
- (b) Concrete or asphalt paving.

4. Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to Council's Supervising Engineer's satisfaction. The cost of rectifying such damage to the subbase shall be borne by the Contractor.

Damage Restoration Contractor's Cost

JOINTS

C247.35 TRANSVERSE CONSTRUCTION JOINTS

1. Transverse construction joints shall:
- be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations.
 - be constructed normal to the edge line and to the dimensions shown on the Drawings.
 - not deviate from a 3 m straightedge placed along the joint by more than 10 mm.
 - be smooth across the joint.

C247.36 LONGITUDINAL CONSTRUCTION JOINTS

1. Longitudinal construction joints shall:
 - be formed no closer than 300mm of the base longitudinal joints as shown in the Drawings, unless directed otherwise by Council’s Supervising Engineer.
 - not deviate from the plan or nominated position at any point by more than 20 mm.
 - not deviate from a 3 m straightedge placed along the joint by more than 10 mm, having made due allowances for any planned curvature.
 - be smooth across the joint.

BOND BREAKER AND SPALL TREATMENT

C247.37 GENERAL

1. Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS 3799 Class A Type 2. **Bond Breaker**
2. Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted. **No Bond Breaker**
3. Subbase with spalled areas shall be treated, where directed by Council’s Supervising Engineer, prior to application of the bond breaker or asphaltic concrete. **Spalled Areas**

C247.38 PREPARATION OF SUBBASE

1. Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of Council’s Supervising Engineer of all loose, foreign and deleterious material. **Subbase Preparation**

C247.39 TREATMENT OF SPALLING

1. Where directed by Council’s Supervising Engineer, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6:1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches. **Method**
2. A spalled area, if directed to be treated, shall have such treatment completed no earlier than five working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor. **Spalling Repair Time**
3. The cost of making good treated spalled areas which have been damaged shall be borne by the Contractor. **Contractor’s Cost**

C247.40 APPLICATION OF BOND BREAKER

1. The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete. **Wax Emulsion**
2. The method of application shall conform to the requirements of Clause C247.33.

C247.41 TREATMENT OF UNPLANNED CRACKS

1. Council's Supervising Engineer shall direct treatment of unplanned cracks whose width exceeds 0.3mm. This may take the form of applying an approved 300mm minimum width Stress Alleviating Membrane (Bituthene or equivalent) over the crack prior to placement of the first asphalt layer, or an extra application of wax emulsion for a width of 300mm along the crack when a concrete base is required.
2. The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

SUBGRADE BEAMS

C247.42 GENERAL

1. Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the Drawings or as directed by Council's Supervising Engineer. They shall extend the full length of joints unless otherwise indicated on the Drawings.

Scope

C247.43 EXCAVATION

1. Excavation for subgrade beams shall be to the dimensions shown on the Drawings. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material.
2. The Contractor shall legally dispose of excavated material.

Excavation Standards

Disposal of Excavated Materials

C247.44 CONCRETE

1. Concrete in subgrade beams shall comply with the requirements of Specification C271 - MINOR CONCRETE WORKS. The minimum compressive strength at 28 days shall be 32MPa.

Compressive Strength

C247.45 STEEL REINFORCEMENT

1. Steel reinforcement shall be of the type and size shown on the Drawings and shall be supplied and installed in accordance with Specification C248 - PLAIN OR REINFORCED CONCRETE BASE.

Type and Size

C247.46 CONSTRUCTION AND PROTECTION

1. Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompacted to the correct level. If the contractor elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade.
2. A steel float shall be used to produce a smooth surface finish, free of any texture.
3. The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. The Contractor shall make good any damage caused. The cost of making good such damage to the subgrade beams shall be borne by the Contractor.

Timing and Type of Finish

Damage Protection Contractor's

Cost

C247.47 CURING

1. The top surface of the subgrade beam shall be cured in accordance with Clause C247.33 before placing the subbase.

Curing

C247.48 BOND BREAKER

1. The top surface of the subgrade beam shall be treated with a bond breaker, which shall consist of a further application of curing compound neither less than twenty-four hours nor more than seventy-two hours before placing of subbase concrete.

Time of Placement

TRIAL CONCRETE SUBBASE

C247.49 GENERAL

1. Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to Council's Supervising Engineer the Contractor's capability of constructing subbase in accordance with the Specification. This section shall be constructed so that it may be incorporated in the finished work.

Location

2. The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints.

Purpose

3. The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

Quality Parameters

4. A trial length of between 100m and 200m for mechanical paving equipment or between 20m and 50m for hand placement is required. The trial length shall be the maximum width proposed to be laid, and shall be constructed in one continuous operation.

Dimensions

5. Unless advised by Council's Supervising Engineer of any deficiencies in the trial concrete subbase, due to failure to comply with this Specification, the Contractor may proceed with placing concrete subbase from a time ten working days after the completion of the trial concrete subbase or such earlier time as Council's Supervising Engineer may allow. In the event of deficiencies in the trial concrete subbase, Council's Supervising Engineer may order the Contractor to construct a further length of trial concrete subbase, which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, Council's Supervising Engineer may require the Contractor to justify to the satisfaction of Council's Supervising Engineer why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

Deficiencies in Trial

Section

6. Council's Supervising Engineer shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by Council's Supervising Engineer to warrant such procedure or when concrete as placed does not comply with this Specification.

New Trial Section

7. Any trial concrete subbase, which does not comply with the Specification, shall be rejected by Council's Supervising Engineer and shall be removed and disposed from the site by the Contractor.

Non-conformancet

8. The cost of removal of rejected trial concrete subbase and the cost of making good any damage caused by such removal to the subgrade or subgrade beams shall be borne by the Contractor.

Contractor's Cost

9. All non-conforming material shall be discarded in a legal fashion at a location that meets Superintendent approval.

LIMITS AND TOLERANCES

C247.50 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in Table C247.4 below:

Item	Activity	Tolerances	Spec Clause
1.	Materials for Concrete		
	a. Misshapen Particles	2:1 ratio < 35 percent	C247.09a
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	C247.09b
	c. Durability	Wet Strength > 50 kN 10% Fines < 35 percent	C247.09c
2.	Concrete		
	a. Shrinkage	Drying Shrinkage <450 microstrain	C247.12
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	C247.13
	c. Air Content	≥3, ≤7 percent	C247.14
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	C247.21
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non-agitating trucks.	C247.25
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5°C or >38°C. Temperature of concrete shall be >10°C but <32°C.	C247.28
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	C247.29

Item	Activity	Tolerances	Spec Clause
3.	Alignment and Surface Tolerances		
	a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ± 25 mm.	C247.32
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the drawings.	C247.32
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	C247.32
4.	Joints		
	a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	C247.35
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm.	C247.36
		(ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	
5.	Bond Breaker		
	a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	C247.40

Table C247.4 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C247.51 RESERVED

C247.52 RESERVED

C247.53 RESERVED

C247.54 RESERVED

C247.55 RESERVED

C247.56 RESERVED

**CONSTRUCTION
SPECIFICATION**

C248

**PLAIN OR REINFORCED
CONCRETE BASE**

SPECIFICATION C248 : PLAIN CONCRETE BASE

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SPECIFICATION C248 : PLAIN OR REINFORCED CONCRETE BASE

GENERAL

C248.01 SCOPE

1. The work to be executed under this Specification consists of the construction, by mechanical or hand placement of plain or reinforced concrete base, including trial sections, slab anchors and terminal slabs to the dimensions and levels shown on the Drawings and in accordance with the provisions of the Contract.

2. The work also includes the construction of reinforced concrete approach slabs at bridge abutments and traffic signal approach slabs where specified on the Drawings.

***Approach
Slabs***

C248.02 THICKNESS AND LEVELS OF BASE

1. The base thickness and levels shall be shown on the Drawings.

C248.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

- C224 - Open Drains including Kerb and Gutter
- C231 - Subsoil and Foundation Drains
- C247 - Mass Concrete Subbase

(b) Australian Standards

- AS 1012.1 - Sampling fresh concrete.
- AS 1012.3 - Determination of properties related to the consistence of concrete.
- AS 1012.4 - Determination of air content of freshly mixed concrete.
- AS 1012.8 - Making and curing concrete compression, indirect tensile and flexure test specimens in the laboratory or in the field.
- AS 1012.9 - Determination of the compressive strength of concrete specimens.
- AS 1012.12 - Determination of mass per unit volume of hardened concrete.
- AS 1012.13 - Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory.
- AS 1012.14 - Securing and testing cores from hardened concrete for compressive strength or indirect tensile strength.
- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1141.14 - Particle shape by proportional caliper.
- AS 1141.18 - Crushed particles of coarse aggregates.
- AS 1141.22 - Wet/dry strength variation.
- AS 1141.24 - Soundness (by use of sodium sulphate solution).
- AS 1160 - Bitumen emulsions for construction and maintenance of pavements.
- AS 1302 - Steel reinforcing bars for concrete.
- AS 1303 - Steel reinforcing wire for concrete.
- AS 1304 - Welded wire reinforcing fabric for concrete.
- AS 1379 - The specification and manufacture of concrete.
- AS 1478 - Chemical admixtures in concrete.
- AS 1554.3 - Welding of reinforcing steel.
- AS 2758.1 - Concrete aggregates.

- AS 3582.1 - Supplementary Cementitious materials - flyash.
- AS 3799 - Liquid membrane - forming curing compounds for concrete.
- AS 3972 - Portland and blended cement.

(c) RMS Test Methods

- T 1160 - Low Temperature Recovery of Preformed Polychloroprene Elastomeric Joint Seals for Bridge Structures.
- T 1161 - High Temperature Recovery of Polychloroprene Elastomeric Joint Seals for Bridge Structures.
- T 1163 - Resistance of Vulcanised Rubber to the Absorption of Oil.
- T1192 - Adhesion of Sealant.
- T1193 - Accelerated Ageing of Cured Sealant.

(d) ASTM Standards

- D792 - Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
- C793 - Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
- C794 - Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- D2240 - Test Method for Rubber Property Durometer Hardness.
- D2628 - Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete.
- D2835 - Specification for Lubricant for Installation of Preformed Compression Seal in Concrete Pavements.

(e) US Military Specifications

- MIL-S-8802 - Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion.

MATERIALS FOR CONCRETE

C248.04 CEMENT

- | | |
|--|--|
| <p>1. Cement shall be Type GP Portland cement complying with AS 3972 and shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.</p> | <p>Quality</p> |
| <p>2. When submitting details of the nominated mix in accordance with Clause C248.19 the Contractor shall nominate the brand and source (including works) of the cement. On approval of a nominated mix by Council's Supervising Engineer, the Contractor shall use only the nominated cement in the work.</p> | <p>Nominated Brand and Source</p> |
| <p>3. The Contractor shall furnish documentary evidence of the quality and source of the cement to Council's Supervising Engineer upon request at any stage of the work.</p> | <p>Proof of Quality</p> |
| <p>4. If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, a re-test shall be required to ensure the cement still complies with AS 3972, before the cement is used in the work.</p> | <p>Storage Time</p> |
| <p>5. The cost of re-testing the cement shall be borne by the Contractor and results of the testing forwarded to the Superintendent prior to incorporation of cement into the works.</p> | <p>Contractor's Cost</p> |
| <p>6. Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.</p> | <p>Transport and Storage</p> |

CONCRETE BASE

C248.05 FLYASH

1. Flyash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. The use and the quality of flyash shall comply with AS 3582.1. **Quality**
2. When submitting details of the nominated mix in accordance with Clause C248.19, the Contractor shall nominate the powerhouse source of the flyash. The Contractor shall use only flyash from the nominated powerhouse. **Source**
3. The Contractor shall furnish documentary evidence of the quality and source of the flyash to Council's Supervising Engineer. **Documentary Evidence**

C248.06 WATER

1. Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish. **Quality**

C248.07 ADMIXTURES

1. Chemical admixtures and their use shall comply with AS 1478. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used. An air-entraining agent shall be included in the mix and the air content of the concrete shall comply with Clause C248.13. **Quality and Use**
2. Fresh concrete with an air content not complying with Clause C248.13 shall be rejected. **Excess Air Content**
3. During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WR Re) approved by Council's Supervising Engineer shall be used to control slump within the limits stated in Clause C248.12. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS 1478 for Type Re or Type WR Re shall be submitted to Council's Supervising Engineer, together with the proposed 'dosage chart' in accordance with Clause C248.19. **Retarder for Warm Season**
4. During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6 per cent reducing sugars (Type WR Re complying with AS 1478) may be used in the mix. If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause C248.21. **Retarder for Cool Season**
5. When submitting details of the nominated mix in accordance with Clause C248.19, the Contractor shall nominate the proprietary source, type and name for each admixture to be used. At any stage of the work, the Contractor shall furnish documentary evidence of the quality to Council's Supervising Engineer upon request. **Source and Type**

C248.08 AGGREGATES

(a) General

1. At least 40 per cent by mass of the total aggregates in the concrete mix shall be quartz sand. Quartz sand is aggregate having a nominal size of less than 5 mm and shall contain at least 70 per cent quartz, by mass. Where present, chert fragments will be regarded as 'quartz' for the purpose of this specification but the ratio of chert to quartz shall not exceed unity. **Quartz Sand Content**

2. When submitting details of the nominated mix in accordance with Clause C248.19, the Contractor shall nominate the sources of aggregate to be used in the concrete and shall submit details of the geological type of each aggregate.

Source and Type

(b) Fine Aggregate

1. Fine aggregate shall consist of clean, hard, tough, durable, uncoated grains uniform in quality. Fine aggregate shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent), and material finer than 2 micrometres, and impurities and reactive materials. The sodium sulphate soundness, determined by AS 1141.24, shall not exceed the limits in Table C248.1.

Quality

Australian Standard Sieve	Per Cent Loss by Mass
4.75mm to 2.36mm	4
2.36mm to 1.18mm	6
1.18mm to 600µm	8
600µm to 300µm	12

Table C248.1 - Sodium Sulphate Soundness Limits

2. In the case of a blend of two or more fine aggregates, the above limits shall apply to each constituent material.

Blending

3. The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table C248.2.

Grading

4. When submitting details of the nominated mix the Contractor shall submit to Council's Supervising Engineer a NATA Certified Laboratory Test Report on the quality and grading of the fine aggregate proposed to be used. The grading shall be known as the "Proposed Fine Aggregate Grading."

Proposed Grading

5. If the Contractor proposes to blend two or more fine aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and Council's Supervising Engineer advised of the proportions in which the various sizes and constituents are to be combined. The fine aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

Test for Each Constituent

6. The grading of the fine aggregate used in the work shall not deviate from that of the Proposed Grading by more than the amounts in Table C248.2.

Grading Deviation

7. Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in Table C248.2.

CONCRETE BASE

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	± 3
2.36mm	65 - 95	± 10
1.18mm	40 - 80	± 10
600µm	24 - 52	± 10
300µm	8 - 25	± 5
150µm	1 - 8	± 2
75µm	0 - 3	

Table C248.2 - Fine Aggregate Grading

(c) Coarse Aggregate

1. Coarse aggregate shall consist of clean, crushed, hard durable rock, metallurgical furnace slag or gravel. Coarse aggregate shall comply with AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5 per cent), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this Specification. If required, coarse aggregate shall be washed to satisfy these requirements.

Quality

2. The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in Table C248.3.

Grading

3. When submitting details of the nominated mix the Contractor shall submit to Council's Supervising Engineer a NATA Certified Laboratory Test Report on the quality and grading of the coarse aggregate proposed to be used. The grading shall be known as the "Proposed Coarse Aggregate Grading."

Proposed Grading

4. If the Contractor proposes to blend two or more coarse aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and Council's Supervising Engineer advised of the proportions in which the various sizes and constituents are to be combined. The coarse aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

Test for Each Constituent

5. The grading of the coarse aggregate used in the work shall not deviate from that of the Proposed Grading by more than the amounts in Table C248.3.

Grading Deviation

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
26.50 mm	100	
19.00 mm	95 - 100	± 2
13.20 mm	(Design)	± 5
9.50 mm	25 - 55	± 5
4.75 mm	0 - 10	± 3
2.36 mm	0 - 2	

Table C248.3 - Coarse Aggregate Grading

6. Notwithstanding these tolerances, the coarse aggregate used in the work shall

comply with the limits shown in Table C248.3.

7. The coarse aggregate shall also conform to the following requirements: - **Additional Tests**
- (i) Wet Strength - AS 1141.22.
Shall not be less than 80 kN for any fraction and/or constituent.
 - (ii) 10 per cent Fines Wet/Dry Variation - AS 1141.22.
Shall not exceed 35 per cent for any fraction and/or constituent.
 - (iii) Soundness - AS 1141.24
The loss in mass when tested with sodium sulphate shall not exceed 9 per cent for any constituent.
 - (iv) Particle Shape - AS 1141.14
The proportion of misshapen particles (2:1 ratio) shall not exceed 35 per cent.
 - (v) Fractured Faces - AS 1141.18.
At least 80 per cent by mass of the particles shall have two or more fractured faces.

(d) Storage

- 1. Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring. **Facilities**
- 2. The area surrounding the storage facilities and mixing plant shall be constructed so that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of Council's Supervising Engineer, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of Council's Supervising Engineer. **Introduction of Foreign Matter**

QUALITY REQUIREMENTS OF CONCRETE

C248.09 CEMENT AND FLYASH CONTENT

- 1. The minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete. The maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete. **Cement and Flyash**

C248.10 COMPRESSIVE STRENGTH

- 1. The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at twenty-eight days shall be 36.0 MPa. **Compressive Strength**

C248.11 SHRINKAGE

- 1. The drying shrinkage of the nominated mix, determined by AS 1012.13, shall not exceed 450 microstrain after three weeks air-drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with AS 1012.13. **Shrinkage Limit**

CONCRETE BASE

C248.12 CONSISTENCY

1. The Contractor's nominated slump, determined in accordance with AS 1012.3, Method 1, shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 55 mm nor more than 65 mm for hand placed concrete.

**Slump
Tolerance**

C248.13 AIR CONTENT

1. The air content of the concrete, determined in accordance with AS 1012.4, Method 2, shall be neither less than 4 per cent nor more than 7 per cent, when discharged from the transport vehicle ready for placement.

Tolerances

STEEL REINFORCEMENT

C248.14 MATERIAL

1. Steel reinforcement shall comply with the requirements of the appropriate following Australian Standards:-

Standards

- (a) AS 1302 Steel Reinforcing Bars for Concrete.
- (b) AS 1303 Steel Reinforcing Wire for Concrete.
- (c) AS 1304 Welded Wire Reinforcing Fabric for Concrete.

2. The type and size of bars shall be as shown on the Drawings.

Type and Size

3. Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, mill scale, mortar or any other coating, but shall not be brought to a smooth polished condition.

Quality

4. The Contractor shall supply evidence satisfactory to Council's Supervising Engineer that steel reinforcement complies with AS 1302, AS 1303 or AS 1304, as appropriate. Test certificates shall show the results of mechanical tests and chemical analysis.

**Documentary
Evidence**

5. Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length. The cost of all samples and tests shall be borne by the Contractor.

Sampling

**Contractor's
Cost**

6. Plastic tips for wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at $23 \pm 5^{\circ}\text{C}$ without being pierced by the wire. The Contractor shall demonstrate that the proposed chairs conform to these requirements.

Wire Chairs

C248.15 BENDING

1. Reinforcement shall be formed to the dimensions and shapes shown on the Drawings. Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of reinforcement for the purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching. Where the radius of a bend or hook is not stated on the Drawings, it shall be made around a pin having a diameter of not less than four times the diameter of the bar bent.

Bending

C248.16 SPLICING

1. All reinforcement shall be furnished in the lengths indicated on the Drawings. Except where shown on the Drawings, splicing of bars shall only be permitted with the approval of Council's Supervising Engineer as to the location and method of splicing.

Plan Lengths

The length of lapped splices not shown on the Drawings shall be as follows for unhooked bars: -

Grade 400Y	- 35 bar diameters
Grade 250R	- 40 bar diameters
Hard drawn wire	- 50 bar diameters

2. Splices in reinforcing fabric shall be measured as the overlap between the outermost wires in each sheet of fabric transverse to the direction of splice. This overlap shall not be less than the pitch of the transverse wires plus 25 mm.

Splice Dimensions

3. In welded splices, bars shall only be welded by an approved electrical method. Grade 400Y reinforcing bars shall not be welded.

Welded Splice

4. Welding shall comply with AS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

Welding Standard

C248.17 STORAGE

1. Reinforcement, unless promptly incorporated into the concrete, shall be stored under a waterproof cover and supported clear of the ground, and shall be protected from damage and from deterioration due to exposure.

Protection of Reinforcement

C248.18 PLACING

1. Reinforcing bars and wire reinforcing fabric shall be accurately placed to the dimensions and details shown on the Drawings. They shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs or metal hangers as approved by Council's Supervising Engineer and by wiring together where required using annealed iron wire not less than 1.25 mm diameter. These supports shall be in a regular grid not exceeding 1 m and steel shall not be supported on metal supports which extend to any surface of the concrete, on wooden supports, nor on pieces of aggregate.

Position

2. Tack welding instead of wire ties may be used on reinforcing steel. Cold-worked reinforcing bars shall not be tack welded.

Tack Welding

3. The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless otherwise shown on the Drawings.

Bar Cover

4. Tie bars shall be placed in the pavement such that after placement they remain in their specified location. Tie bars shall not be placed through the finished upper surface of the pavement. Tie bars shall be placed either ahead of paving or by a bar vibrator into the edge of the joint or by an automatic tie bar inserter on the mechanical paver. Irrespective of the method of placement, tie bars extending from any side face of base concrete or gutter shall be anchored in a manner which will develop 85 per cent of the yield strength of the bar in tension.

Tie Bars

5. Placing and fastening of all reinforcement in the work shall be approved by Council's Supervising Engineer before concrete is placed and adequate time shall be allowed for inspections and any corrective work which Council's Supervising Engineer may require. Notice for inspection shall not be less than four working hours before the intended time of commencement of concrete placement or such time as determined by Council's Supervising Engineer.

Inspection

DESIGN AND CONTROL OF CONCRETE MIXES

C248.19 GENERAL

1. The Contractor shall submit, for approval by Council's Supervising Engineer, details of the concrete mix (or mixes) and the materials, including source, to be used for each of mechanically placed and hand placed base, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a 'nominated mix'.

Nominated Mix

2. Also, the Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve-month period before the date of submission to Council's Supervising Engineer.

Certified Test Results

3. In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS 1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 2.0 MPa of the median and the compressive strength for 28 days shall not be less than 36.0 MPa.

Compressive Strength

4. These details shall be submitted at least 21 days before using the nominated mix in the work.

Submission of Details

C248.20 VARIATIONS TO APPROVED MIXES

1. The Contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of Council's Supervising Engineer.

Approval for Mix Variation

2. Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C248.19. If the variations to the quantities of the constituents in the approved mix are less than 10 kg for Portland cement and flyash, and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete Council's Supervising Engineer may approve the changes without new trials being carried out.

Contractor's Responsibility

3. Notwithstanding these tolerances the minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete and the maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.

Content per Cubic Metre

CONFORMANCE OF CONCRETE STRENGTH, COMPACTION AND THICKNESS

C248.21 CONCRETE CYLINDERS

(a) Test Specimens

1. Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this Clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to Council's Supervising Engineer. **Contractor's Responsibility**

2. Samples of concrete for testing shall be taken in accordance with AS1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable. **Sampling**

3. The method of making and curing specimens shall be in accordance with AS1012.8 with compaction by internal vibration. **Curing**

4. The Contractor shall mark the specimens for identification purposes. **Marking**

5. The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor. **Contractor's Cost**

(b) Frequency of Moulding of Test Specimens **Moulding of Cylinders**

1. Test specimens shall be moulded as follows: -

(i) For the determination of the compressive strength at twenty-eight days.

For each lot of up to 50 cubic metres
of concrete placed at the one time: One pair of specimens

(ii) For the determination of the compressive strength at seven days.

For each lot of up to 50 cubic metres
of concrete placed at the one time: One pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor.

For each lot of up to 50 cubic metres
of concrete placed at the one time: One pair of specimens

2. A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed. **Lot Size**

(c) Inspection, Capping and Crushing of Specimens **NATA Laboratory Contractor's Cost**

1. Specimens required by this Specification shall be tested at the NATA registered laboratory nominated by the Contractor. The cost of such testing shall be borne by the Contractor.

2. Specimens shall be inspected, capped and crushed in accordance with AS1012.9. **Standards**

3. Before crushing, the mass per unit volume of the seven-day specimens shall also be determined in accordance with AS1012.12 Method 2, so that the relative compaction of cores taken from the same lot of concrete base can be determined. **Mass Unit Volume**

C248.22 COMPRESSIVE STRENGTH OF CONCRETE

(a) General

1. The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens unless the two results differ by more than 3.0 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete.

Determination of Strength

(b) Adjustment of Test Compressive Strength for Age of Specimen

1. Should any specimen be tested more than twenty-eight days after moulding the equivalent twenty-eight day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table C248.4. For intermediate ages the factor shall be determined on a pro-rata basis.

Strength Age Factor

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

Table C248.4 - Concrete Age Conversion Factors

(c) Conformance for Compressive Strength

1. If the 28 day compressive strength of test cylinders for any lot is less than 33.0 MPa or greater than 45.0 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.

Limits

2. In case of non-conformance the Contractor may elect to core the in situ base concrete for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by Council's Supervising Engineer. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Base concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

Coring

3. After testing for compressive strength of cores, where required, Council's Supervising Engineer shall consider the test results and shall at his absolute discretion determine the compressive strength of the concrete to be either: -

Council Supervising Engineer's Absolute Discretion

(i) The average of the twenty-eight day compressive strength of the pair of specimens moulded at the time of placing; or

(ii) The equivalent twenty-eight day compressive strength of the core.

4. A lot is defined as a continuous pour of up to 50 cubic metres of base represented by a pair of test specimens cast from a sample of the concrete used in its construction. **Lot Size**

C248.23 CONFORMANCE FOR THICKNESS

1. Thickness measurements of the concrete base shall be determined by survey, measurements at the edges or by coring. Audit checks using a suitable probe may be carried out whilst the concrete is being placed. The readings shall be rounded off to the nearest 5mm. **Thickness Measurement**

2. Base, which is below the specified thickness, shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52. **Remove and Replace**

3. Base, which is thicker than the design thickness, will be acceptable ,provided the finish satisfies the requirements of Clause C248.31.

C248.24 RELATIVE COMPACTION OF CONCRETE

(a) Test Specimens

1. Test specimens for determining the relative compaction of the concrete placed in the work shall be cores cut from the work. Cores shall be cut from the full depth of the concrete base to the requirements of AS 1012.14, with the following exceptions: - **Cores**

- (i) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However before removal, concrete must be not less than three days old in the warm season and six days old in the cool season.

- (ii) The nominal diameter of the cores shall not be less than 75 mm.

2. The location of coring shall be chosen to exclude joints, steel reinforcement or tie bars from the core. The locations are not intended to be random, but are intended to ensure that the whole of the concrete base conforms to the minimum requirements of the Specification. Cores shall be marked for identification. **Location of Cores**

3. Cores shall be placed immediately either in a tank of lime-saturated water or in an individual plastic bag and sealed to prevent water loss. Cores stored in plastic bags shall be kept in the shade. **Storage**

4. Cores shall not be subjected to temperatures in excess of either ambient temperature or 23°C whichever is the higher and they shall not be subjected to temperature less than 10°C, until delivered to the testing laboratory. **Temperature Control**

(b) Frequency of Coring

1. The Contractor shall take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded in accordance with Clause C248.21. **Minimum**

2. In the case of hand-placed base concrete, two cores shall be taken to represent a section of work. A section of work shall be confined between construction joints. Hand-worked or placed base that is cast with machine-placed concrete and not separated from the machine-placed concrete shall be deemed to be part of the machine-placed concrete, and be cored and tested as part of the machine-placed concrete base. **Hand Placed Concrete**

(c) Repair of Core Holes

1. The Contractor shall clean and restore all core holes taken in the base with non-shrink cementitious concrete having a compressive strength of not less than that in the base and a maximum nominal aggregate size of 10 mm. **Contractor's Responsibility**

CONCRETE BASE

2. The surface of the restored hole shall be similar to the surrounding surface in texture and colour. **Surface Condition**
3. The cost of core restoration or reparation shall be borne by the Contractor. **Contractor's Cost**

(d) Testing of Cores for Compaction

1. The core specimens shall be wet conditioned in accordance with AS 1012.14 for not less than 24 hours immediately prior to testing for compaction. Testing to determine mass per unit volume shall be carried out on specimens at age seven days. **Curing**
2. The relative compaction of a core specimen shall be the ratio, expressed as a percentage, of the mass per unit volume of the core specimen to the average mass per unit volume of the standard cylinders used to determine the seven day compressive strength from the same lot of concrete base. The mass per unit volume of both standard cylinders and cores shall be determined in accordance with AS 1012.12 Method 2. All costs associated with obtaining, curing and testing of cores shall be borne by the Contractor. **Relative Compaction**
Contractor's Cost

(e) Conformance for Compaction

1. If the relative compaction is less than 97.0 per cent, the lot represented by the core shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52. **Rejection Percentage**
2. Core specimens for compressive strength testing shall be wet-conditioned, prepared and tested in accordance with AS 1012.14. Cores obtained for compaction shall not be re-used for compressive strength testing. **Core Preparation**
3. The test strength shall be adjusted for age at test in accordance with Clause C248.22 and for length/diameter ratio in accordance with Table C248.5 by multiplying the correction factor in Table C248.5. **Adjustment for Age**
4. If the 28-day compressive strength of the core is less than 33.0 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52. **Core Compressive Strength**

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

C248.25 PRODUCTION AND HANDLING OF CONCRETE

1. At least four weeks before commencing work under this Specification, the Contractor shall submit, for the information of Council's Supervising Engineer, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport. **Contractor's Responsibility**
2. The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements: - **Handling and Batching**

Methods

- (a) Certificates of Calibration issued by a recognised authority shall be made available for inspection by Council's Supervising Engineer, as evidence of the accuracy of the scales.
- (b) Cementitious material shall be weighed in an individual hopper, with the Portland cement weighed first.
- (c) The moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.

3. Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS 1379, with the additional requirement that in Appendix A of AS 1379 the maximum permissible difference in slump shall be 10 mm.

Mixer

Requirements

C248.26 MIXING AND TRANSPORT

1. Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements: -

Methods

- (a) The mixer shall be charged in accordance with the manufacturer's instructions.
- (b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray.
- (c) For truck-mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten minutes of completion of batching and within 200 m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location.
- (d) Admixtures shall be separately prediluted with mixing water and shall be incorporated by a method that ensures that no adverse interaction occurs.
- (e) After addition of the cement to the aggregate, concrete shall be incorporated into the work within: -
 - One and a half hours, where transported by truck mixer or agitator;
 - One hour, where transported by non-agitating trucks.

Means of verification, satisfactory to Council's Supervising Engineer, of the times of addition of cement to the aggregate shall be provided. The times within which the concrete shall be incorporated into the work may be reduced if Council's Supervising Engineer considers the prevailing weather, mix type, or materials being used warrant such a change.

- (f) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 per cent of the gross volume of the drum of the mixer.

C248.27 MAXIMUM MIXING TIME

1. Minimum mixing time will be as determined for the approved mix and verified when the trial concrete base is constructed.

2. Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may

Batch in Mixer

CONCRETE BASE

be continued for a maximum of ten minutes except for split drum mixers where the maximum shall be five minutes.

3. For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

Long Delays

248.28 CONSISTENCY

1. At all times between mixing and discharge, the slump shall be within 10mm of the Contractor's nominated slump for the nominated mix for mechanically placed concrete and within 15mm thereof for hand placed concrete.

Tolerances

2. The consistency of the concrete shall be checked by use of a slump cone in accordance with AS1012.3 Method 1. The test shall be made on concrete samples obtained in accordance with AS1012.1.

Test Method

3. The consistency of the concrete shall be checked within 30 minutes of adding cement to the aggregate. If the actual haul time exceeds 45 minutes, the consistency shall also be checked immediately prior to discharge. Concrete, which is non-conforming in relation to consistency, shall not be incorporated into the work. Check tests shall be done on each truckload of concrete. The cost of consistency testing shall be borne by the Contractor.

Timing of Testing

Contractor's Cost

4. Check tests shall be done on each truckload of concrete.

Check Tests

PLACING AND FINISHING CONCRETE BASE

C248.29 GENERAL

1. At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of Council's Supervising Engineer, full details of the equipment and methods proposed for placing and finishing the concrete base together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

Contractor's Responsibility

2. The Contractor shall give Council's Supervising Engineer seven days written notice of the intention to commence construction of the base on any section of work (including the placement of the trial concrete base in accordance with Clause C248.39.

Written Notice

3. The subbase surface shall be clean and free of loose or foreign matter and prepared in accordance with Specification C247 - MASS CONCRETE SUBBASE.

Subbase Condition

4. Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

Air Temperature

5. The temperature of the concrete at the point of discharge from transport vehicles shall be neither less than 10°C nor more than 32°C.

Concrete Temperature

6. Where required, slab anchors shall be constructed prior to construction of the base.

Slab Anchors

C248.30 RATE OF EVAPORATION

1. When the value of Rate of Evaporation, determined from the graph in Figure C248.1, exceeds 0.50 kilograms per square metre per hour the Contractor shall take precautionary measures satisfactory to Council's Supervising Engineer for the prevention of excessive moisture loss. If, in the opinion of Council's Supervising Engineer, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour.

Evaporation Limit

2. Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull-floating, are complete.

Use of Retarder

3. The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity at the site throughout the course of the work. The Contractor shall provide and maintain all equipment, and shall provide suitable personnel necessary for all such measuring and recording.

Contractor's Responsibility

4. The cost of providing and maintaining such equipment, providing suitable personnel and taking precautionary measures for the prevention of excessive moisture loss shall be borne by the Contractor.

Contractor's Costs

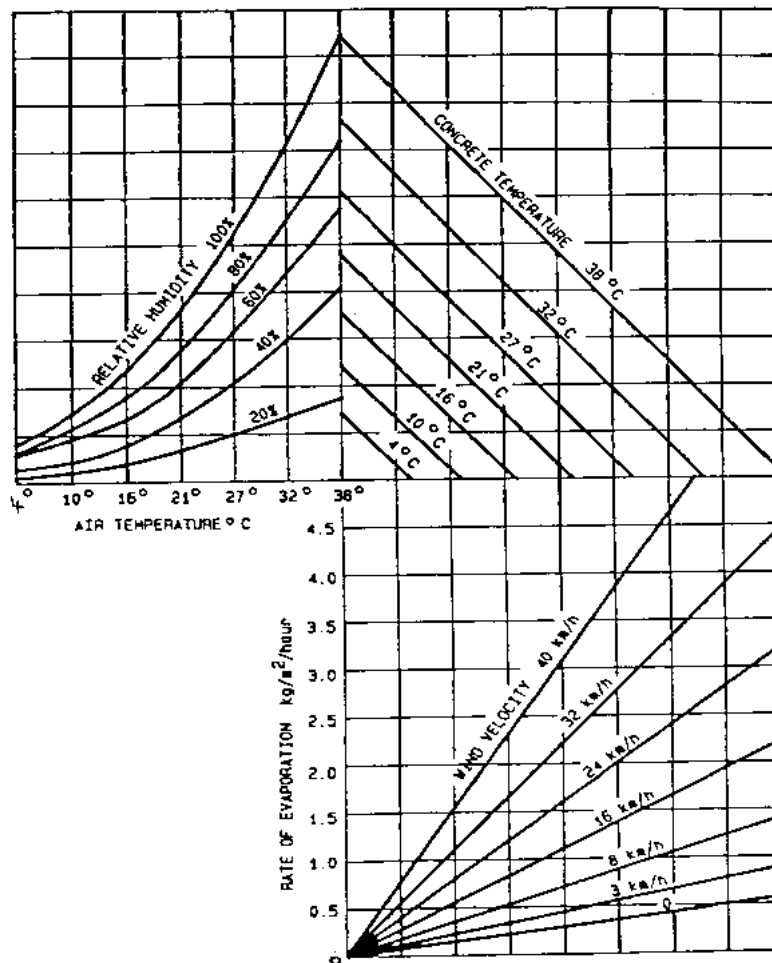


Figure C248.1 - Rate of Evaporation

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27°C
- with relative humidity at 40%
- with concrete temperature at 27°C
- with a wind velocity of 26km/h the rate of evaporation would be 1.6 kg/m²/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27°C. Move

CONCRETE BASE

vertically down to the respective wind velocity curve - in this case interpolating for 26km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

C248.31 MECHANICAL PAVING

1. The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features: -

Paving Machine

- (a) An automatic control system with a sensing device to control line and level to the specified tolerances.
- (b) Means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components.
- (c) Internal vibrators capable of compacting the full depth of the concrete.
- (d) Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- (e) Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

2. The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with Clause C248.34.

Concrete Finish

3. The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

Supporting Surface

4. Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, Council's Supervising Engineer may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

Continuity of Paving Operation Contractor's Cost

5. Where an interruption to paving occurs, which is likely to result in a non-monolithic concrete mass, the Contractor shall form a transverse construction joint in accordance with Clause C248.41.

Interruption to Paving

6. Should subsequent testing at the location of an interruption indicate the presence of non-monolithic concrete, such concrete shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.

Non-monolithic Concrete

C248.32 HAND PLACING

1. Hand placement shall only be used in areas where mechanical placement is impracticable or where Council's Supervising Engineer, prior to commencement of work, has approved it.

Restriction

2. Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non-adhesion of concrete to the forms.

Formwork

3. Concrete shall be delivered in agitator vehicles and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand-guided vibratory screed traversing the full width of the slab on each pass. Any build-up of concrete between the forms and vibratory screed shall be prevented.

Placing in Forms

4. If disruptions occur for any reason, Council's Supervising Engineer may direct that a

Disruption

construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

Contractor's Cost

5. A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with Clause C248.34.

Concrete Finish

6. Where an interruption to placing occurs, which is likely to result in a non-monolithic concrete mass, the Contractor shall form a transverse construction joint in accordance with Clause C248.41.

Transverse Construction Joint

7. Should subsequent testing at the location of an interruption indicate the presence of non-monolithic concrete, such concrete shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.

Non-Monolithic Concrete

C248.33 ALIGNMENT AND SURFACE TOLERANCES

(a) Horizontal Alignment Tolerance

1. The outer edges of the base shall be square to the subbase and shall not deviate from the plan position at any point by more than 10 mm.

Outer Edge

2. Where an edge of a slab is to form a longitudinal joint line the allowable horizontal alignment tolerances shall comply with Clause C248.46.

Longitudinal Joint Line

(b) Tolerances and Rideability

1. The tolerance on thickness of the base shall be zero below the specified thickness and in accordance with Clause C248.23 for excess thickness.

Top of Base Level

2. The top surface of the base shall also not deviate from a 3 m straightedge, laid in any direction; by more than 5 mm. Measurements shall be taken at 10 metre intervals in each lane as determined by Council's Supervising Engineer. Ten measurements shall be taken within each lot in each lane. Notwithstanding this requirement, the surface shall not pond water.

Surface Level

C248.34 TEXTURING OF SURFACE

1. Texturing of the concrete surface may be affected by use of a fine broom or hessian drag. The Contractor shall submit to Council's Supervising Engineer details of the proposed texturing method and equipment.

C248.35 CURING

1. The base shall be cured by the use of one of the following:

Compounds

- (a) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt wearing surface is used, or
- (b) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if no asphalt wearing surface is used, or
- (c) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt wearing or no asphalt wearing surface.

2. The Contractor shall submit, for the information of Council's Supervising Engineer, a current Certificate of Compliance from a NATA registered laboratory, approved by Council's Supervising Engineer, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.

Efficiency Index

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3. The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres per square metre. When applied with a hand lance the rates shall be increased by 25 per cent.

4. The average application rate shall be checked by the Contractor and certified to Council's Supervising Engineer by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by Council's Supervising Engineer.

**Application
Rate**

5. The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by hand spraying of the affected areas.

Curing Period

6. Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

**Equipment on
Site**

C248.36 PROTECTION OF WORK

1. The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first twenty-four hours after placing. The Contractor shall provide, for the information of Council's Supervising Engineer, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5°C and if, in the opinion of Council's Supervising Engineer, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

**Temperature
Control**

2. The Contractor shall protect the work from rain damage and shall provide, for the information of Council's Supervising Engineer, detailed proposals for procedures and equipment to be used for such protection.

Rain Protection

3. Neither traffic nor construction equipment, other than that associated with testing, saw cutting, groove cleaning or joint sealing, shall be allowed on the finished base until the joints have been permanently sealed and at least 10 days have elapsed since placing concrete, and the concrete has reached a compressive strength of at least 20MPa.

**Traffic
Restrictions**

C248.37 ODD-SHAPED AND MISMATCHED SLABS

1. A slab is a portion of concrete base bounded by joints or free edges. A slab shall be considered to be odd-shaped if the ratio of the longer dimension to the shorter dimension exceeds 1.6 or if the joint pattern produces an angle of less than 80 degrees between two adjacent sides. Slab dimensions shall be taken as the average dimension measured normal and parallel to the longitudinal joints. Slabs containing blockouts for drainage structures shall be considered as odd-shaped.

Definition

2. Where any joint meets a slab and is not continued across that slab, that slab shall be considered a mismatched slab.

3. Unless otherwise shown on the Drawings, odd-shaped and mismatched slabs shall be reinforced with F82 reinforcing fabric placed with 50 mm to 60 mm cover to the surface of the base. Fabric shall be clear of all transverse and longitudinal joints by 50 mm to 100 mm.

**Reinforcing
Fabric**

C248.38 TERMINAL SLABS

1. Terminal slabs shall be constructed adjoining bridge approach slabs and at changes from a rigid pavement to a flexible pavement. Terminal slabs shall be constructed to the dimensions and details shown on the Drawings.

Position

C248.39 TRIAL CONCRETE BASE

- | | |
|--|---|
| <p>1. Before the commencement of paving, the Contractor shall construct a trial section of concrete base on the carriageway to demonstrate to Council's Supervising Engineer the Contractor's capability of constructing base in accordance with the Specification. This section shall be constructed so that it may be incorporated in the finished work.</p> | <p>Location</p> |
| <p>2. The trial base shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining base work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound, and the construction and sawing of joints and the placement of tie bars and dowels.</p> | <p>Purpose</p> |
| <p>3. The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.</p> | <p>Quality Parameters</p> |
| <p>4. A trial length of between 100m and 200m for mechanical paving equipment or between 20m and 50m for hand placement is required. The maximum width proposed to be laid shall be constructed in one continuous operation.</p> | <p>Dimensions</p> |
| <p>5. Unless advised of any deficiencies in the trial concrete base by Council's Supervising Engineer, due to failure to comply with this Specification, the Contractor may proceed with placing concrete base from a time ten working days after the completion of the trial concrete base or such earlier time as Council's Supervising Engineer may allow. In the event of deficiencies in the trial concrete base, Council's Supervising Engineer may order the Contractor to construct a further length of trial concrete base, which shall be treated as the first. If, after three trials, the base still is deficient in some way, Council's Supervising Engineer may require the Contractor to justify to the satisfaction of Council's Supervising Engineer why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.</p> | <p>Deficiencies in Trial Section</p> |
| <p>6. Council's Supervising Engineer shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by Council's Supervising Engineer to warrant such procedure or when concrete as placed does not comply with this Specification.</p> | <p>New Trial Section</p> |
| <p>7. Any trial concrete base, which does not comply with the Specification, shall be rejected by Council's Supervising Engineer and shall be removed by the Contractor in accordance with Clauses C248.50, C248.51 and C248.52.</p> | <p>Non-conformance</p> |

JOINTS

C248.40 GENERAL

- | | |
|---|------------------------|
| <p>1. Joints shall be provided at locations indicated on the Drawings or as approved by Council's Supervising Engineer.</p> | <p>Location</p> |
|---|------------------------|

C248.41 TRANSVERSE CONSTRUCTION JOINTS

- | | |
|---|------------------------|
| <p>1. Transverse construction joints shall:</p> <ul style="list-style-type: none"> - be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations. - not be placed closer than 1.5 m to a transverse contraction joint. Where necessary, Council's Supervising Engineer shall authorise a change in the spacing and/or skew of transverse contraction joints to ensure that sufficient | <p>Location</p> |
|---|------------------------|

CONCRETE BASE

clearance is obtained.

- be constructed normal to the control line and to the dimensions and details shown on the Drawings. The tie bars shall comply with Clauses C248.14 and C248.18.
- be smooth across the joint before texturing.
- not deviate from a 3 metre straight edge placed along the joint by more than 10 mm.

2. Prior to placing adjacent concrete the surface of the concrete shall be roughened to expose coarse aggregate. The roughened surface and the projecting reinforcement shall be washed clean and all excess water and loose material removed.

***Placing
Adjoining
Concrete***

C248.42 TRANSVERSE CONTRACTION JOINTS

(a) General

1. Transverse contraction joints shall be continuous across the full width of the base and shall be sawn unless otherwise approved by Council's Supervising Engineer.

Details

2. Where the concrete base is to be overlaid with asphalt wearing course, Council's Supervising Engineer may approve the joint to be formed with a suitable plastic joint inducing system.

3. Transverse contraction joints shall be constructed normal to the control line and to the dimensions and details shown on the Drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors.

Skewed Joints

(b) Saw cutting

1. The Contractor shall ensure that saw cutting be conducted between 6 and 24 hours after initial paving so as not to cause excessive ravelling of aggregate adjacent to the cut and so as to prevent cracking of the base concrete other than at the bottom of the 3 mm sawcut. The Contractor shall use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn and shall have sufficient standby equipment available on site to maintain continuity of sawing.

***Timing and
Equipment***

2. The line of the transverse contraction joint shall be without any discontinuities. No edge shall deviate from a 3 metre straight edge by more than 10 mm.

Tolerances

3. The surface of the transverse contraction joint shall not exhibit more than 5 mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300 mm in any 1 m length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

4. Council's Supervising Engineer shall reject all sawcuts that do not conform to the requirements of this Clause. Rejected sawcuts may be repaired by a method approved by Council's Supervising Engineer.

***Rejected
Sawcuts***

(c) Cleaning

1. Immediately after any sawing, the sawcut shall be cleaned of all debris. The cleaning method used shall not damage the sawcut nor leave any substance deleterious to the concrete or to the adhesion of the joint sealants to be used. The method shall incorporate a pressurised liquid or liquid/air jet. Cleaning liquid shall not be gravity fed from tanks.

***Debris
Removed***

(d) Temporary Sealing

1. Immediately after cleaning following the second sawcut, if the transverse contraction joint is produced by a two-cut operation, the joint shall be temporarily sealed by a continuous closed-cell polyethylene backer rod of diameter shown on the Drawings or as required by Council's Supervising Engineer. **Material**
2. The top of the sealant shall be neither higher than nor more than 10 mm below the concrete surface. The backer rod shall pass over any longitudinal joint seal already in place. **Tolerance**
3. The Contractor shall maintain the temporary sealant until the joint is sealed permanently. Damaged or disturbed temporary sealants shall be removed, the transverse contraction joint re-cleaned to the satisfaction of Council's Supervising Engineer and a new temporary sealant inserted. **Maintenance**
- (e) Permanent Sealing**
- (i) General**
1. Within ten days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint. **Timing**
2. The permanent sealant shall be either a neoprene compression seal or an in situ cast silicone sealant. The Contractor shall submit for the approval of Council's Supervising Engineer, a full technical description of the proposed sealant including its operating parameters and the method of installation recommended by its manufacturer. **Sealant Quality**
- (ii) Neoprene Compression Sealants**
1. Neoprene compression sealants shall comply with all the requirements of ASTM 2628. Test methods used to determine compliance with these requirements shall include Test Methods T1160, T1161 and T1163. **Standards**
2. At least four weeks before installation of the sealant, the Contractor shall submit to Council's Supervising Engineer a Certificate of Compliance from a NATA registered laboratory showing that the sealant meets all the requirements of ASTM 2628. **Certification of Compliance**
3. At the time of installation, the sides of the neoprene sealant shall be coated with a clear or concrete-coloured lubricant compound approved by Council's Supervising Engineer and complying with ASTM D-2835. The sealant shall be inserted into the joint by means of suitable equipment, which shall not damage the sealant during its insertion. The maximum increase in length of the sealant after installation shall be 5 per cent of original length. Any sealant exceeding 5 per cent extension shall be rejected. The sealant shall be located in the transverse contraction joint in the design orientation without twist or buckle. **Installation**
4. The sealant shall be continuous between formed longitudinal joints. Where such a discontinuity occurs, the sealant shall be angle butt jointed by a method approved by Council's Supervising Engineer. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base and shall overlay any longitudinal sealants. **Tolerances**
- (iii) Silicone Sealants**
1. Silicone sealants shall be formed using a silicone joint sealant complying with the requirements listed in Table C248.6. At least four weeks before the installation of the sealant, the Contractor shall submit to Council's Supervising Engineer a Certificate of Compliance, from a NATA registered laboratory, showing that the sealant meets all the requirements of Table C248.6. **Certificate of Compliance**
2. The silicone joint sealant shall be grey in colour and shall be stored and installed in accordance with the manufacturers written instructions. Installation of a silicone sealant shall take place only when the sidewalls of the groove have been grit blasted and are surface dry. **Installation**

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3. Immediately before introducing the silicone sealant into the groove, any foreign or disturbed material shall be cleaned from the joint and from the top of the backer rod by dry air jet. The backer rod shall then be depressed to the depth such that the bottom of the silicone sealant shall be at the planned location and of the correct shape.

Action Before Sealing

4. If the backer rod is damaged in any way it shall be replaced for the full length of the joint.

5. The method to be used for permanent sealing with silicone sealant shall be approved by Council's Supervising Engineer before permanent sealing commences. Notwithstanding any approval given by Council's Supervising Engineer to a proposed method, the Contractor shall be responsible for producing a permanent seal complying with all requirements of this Specification.

Contractor's Responsibility

Test Method	Test	Requirements
ASTM-D-792	Specific Gravity	1.1 to 1.55
MIL-S-8802	Extrusion Rate	90 to 250 g per min
MIL-S-8802	Tack Free Time	30 to 70 min
ASTM D 2240	Durometer	10 to 25
T1192 T1193	Durability	Extension to 70% Compression to 50%
ASTM C794	Adhesion to Concrete	35N minimum average peel strength
ASTM C 793-7	Accelerated Weathering at 5,000 hours	No cracks, blisters or bond loss

Table C248.6 - Silicone Joint Sealant Requirements.

C248.43 TRANSVERSE ISOLATION JOINTS

1. Transverse isolation joints shall be provided at bridge approach slabs and at slab anchors where shown on the Approved Drawings or as directed by Council's Supervising Engineer.

Location

2. Transverse isolation joints shall be continuous across the full width of the base normal to the control line and shall be constructed in accordance with the Drawings.

Construction

3. Transverse isolation joints shall not be placed closer than 2.0 m to other transverse joints. Where necessary, Council's Supervising Engineer shall authorise a change in the spacing and/or skew of adjacent transverse contraction joints to ensure that sufficient clearance is obtained.

Spacing

4. Joint filler shall comply with RTA Specification 3204 and joint sealant with the silicone sealant requirements of Clause C248.42. They shall be installed in accordance with the Drawings and in a manner conforming to the manufacturers recommendations except that reference to backer rods shall not apply.

Standards

5. The line of the isolation joint shall not deviate from a 3m straightedge more than 10mm.

Tolerance

C248.44 LONGITUDINAL TIED JOINTS

(a) **General**

<p>1. Longitudinal tied joints shall be provided at the locations shown on the Drawings or where directed by Council's Supervising Engineer. The joints shall be parallel to the control line and/or to the dimensions and details shown on the Drawings.</p>	<p>Location</p>
<p>2. Longitudinal tied joints shall be formed or induced either by sawing or by machine insertion of a crack inducer ribbon.</p>	<p>Formation</p>
<p>3. The ties shall be 12 mm diameter deformed steel bars Grade 400Y, 1 metre long and shall be inserted in accordance with Clause C248.18. Tie bars shall be located and spaced as shown on the Drawings. All parts of any tie bar shall lie within 50 mm of its designed position. Tie bars shall be omitted within 500 mm of a transverse joint. The epoxy to be used when installing tie bars in existing concrete shall be hydrophilic epoxy resin. The setting system used shall develop anchorage strength at least 85 per cent of the yield strength of the bar.</p>	<p>Ties</p>
<p>4. The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10 mm. The line shall also not deviate from a 3 m straightedge by more than 10 mm having made due allowance for any planned curvature.</p>	<p>Tolerances</p>
<p>5. Where the longitudinal tied joint is formed or slip-formed, the joint face shall be corrugated in accordance with the details shown on the Drawings.</p>	<p>Corrugated Joint Face</p>
<p>6. Where the multi-lane width is greater than 18 m, a longitudinal isolation joint shall be constructed at each location shown on the Drawings and in accordance with Clause C248.46.</p>	<p>Isolation Joint</p>
<p>(b) Sawn-Induced Joints</p>	
<p>1. Sawn longitudinal tied joints shall be provided to the dimensions shown on the Drawings. Saw cutting shall comply with Clause C248.42 (b).</p>	<p>Location</p>
<p>2. Within twenty-four hours of sawing, the longitudinal tied joint shall be thoroughly cleaned of all debris and a neoprene backing rod shall be inserted in accordance with the details shown on the Drawings.</p>	<p>Sealant Quality</p>
<p>3. The sealant shall be coated with a lubricant-adhesive compound approved by Council's Supervising Engineer. The compound shall have a colour compatible with the pavement colour. The sealant shall be inserted into the groove by means of suitable equipment, which shall not damage the sealant during insertion. The maximum increase in length of the sealant after installation shall be 10 per cent of the original length; otherwise the sealant shall be rejected.</p>	<p>Sealant Insertion</p>
<p>4. Joints in the sealant shall be kept to a minimum and shall be cemented together by an adhesive recommended by the Manufacturer. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base, except where the sealant is depressed to lie under the transverse joint sealant.</p>	<p>Sealant Joints</p>
<p>(c) Ribbon-Induced Joints</p>	
<p>1. Ribbon-induced longitudinal tied joints shall be provided to the dimensions and details shown on the Drawings. The inducer ribbon shall be machine-inserted so that the top of the ribbon does not protrude above the surface of the base, nor shall it lie below the surface of the base by more than 3 mm.</p>	<p>Location and Insertion</p>
<p>2. The inducer ribbon shall be a minimum of 0.5 mm thick. When placed, it shall be within 5° of the vertical plane. Inducer ribbon which curls on placement and when cut in the base is found to be curved in transverse section by more than 3 mm from straight shall be rejected.</p>	<p>Finish</p>
<p>3. At transverse construction joints, the inducer ribbon shall be carried through the joint sufficiently to allow a connection by strong stapling, or other method approved by Council's Supervising Engineer, to the inducer ribbon to be used on the other side of the joint. When</p>	<p>Join in Ribbon</p>

CONCRETE BASE

a joint is necessary in the inducer ribbon during paving, the inducer ribbon on the new spool shall be similarly joined to the tail of the inducer ribbon on the old spool.

(d) Treatment of Sawn Longitudinal Tied Joints Prior to Asphalt Overlay

1. Where asphalt surfacing over sawn longitudinal tied joints is specified, the sealant shall be depressed to a depth below the concrete surface of not less than 10 mm and, following thorough cleaning, the joint shall be sealed flush with the concrete surface with a bituminous rubber compound, approved by Council's Supervising Engineer, compatible with the narrow groove.

**Bituminous
Rubber
Compound**

C248.45 LONGITUDINAL JOINT WITH KERB AND/OR GUTTER

1. Where kerbs and/or gutters are to be constructed within the shoulder of a concrete base, they shall be formed directly onto the concrete subbase and they may be cast either integrally with the concrete base or separately.

Form

2. Where constructed separately, they shall be tied to the concrete base by deformed steel tie bars Grade 250S or 400Y 12 mm diameter 1000 mm long at 1 m centres.

Tie Bars

3. The longitudinal joint shall be constructed parallel to the control line (parallel to the centre line for ramps) and to the dimensions shown on the Drawings. The tie bars shall be inserted in accordance with the Drawings and Clause C248.18.

Location

4. The face of the longitudinal joint need not be scabbled and the joint need not be sealed.

Face of Joint

5. The line of the longitudinal joint shall be constructed to the tolerances specified for longitudinal tied joints in accordance with Clause C248.44.

Tolerances

6. The construction of kerb and/or gutter shall be in accordance with Specification C224 - OPEN DRAINS INCLUDING KERB AND GUTTER regardless of method of construction except that the strength of the concrete used in the kerb and/or gutter shall be 36 MPa.

Specification

C248.46 LONGITUDINAL ISOLATION JOINTS

1. Longitudinal isolation joints shall be provided where shown on the Drawings or where directed by Council's Supervising Engineer.

Location

2. The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10 mm. The line of the joint shall not deviate from a 3 metre straight edge by more than 10 mm.

Tolerances

3. The joint filler shall consist of preformed jointing material of bituminous fibreboard and the joint sealant shall comply with the silicone sealant requirements of Clause C248.42. They shall be installed in accordance with the Drawings and in a manner conforming to the manufacturer's recommendations except that reference to backer rods shall not apply.

**Filler and
Sealant**

SLAB ANCHORS

C248.47 GENERAL

1. Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the Drawings.

Location

2. Slab anchors shall extend over the full width of the base and the associated transverse expansion joint shall not be placed closer than 2.0 m to other transverse joints. Where necessary, Council's Supervising Engineer shall authorise a change in the spacing of transverse contraction joints to ensure that this minimum clearance is obtained.

**Transverse
Joint**

C248.48 EXCAVATION

- | | |
|---|--|
| <p>1. Excavation of trenches for slab anchors shall be to the dimensions and details shown on the Drawings.</p> | <p><i>Dimensions</i></p> |
| <p>2. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be re-compacted, where required, to the degree of consolidation of the adjacent undisturbed material.</p> | <p><i>Trim and Consolidate</i></p> |
| <p>3. The Contractor shall dispose of excavated material at locations approved by Council's Supervising Engineer.</p> | <p><i>Spoil</i></p> |
| <p>4. Where a slab anchor is required at the junction of an existing flexible pavement, a straight sawcut to the full depth of the asphaltic concrete or bituminous seal shall be made in the flexible pavement along the joint line. Excavation of the trench shall then take place as described above without disturbance or damage to the existing flexible pavement. Any disturbance or damage to the flexible pavement shall be made good as directed by Council's Supervising Engineer.</p> | <p><i>Adjacent to Flexible Pavement</i></p> |
| <p>5. The cost of making good any disturbance or damage to the flexible pavement shall be borne by the Contractor.</p> | <p><i>Contractor's Cost</i></p> |
| <p>6. A subsoil drain shall be provided at the bottom of the trench, in accordance with Specification C231 - SUBSOIL AND FOUNDATION DRAINS and details shown on the Drawings.</p> | <p><i>Sub-Soil Drains</i></p> |

C248.49 CONCRETE

- | | |
|---|--|
| <p>1. Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements for hand-placed base concrete.</p> | <p><i>Slab Anchors</i></p> |
| <p>2. Slab anchors shall be poured separately from the base slabs to the dimensions and details shown on the Drawings up to the top surface of the subbase.</p> | <p><i>Detail</i></p> |
| <p>3. A transverse isolation joint shall be provided on the downhill side of the slab anchor.</p> | <p><i>Isolation Joint</i></p> |
| <p>4. Steel reinforcement in slab anchors shall be of the type and size shown on the Drawings and shall be supplied and fixed in accordance with Clauses C248.14 and C248.18 of the Specification.</p> | <p><i>Steel Reinforcement</i></p> |
| <p>5. Bridge approach slabs, if not in the bridge contract, shall be constructed at bridge abutments to the dimensions and details shown on the Drawings and in accordance with the requirements for base concrete.</p> | <p><i>Bridge Approach Slabs</i></p> |

REMOVAL AND REPLACEMENT OF BASE

C248.50 GENERAL

- | | |
|--|---|
| <p>1. Where directed by Council's Supervising Engineer, rejected base shall be removed and replaced in accordance with this Clause. Rejected base, which extends more than 25 m longitudinally, shall be replaced by mechanical means unless the slabs are odd-shaped or mismatched. Replacement shall be in full slab widths between longitudinal joints and/or external edges.</p> | <p><i>Replacement Method</i></p> |
| <p>2. At least seven days before the commencement of base removal, the Contractor shall submit, for the approval of Council's Supervising Engineer, details of the proposed methods of carrying out the work, which shall be such as to prevent damage to the adjoining base and the underlying subbase.</p> | <p><i>Details</i></p> |

CONCRETE BASE

3. The cost of all work and materials under this Clause shall be borne by the Contractor. **Contractor's Cost**

C248.51 REMOVAL AND DISPOSAL OF BASE

1. At each end of the section of base to be removed, a transverse sawcut shall be made for the full depth of the base layer. Such transverse sawcuts shall be normal to the control line and not closer than 1.5 m to an existing contraction joint in the base. No over sawing into the adjoining base or underlying subbase shall be permitted. **Transverse Sawcut**

2. Longitudinal sawcuts shall be made along existing longitudinal joints to define the edges of the base section to be removed. Such longitudinal sawcuts shall not extend more than 250 mm past the transverse sawcut at each end of the section to be removed and shall not extend into the underlying subbase. **Longitudinal Sawcuts**

3. No over sawing shall be permitted on any additional internal sawcuts the Contractor may make to aid the removal of the base. **Oversawing**

4. The Contractor shall dispose of the removed base slabs at locations that are acceptable to Council's Supervising Engineer and the Local Government Authority. **Disposal**

5. Any slab, adjoining the removed slabs, damaged by the Contractor's operations shall also be removed and replaced in accordance with this Clause. **Contractor's Responsibility**

C248.52 REPLACEMENT OF BASE

1. Before construction of the replacement base, the subbase shall be prepared and de-bonded in accordance with Specification C247 - MASS CONCRETE SUBBASE. **Subbase Preparation**

2. All work involved in the replacement of base shall comply with the Specification, including the following additional requirements: - **Additional Requirements**

- (a) The joint faces on the adjoining slab at the transverse sawcuts shall be deeply scabbled below the top 25 mm, which shall be left smooth. Tie bars shall be provided to form a transverse construction joint in accordance with Clause C248.41.
- (b) Transverse contraction joints shall be continuous across the full width of the base containing the replaced section. The length of the joint across the full width of the base shall be sealed with the same sealant as in adjacent work and in accordance with Clause C248.42.
- (c) The lower two-thirds of the depth of the longitudinal joint faces shall be deeply scabbled and any concrete considered to be unsound by Council's Supervising Engineer shall be removed. A crack inducer ribbon shall be attached to the surface of any formed longitudinal joint in the replacement base and tie bars provided to form a longitudinal tied joint in accordance with Clause C248.44.
- (d) Tie bars placed into hardened concrete shall be set by the use of a hydrophilic epoxy resin. The setting system used shall develop anchorage strength at least 85 per cent of the yield strength of the bar.
- (e) Neither traffic nor construction equipment other than that associated with testing, saw cutting, groove cleaning or joint sealing shall be allowed on the section of base containing the replacement base until the joints have been permanently sealed and at least ten days have elapsed since placing replacement base concrete or the concrete has reached a compressive strength of at least 20MPa.

LIMITS AND TOLERANCES

C248.53 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in Table C248.7 below:

Item	Activity	Tolerances	Spec Clause
1.	Aggregates		
	a. General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	C248.08a
	b. Fine Aggregate		
	(i) Grading	To be within the limits as per Table C248.2 and shall not deviate from Proposed Grading by more than amounts in Table C248.2	C248.08b
	(ii) Wet Strength	Not less than 80kN for any fraction and/or constituent	C248.08c
	(iii) 10% Fines Wet/Dry Variation	Not to exceed 35% for any fraction and/or constituent	C248.08c
	(iv) Soundness	The loss in mass when tested with sodium sulphate to be less than 9% for any constituent	C248.08c
	(v) Particle Shape	The proportion of misshapen particles (2:1 ratio) to be less than 35%	C248.08c
	(vi) Fractured Faces	At least 80% by mass of the particles shall have two or more fractured faces	C248.08c
2.	Concrete Quality		
	a. Cement Content	At least 270kg per yielded cubic metre of concrete	C248.09
	b. Flyash	Not greater than 50kg per yielded cubic metre of concrete	C248.09
	c. Compressive Strength	The minimum 28 day compressive strength shall be 36.0 MPa	C248.10
	d. Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	C248.11
2.	Concrete Quality (Cont'd)		
	d. Consistency	Nominated slump shall be neither less than 30mm nor more than 40mm for mechanically placed concrete. It shall be neither less than 55mm nor more than 65mm for hand placed concrete.	C248.12
	e. Air content	Shall not be less than 4% nor more	C248.13

CONCRETE BASE

Item	Activity	Tolerances	Spec Clause
		than 7% when discharged from the transport vehicle ready for placement	
3.	Concrete Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non-agitating trucks.	C248.26
4.	Concrete Placing	Concrete shall not be placed when the air temperature in the shade is below 5°C or above 38°C. The temperature of the concrete shall be neither less than 10°C nor more than 32°C.	C248.29
		Where the value of Rate of Evaporation exceeds 0.50kg per square metre per hour, the Contractor shall cease work.	C248.30
5.	Alignment and Surface		
	a. Horizontal Alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 10mm.	C248.33a
	b. Surface Level	The level at any point on the top of the base shall not vary by more than +10mm or -0mm from that shown on the Drawings or as directed by Council's Supervising Engineer. The top surface of the base shall not deviate from a 3m straightedge, laid in any direction, by more than 5mm.	C248.33b
6.	Concrete Protection		
	a. Temperature	The temperature of the concrete shall not be permitted to fall below 5°C during the first twenty-four hours after placing.	C248.36
7.	Joints		
	a. Transverse Construction	The line of the transverse construction joints shall not deviate from a 3m straightedge placed along the joint by more than 10mm.	C248.41
	b. Transverse Contraction	(i) May be reduced locally to a skew of 1 in 12 to accommodate construction joints and slab anchors. (ii) No edge shall deviate from a 3m straightedge by more than 10mm. (iii) The surface of the transverse	C248.42

Item	Activity	Tolerances	Spec Clause
		<p>contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300mm in any 1m length of joint on each edge.</p>	
		<p>(iv) Temporary Sealing - the top of the sealant shall be neither higher than nor more than 10mm below the concrete surface.</p>	
		<p>(v) Permanent Sealing The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base.</p>	
	c. Transverse Isolation	<p>The line of the transverse expansion joint shall not deviate from a 3m straight edge more than 10mm.</p>	C248.43
7.	d. Longitudinal Tied Joints	<p>(i) All parts of any tie bar shall be within 50mm of its designed position.</p> <p>(ii) The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10mm. The line shall also not deviate from a 3m straightedge by more than 10mm having made due allowance for any planned curvature.</p> <p>(iii) For Sawn-Induced joints, the maximum increase in length of the sealant after installation shall be 10% of the original length. The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base.</p> <p>(iv) For Ribbon-Induced joints, the inducer ribbon shall be a minimum of 0.5mm thick and when placed it shall be within 5° of the vertical plane.</p>	C248.44
	e. Longitudinal Isolation Joints	<p>The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10mm. The line of the joint shall not deviate from a 3m straightedge by more than 10mm.</p>	C248.46
8.	Slab Anchors	<p>Not placed closer than 2.0m to</p>	C248.47

CONCRETE BASE

Item	Activity	Tolerances	Spec Clause
		transverse joints (other than associated transverse expansion joints).	

Table C248.7 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C248.54 RESERVED

C248.55 RESERVED

C248.56 RESERVED

C248.57 RESERVED

C248.58 RESERVED

CONSTRUCTION
SPECIFICATION

C254

SEGMENTAL PAVING

SPECIFICATION C254 : SEGMENTAL PAVING

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SEGMENTAL PAVING

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ANNEXURES

C254-A LAYING PATTERNS

SPECIFICATION C254 : SEGMENTAL PAVING

GENERAL

C254.01 SCOPE

1. This Specification covers the construction of both clay masonry and concrete segmental paving for road pavements medians, traffic islands, driveways, cycleways, footpaths and other pedestrian areas.
2. The work to be executed under this Specification consists of the supply, placement and compaction of segmental paving units including the provision of sand bedding course and joint filling sand, over bound or unbound base and/or subbase layer/s.
3. This Specification should be read in conjunction with the appropriate Specifications for the construction of the base and subbase layers beneath the segmental paving, i.e. C242 - FLEXIBLE PAVEMENTS and C247 - MASS CONCRETE SUBBASE.

C254.02 TERMINOLOGY

1. Concrete segmental paving units are units of not more than 0.09 square metres in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges.

Size

2. Concrete paving units are identified by shape as being one of the following types:

**Concrete
Pavers**

Shape Type A

Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.

Shape Type B

Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces.

Shape Type C

Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

Shape Type X

Units which may or may not conform to the above definitions but which are designed to have specific characteristics to provide interlock.

3. Clay masonry pavers are manufactured from clay, shale or argillaceous materials, which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2mm.

Clay Pavers

4. Clay pavers shall be Class 4.

Classification

5. Laying patterns of paving units are identified as being Herringbone, Basket Weave

Pattern

SEGMENTAL PAVING

or Stretcher as shown in Annexure C254-A. Each of these may be laid at either 90° or 45° to the line of edge restraints. A variation of Stretcher is the Zig-Zag Running Bond, also shown in Annexure C254-A.

C254.03 CHOICE OF PAVER TYPE, SHAPE, CLASS AND LAYING PATTERN

- | | | |
|----|--|-----------------|
| 1. | The choice of concrete or clay segmental paving units, the paver dimensions, class, shape and laying pattern shall be as shown on the Drawings. | Type |
| 2. | If not otherwise specified, concrete paving units for road pavements shall be Shape Type A concrete paving units, 80mm thick, and laid in a herringbone pattern. | Concrete |
| 3. | If not otherwise specified, clay pavers for road pavements shall be Class 4, minimum 65mm nominal thickness, and laid in a herringbone pattern. | Clay |

C254.04 REFERENCE DOCUMENTS

- | | | |
|----|---|---|
| 1. | Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. | Documents
Standards Test
Methods |
|----|---|---|

(a) Council Specifications

- | | | |
|------|---|---------------------------------------|
| C213 | - | Earthworks |
| C224 | - | Open Drains including Kerb and Gutter |
| C241 | - | Stabilisation |
| C242 | - | Flexible Pavements |
| C247 | - | Mass Concrete Subbase |
| C271 | - | Minor Concrete Works |

(b) Australian Standards

- | | | |
|-------------|---|--|
| AS 1141.11 | - | Particle size distribution by dry sieving. |
| AS/NZS 4455 | - | Masonry Units & Segmental Pavers. |

(c) Concrete Masonry Association of Australia Specifications

- | | | |
|-----|---|--|
| T44 | - | Concrete Segmental Pavements - Guide to Specifying. |
| T45 | - | Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads. |
| T46 | - | Concrete Segmental Pavements - Detailing Guide. |

(d) Clay Brick and Paver Institute Specifications

- | | | |
|--------------|---|-----------------------------------|
| Paver Note 1 | - | Specifying and Laying Clay Pavers |
|--------------|---|-----------------------------------|

(e) RTA Specifications

- | | | |
|------|---|--|
| 3204 | - | Preformed Joint Fillers for Concrete Road Pavements and Structures |
|------|---|--|

MATERIALS

C254.05 GENERAL

1. The Contractor shall submit details of all proposed segmental paving materials, including bedding sand and joint filling sand. These details shall be submitted to the Council's Supervising Engineer for approval supported with test results from a nominated NATA registered laboratory, confirming that the constituents comply with the requirements of this Specification.

**Details
Required**

2. No material shall be delivered until the Council's Supervising Engineer has approved the sources of supply. Such approval shall not relieve the Contractor of any responsibility for supplying materials that comply with this Specification.

**Superinten-
dent's
Approval**

C254.06 CONCRETE SEGMENTAL PAVING UNITS

1. Concrete segmental pavers shall comply with the requirements of T44, T45, T46 and AS/NZS 4455 for each area of application.

Specification

2. Unless otherwise indicated, concrete paving units for all road and driveway pavements shall be 80mm thick with a minimum 28 day characteristic compressive strength of 45MPa, as determined in accordance with MA20.

Strength

2. The material requirements for concrete pavers for each application, derived from T44, are shown in Table 254.1.

Requirements

Application	Characteristic breaking load ³ (kN)	Characteristic flexural strength ³ (MPa)	Minimum Thickness (mm)	Shape ⁴ (type)	Dimensional deviations (Category - AS 4455)	Abrasion resistance (mean abrasion index)
Residential Driveways	3	2	No limit	Any	DPA1 or DPB1	7
Light Traffic	5	3	No limit	Any	DPA1 or DPB1	7
Medium Traffic ¹						
Public Footpaths						
Low Volume	5	3	No limit	Any	DPB2	5
High Volume and Pedestrian Malls ¹	5	3	No limit	Any	DPB2	3.5
Roads ⁴						
Minor	5	3	80	Any	DPB2	5
Local and Collector	5	3	80	Any	DPB2	5
Distributor	5	3	80	A	DPB2	5
Industrial Pavements ²	10	4	80	A	DPB3	7

**Table 254.1
Material Requirements for Concrete Segmental Pavers**

SEGMENTAL PAVING

- Notes:
1. Capable of taking occasional 8.2-t axle loads.
 2. The resultant joint width is a combination of paver dimensional deviation and laying procedures.
 3. At 28 days.
 4. Interlocking shapes offer superior performance in road applications.

3. The pavers shall meet the requirements for the relevant application given in Table 254.1 when tested in accordance with the following test methods: **Test Methods**

• characteristic breaking load	AS/NZS 4456.5
• characteristic flexural strength	AS/NZS 4456.5
• Minimum thickness	Not Applicable
• Shape type	Not Applicable
• Dimensional deviations	AS/NZS 4456.3
• Abrasion resistance	AS/NZS 4456.9

C254.07 CLAY SEGMENTAL PAVING UNITS

1. Clay segmental pavers shall comply with the requirements of Part 1 - Specifying Clay Pavers of Paver Note 1 - 'Specifying and Laying Clay Pavers' and with the requirements of AS/NZS 4455. **Specification**

2. The abrasion resistance as determined by the SCC Abrasion Test (Paver Note1) shall conform to the recommended characteristic abrasion losses contained in Paver Note 1. **Abrasion Resistance**

C254.08 BEDDING SAND

1. The bedding sand shall be well-graded sand, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75mm sieve. The bedding sand shall be from a single source or blended to achieve, when tested in accordance with AS 1141.11, the following grading: **Grading**

<u>AS Sieve</u>	<u>% Passing</u>
9.52mm	100
4.75	95 - 100
2.36	80 - 100
1.18	50 - 85
600µm	25 - 60
300	10 - 30
150	5 - 15
75	0 - 10

2. The sand shall be of uniform moisture content when spread. It shall be covered when stored on site to protect it from rain penetration. **Protection**

3. The bedding sand shall be free of deleterious soluble salts or other contaminants that may cause, or contribute to, efflorescence. **Cleanliness**

C254.09 JOINT FILLING SAND

1. The joint filling sand shall be well graded passing a 2.36mm sieve, and when tested in accordance with AS 1141.11, having the following grading: **Grading**

<u>AS Sieve</u>	<u>% Passing</u>
2.36mm	100
1.18	90 - 100

600µm	60 - 90
300	30 - 60
150	15 - 30
75	5 - 10

- The sand shall be dry when spread. It shall be covered when stored on site to protect it from rain penetration. **Protection**
- The sand shall be free of deleterious soluble salts or other contaminants. **Cleanliness**
- Sand used for bedding is not suitable for joint filling.

C254.10 CONCRETE FOR EDGE RESTRAINTS

- Concrete supplied and placed for the construction of edge strips shall comply with Specification C271 - MINOR CONCRETE WORKS. **Specification**
- Unless otherwise indicated on the Drawings, or where kerb and/or gutter provide the edge restraint, the concrete used for edge restraints shall have a minimum 28-day characteristic compressive strength of 32MPa for edge restraints to paving units on road pavements and 25MPa for edge restraints elsewhere. **Strength**

CONSTRUCTION

C254.11 SUBGRADE PREPARATION

- The subgrade shall be formed to the required depth below finished surface level as shown on the Drawings in accordance with Specification C213 - EARTHWORKS. **Levels**
- The finished subgrade foundation for the provision of subbase and/or base shall be subject to the approval of the Council's Supervising Engineer. **Superintendent's Approval**

C254.12 SUBBASE

- Where shown on the Drawings a subbase or working platform shall be constructed in accordance with the relevant Specifications C241 - STABILISATION, C242 - FLEXIBLE PAVEMENTS, or C247 - MASS CONCRETE SUBBASE. **Specifications**
- The subbase shall be constructed to the specified thickness and depth below finished surface level and to the design grade and crossfalls of the finished surface. **Levels**
- The finished subbase shall be subject to the approval of the Council's Supervising Engineer. **Superintendent's Approval**

C254.13 BASE

- The base shall be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the Drawings in accordance with Specification C242 - FLEXIBLE PAVEMENTS. **Levels**
- The base course shall extend in width to at least the rear face of all new edge restraints. **Extent**
- Notwithstanding the finished level tolerances contained within Specification C242 - FLEXIBLE PAVEMENTS for base of $\pm 10\text{mm}$ of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving shall be trimmed to within $+ 10\text{mm}$ or $- 0\text{mm}$ of design levels. The deviation from a 3m long straight **Tolerances**

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edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving shall not exceed 10mm. Sand bedding material shall not be used as a levelling material to compensate for base finishing outside the above tolerances.

4. The finished surface of the base shall drain freely without ponding. **Free Drainage**
5. The finished base shall be subject to the approval of the Council's Supervising Engineer. **Superintendent's Approval**

C254.14 EDGE RESTRAINTS

1. Edge restraints in the form of Kerb and/or Gutter or Edge Strips shall be constructed along the perimeter of all segmental paving as shown on the Drawings. Concrete Kerb and/or Gutter and Edge Strips shall be constructed in accordance with Specifications C224 - OPEN DRAINS INCLUDING KERB AND GUTTER and C271 - MINOR CONCRETE WORKS. **Requirements**
2. Faces of edge restraints abutting paving units shall vertical.
3. Edge restraints shall be supported on compacted base and/or subbase of the thickness as shown on the Drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints shall be 100mm adjacent to road pavements and medians, and 50mm elsewhere. **Support**
4. Unless otherwise shown on the Drawings, contraction joints, 20mm depth shall be formed every 5m of edge restraint length. **Joints**
5. After the concrete has hardened and not earlier than three days after placing, unless otherwise directed by the Council's Supervising Engineer the spaces at the back of the edge restraint shall be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding of design levels. **Back Filling**

C254.15 SAND BEDDING COURSE

1. The sand bedding course shall be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 20-25mm layer following final compaction of the segmental paving. **Allowance Levels**
2. Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and re-screeded before laying paving units. **Depressions**
3. For the manual placing of paving units, the bedding sand shall be maintained at a uniform loose density. For mechanised laying, the bedding sand shall be uniformly and firmly, but not fully, compacted. **Compaction**
4. Screeded sand left overnight or subject to rain shall be checked for level and re-screeded where necessary before paving units are placed. The sand shall not be screeded more than two metres in advance of the laying face at the completion of work on any day. **Screeding**

C254.16 LAYING PAVING UNITS

1. Paving units shall be uniformly placed on the screeded sand bedding to the nominated laying pattern. Paving units shall be placed so that they are not in direct contact with each other and shall have uniform 3mm nominal joint widths. **Joints**
2. The first row shall be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of paving units in the completed pavement. **Sequence**

- | | |
|---|------------------------------------|
| <p>3. In each row, full units shall be laid first. Edge or closer units shall be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of paving units which are smaller in size than one quarter of a full block shall not be used.</p> | <i>Odd Shapes</i> |
| <p>4. Manholes, drainage gullies and similar penetrations through the pavement shall be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.</p> | <i>Penetrations</i> |
| <p>5. Where pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, a joint is to be provided in the pavers. The joint shall consist of 10mm thick preformed joint filler in accordance with RTA Specification 3204.</p> | <i>Formed Joints</i> |
| <p>6. Any foot or barrow traffic shall use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic shall be allowed on the pavement prior to compaction and provision of joint filling sand.</p> | <i>Construction Traffic</i> |
| <p>7. On completion of subsequent bedding compaction and joint filling operations, no more than 10 per cent of joints along any 10 metre line along a major axis of the laying pattern shall have widths outside the range 2-4mm.</p> | <i>Tolerance</i> |

C254.17 BEDDING COMPACTION

- | | |
|---|--------------------------------------|
| <p>1. After laying the paving units the sand bedding shall be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor, which covers at least 12 units. Compaction shall continue until lipping between adjoining units has been eliminated.</p> | <i>Compaction</i> |
| <p>2. Any units, which are structurally damaged during bedding compaction, shall be removed and replaced. The pavement shall then be recompacted for at least one metre surrounding each replacement unit.</p> | <i>Damage</i> |
| <p>3. The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction shall not be attempted within one metre of the laying face except on completion of the pavement against an edge restraint.</p> | <i>Progressive Compaction</i> |
| <p>4. The finished surface level shall not vary from the design level at any point laid in any direction, by more than 6mm. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, shall not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 6mm.</p> | <i>Finished Levels</i> |
| <p>5. The channels formed between abutting chamfered units shall finish with their inverts not less than 5mm nor more than 10mm above adjacent drainage inlets.</p> | <i>Drainage Inlets</i> |
| <p>6. All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.</p> | <i>Joint Filling</i> |

C254.18 FILLING JOINTS

- | | |
|---|-------------------------|
| <p>1. As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming.</p> | <i>Timing</i> |
| <p>2. To ensure complete filling of the joints, both the filling sand and paving units shall be as dry as practicable when sand is spread and broomed into the joints.</p> | <i>Condition</i> |
| <p>3. The pavement shall then receive one or more passes of a plate compactor and the</p> | <i>Process</i> |

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joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

C254.19 PROTECTION OF WORK

1. Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic shall not use the pavement until bedding compaction and joint filling operations have been completed.

Restricted Use

C254.20 OPENING TO TRAFFIC

1. As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area of pavement to assist in the development of 'lock-up'.

No Tracking

2. Excess joint filling sand shall be removed prior to opening to traffic.

Excess Sand

3. The Contractor shall then inspect the pavement at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled.

Inspections

LIMITS AND TOLERANCES

C254.21 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	Base (a) Surface Level	Finished level of base for road pavements to be within +10mm or -0mm of design levels.	C254.13
		Finished level of base other than for road pavements, to be within ± 10 mm of design levels.	C254.13
		The top surface of the base for all segmental paving shall not deviate from a 3m straight edge, laid in any direction, by more than 10mm.	C254.13
2.	Laying Paving Units (a) Joint widths	No more than 10% of joints along any 10 metre line of joints along a major axis of the laying pattern shall have widths outside the range 2 -4mm.	C254.16
3.	Completed Segmental Paving (a) Surface level	Finished surface level of pavers shall not vary from design levels by more than ± 6 mm.	C254.17
		Finished surface of pavers shall not deviate from a 3m straight edge, laid in any direction, by more than 6mm.	C254.17
	(b) Level adjacent to drainage inlets	Invert level of channels between abutting chamfered units shall be not less than 5mm and not more than 10mm above the level of adjacent drainage inlets.	C254.17

Table C254.1 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C254.22 RESERVED

C254.23 RESERVED

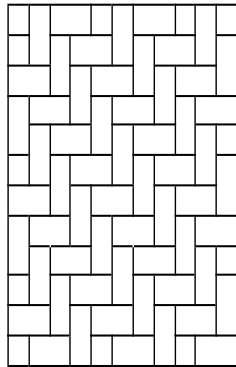
C254.24 RESERVED

C254.25 RESERVED

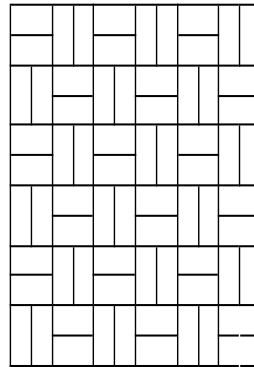
C254.26 RESERVED

ANNEXURE C254-A

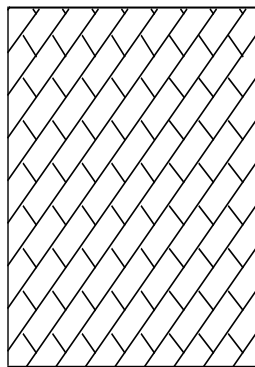
LAYING PATTERNS



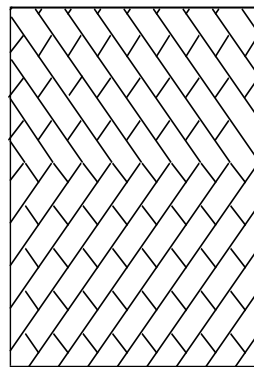
Herringbone



Basketweave



Stretcher



Zig Zag Running Bond

CONSTRUCTION
SPECIFICATION

C255

**BITUMINOUS
MICROSURFACING**

SPECIFICATION C255 : BITUMINOUS MICROSURFACING

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SPECIFICATION C255 : BITUMINOUS MICROSURFACING

GENERAL

C255.01 SCOPE

1. The work to be executed under this Specification consists of the design, supply, mixing and placement of bituminous microsurfacing for surface correction and wearing surface applications on road pavements, carparks, cycleways and footpaths.

2. Bituminous microsurfacing shall consist of a mixture of emulsified polymer modified bitumen binder, mineral aggregate, mineral filler, additives and water proportioned and mixed to form a slurry which is placed and spread evenly on the road surface. It shall be capable of being spread in variably thick layers for surface correction and for wearing surface applications.

Bituminous Slurry

3. The size, nominal thickness and extent of bituminous microsurfacing shall be as shown on the Drawings or as directed by the Council's Supervising Engineer.

Size and Extent

4. For all new works on road and carpark pavements, this Specification should be read in conjunction with Specification C244 - SPRAYED BITUMINOUS SURFACING. For new works on road and carpark pavements, bituminous microsurfacing shall be preceded by the application of a sprayed bituminous seal a minimum of two weeks prior to the application of the bituminous microsurfacing wearing course.

Preceded by Sprayed Bituminous Seal

C255.02 TERMINOLOGY

1. Bituminous microsurfacing is one of two types of bituminous slurry surfacing. It is distinguished from the other type, slurry seals, by the incorporation of polymer and/or other additives to the bituminous binder to improve the performance of the slurry surfacing.

Polymer Modified Binder

2. Bituminous microsurfacing is also commonly known under various proprietary names such as 'cold overlay', 'microsealing', 'paveseal', 'microasphalt', etc.

Proprietary Names

3. The size of the bituminous microsurfacing is based on the nominal largest stone size in the mix. For the purpose of this Specification, the size shall be either Size 5 or Size 7.

Size

C255.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Documents Standards Test Methods

(a) Council Specification

C244 - Sprayed Bituminous Surfacing

(b) Australian Standards

- AS 1141.11 - Particle size distribution by dry sieving
- AS 1141.12 - Material finer than 75 µm in aggregates (by washing)
- AS 1141.22 - Wet/dry strength variation
- AS 1141.23 - Los Angeles value
- AS 1141.25 - Degradation factor - source rock
- AS 1141.42 - Pendulum friction test (PAFV)
- AS 1160 - Bitumen emulsions for construction and maintenance of pavements
- AS 1289.C7.1 - Determination of the sand equivalent of a soil using a power-operated shaker
- AS 2008 - Residual bitumen for pavements

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- AS 2357 - Mineral fillers for asphalt
- AS 2891.3.1 - Bitumen content and aggregate grading (reflux method)

(c) International Slurry Surfacing Association

- ISSA TB 100 - Test method for wet track abrasion of slurry surfaces
- ISSA TB 114 - Wet stripping test for cured slurry seal mix
- ISSA TB 139 - Test method to classify emulsified asphalt/aggregate mixture systems by modified cohesion tester measurement of set and cure characteristics
- SSA TB 144 - Test method for classification of aggregate filler-bitumen compatibility by Schulze-Breuer and ruck procedure

MATERIALS

C255.04 BINDER

1. The binder supplied and used in the works shall be emulsified polymer modified bitumen, formulated to meet the performance requirements of the mix specified in Clauses C255.10 and C255.18. **Polymer Modified Bitumen Emulsion**
2. Prior to emulsification, incorporation of polymer and/or additives, the bitumen shall comply with AS 2008. **Specification**
3. The Contractor shall provide the Council's Supervising Engineer with sufficient information to verify that the binder supplied is the same as that nominated in the mix design. **Verification**

C255.05 MINERAL AGGREGATES

1. Mineral aggregates shall consist of crushed rock or crushed gravel, or a mixture of crushed rock or crushed gravel and natural sand. It shall consist of clean, hard, angular, durable particles, and be free from clay, dirt, organic material or other deleterious matter. **Quality**
2. The aggregate from each source shall comply with the requirements given in Table C255.1. **Aggregate Properties**

Property	Test Method	Requirement
Degradation Factor	AS 1141.25	50 minimum
Los Angeles Value	AS 1141.23	30 maximum
Aggregate Wet Strength	AS 1141.22	150 kN minimum
Wet/Dry Strength Variation	AS 1141.22	30% maximum
Polished Aggregate Friction Value	AS 1141.42	45 minimum
Sand Equivalent	AS 1289.C7.1	60 minimum

Table 255.1 - Aggregate Properties

3. When tested in accordance with AS 1141.11 and AS 1141.12, the aggregate (including mineral filler) shall conform to the grading limits given in Table C255.2. **Grading Limits**

Sieve Size	Percent Passing by Mass	
	Size 5	Size 7
13.2 mm	100	100
9.50 mm	100	100
6.70 mm	100	85-100
4.75 mm	90-100	70-90
2.36 mm	50-70	45-70
1.18 mm	30-50	28-50
600 µm	20-35	19-34
300 µm	12-25	12-25
150 µm	7-18	7-18
75 µm	4-10	5-15

Table C255.2 - Grading Limits for Combined Aggregate/Filler

4. The Contractor shall nominate the source/s of aggregates to the Council's Supervising Engineer, and shall submit NATA certified test reports on the quality and grading of the combined aggregate proposed to be used. **NATA Certification**

5. The Contractor shall submit test results to the Council's Supervising Engineer for each lot/stockpile of aggregate a minimum of seven days prior to incorporation in the works. **7 Days**

C255.06 MINERAL FILLER

1. Mineral filler shall consist of hydrated lime, flyash, portland cement, or other material approved by the Council's Supervising Engineer. **Type**

2. The mineral filler shall be dry, free from lumps and any deleterious material, with a minimum of 85 per cent passing a 75 µm sieve. In all other respects, the mineral filler shall comply with the requirements of AS 2357. **Quality**

3. The quantity of filler added to the bituminous slurry during placement shall not vary by more than 1 per cent from the filler content nominated in the mix design. **Proportion**

C255.07 WATER

1. Water added to the bituminous slurry shall be potable and shall be compatible with the component materials. **Potable**

C255.08 ADDITIVES

1. Details of the type, source and nominal proportions of additives shall be submitted to the Council's Supervising Engineer with the mix design. **Type and Proportion**

C255.09 SAMPLING AND TESTING OF MATERIALS

1. Sampling and testing of materials shall be arranged by the Contractor and carried out by a NATA registered laboratory for the nominated test methods. **Contractor's Responsibility**

2. All costs associated with sampling and testing of materials shall be borne by the Contractor. **Contractor's Costs**

MIX DESIGN

C255.10 MIX PROPERTIES

1. The nominated mix design shall satisfy the properties given in Table C255.3.

Mix Properties

Mix Property	Test Method	Requirement
Wear Loss	ISSA TB 100 1 hour 6 day	540 g/m ² maximum 800 g/m ² maximum
Traffic Time	ISSA TB 139 30 minutes 60 minutes	12 kg.cm minimum 20 kg.cm minimum
Adhesion	ISSA TB 114 or ISSA TB 144	≥ 90% or 11 grade points minimum (AAA, BAA)

Table C255.3 - Mix Properties

C255.11 NOMINATED MIX

1. At least seven days before commencing bituminous microsurfacing work, the Contractor shall submit to the Council’s Supervising Engineer for approval, details of the nominated bituminous microsurfacing mix design for the work. The details shall include the target application rate (m³ of mix/m² of road surface) and the corresponding nominal layer thickness, together with NATA certification and test results demonstrating that the nominated mix and its constituents meet the requirements of the Specification.

Submit for Approval

2. The details of the nominated mix design shall include the following:

Mix Design Details

- (a) Bitumen emulsion content of the mix, and the residual binder content of the emulsion;
- (b) Target combined aggregate/filler grading;
- (c) Proportions of constituent materials used; and
- (d) Type and sources of aggregates, filler and binder.

C255.12 NOT USED

PRODUCTION AND PAVING

C255.13 REQUIREMENTS OF PRODUCTION MIX

1. Bituminous microsurfacing produced in the paving unit at the site shall be known as the 'production mix'.

Production Mix

2. The production mix shall comply with the requirements given in Table C255.4.

Permitted

Variation

Production Mix Properties	Maximum Permitted Variations from Approved Mix (by mass)	
	Size 5	Size 7
Grading*		
Passing 9.50mm AS sieve and larger	Nil	Nil
Passing 6.70mm	Nil	± 7%
Passing 4.75mm	± 6%	± 6%
Passing 2.36mm and 1.18mm	± 5%	± 5%
Passing 0.600mm	± 4%	± 4%
Passing 0.300mm	± 3%	± 3%
Passing 0.150mm	± 2%	± 2%
Passing 0.075mm	± 1.5%	± 1.5%
Residual Binder Content	- 0.5% + 1.0%	- 0.5% + 1.0%
* Notwithstanding, these allowable variations shall not fall outside the limits for design of nominated mix as given in Table C255.2.		

Table C255.4 - Maximum Permitted Variations from Approved Mix

C255.14 PAVING UNIT CALIBRATION

1. The paving unit to be used shall be calibrated for the component materials of the approved mix prior to the commencement of paving. Previous calibration documentation covering the same materials and approved mix shall be acceptable provided that calibration has been carried out within the previous twelve months.

Calibration

2. The documentation shall include an individual calibration for each component material at various settings, which can be related to the paving unit's metering devices.

Documentation

3. No paving unit shall be allowed on the work until the calibration has been completed and approved by the Council's Supervising Engineer.

Approval by Superintendent

C255.15 PREPARATION OF PAVEMENT

1. The existing surface shall be clean and free from any loose stones, dirt, dust and foreign matter. The surface shall be swept beyond the edge of the area to be surfaced by at least 300mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Council's Supervising Engineer.

Clean Pavement

2. Minor surface defects existing in the primer seal or seal shall be repaired to the satisfaction of the Council's Supervising Engineer prior to the spreading of bituminous slurry.

Minor Repairs

3. The Contractor shall take all necessary precautions to prevent the bituminous slurry or other materials used on the work from entering or adhering to kerbs, gutters, driveways, gratings, hydrants, valve boxes, manhole covers, bridge or culvert decks or other road fixtures. After the bituminous slurry has been spread the Contractor shall clean off any such material and leave such gratings, manholes and other road fixtures, in a clean and satisfactory condition.

Protection of Services

C255.16 WEATHER LIMITATIONS

1. Bituminous microsurfacing shall not commence if either the pavement or air

Temperature

BITUMINOUS MICROSURFACING

temperature is below 10°C.

2. Bituminous slurry may be applied when both pavement and air temperatures are above 7°C and rising, or above 10°C. **Temperature**

3. Spreading shall not proceed during rain or when rain appears imminent. **Rain**

C255.17 SPREADING

1. The surface may be pre-dampened if necessary by fogging ahead of the spreader box. Water used for pre-wetting the surface shall be applied so that the entire surface is damp with no apparent flowing water ahead of the spreader box. The application rate of the fog spray shall be adjusted to suit temperature, surface texture, humidity and dryness of the surface being covered. **Water Fog Spray**

2. Bituminous microsurfacing shall be mixed and applied using a purpose built paver. The slurry mix shall be of the desired consistency when deposited in the spreader box, and nothing more shall be added other than minor amounts of water for the purpose of overcoming temporary build-up of slurry in the corners of the spreader box. **Paving Unit**

3. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the resulting mixture shall be conveyed into the moving spreader box at a sufficient rate to always maintain an ample supply across the full width of the strike-off. **Mixing Time and Rate**

4. The strike-off shall be adjusted to provide an application rate that will completely fill the surface voids and provide the nominal application rate of bituminous microsurfacing as scheduled. **Application Rate**

5. After the bituminous slurry has been spread, the Contractor shall ensure that all kerbs, gutters, driveways, gratings, hydrants, valve boxes, manhole covers, etc are uncovered and left in a clean and satisfactory condition. **Clean Services**

6. After the emulsion has broken and the mix is sufficiently stable, rolling shall be carried out using pneumatic tyred rollers to produce a dense, even, homogeneous compacted surface. **Rolling**

7. Bituminous microsurfacing shall be capable of carrying slow moving traffic (<40km/h) within one hour of application without undue permanent damage such as rutting or ravelling occurring. When the time before the slurry is capable of carrying traffic exceeds one hour, work shall cease if so directed by the Council's Supervising Engineer. **Traffic**

C255.18 SURFACE TEXTURE

1. The resulting surface after spreading shall be uniform in appearance and free of areas exhibiting segregation or excessive or insufficient binder. **Uniform Texture**

2. The surface texture shall be demonstrated on a short test run for approval by the Council's Supervising Engineer. If the surface texture is acceptable to the Council's Supervising Engineer, then all subsequent work shall be finished to an equivalent surface texture. **Test Run**

3. Where increased surface texture is required, a fabric skirt may be trailed behind the spreader box. **Increased Texture**

C255.19 JOINTS

1. Longitudinal joints in the wearing course shall be straight and placed at either the edge or the centre of a traffic lane. If necessary, the edges and joints shall be lightly screeded with a hand squeegee to achieve a smooth uniform appearance and to remove excess build-up of material. **Uniform Joints**

C255.20 SAMPLING AND TESTING OF PRODUCTION MIX

(a) Lot Definition

1. Compliance sampling and testing of bituminous microsurfacing shall be undertaken on a lot by lot basis. For this purpose, 50m³ or one day's production (whichever is the lesser), or such smaller quantity which is considered as representative of consistent production of the paving unit, shall be considered as representative of consistent production of the paving unit. **Lots**

(b) Responsibility of Sampling

1. The Contractor shall be responsible for taking samples and shall supply all facilities, equipment and labour for that purpose. **Contractor's Responsibility**

2. The costs associated with taking samples of production mix shall be borne by the Contractor. **Contractor's Cost**

(c) Frequency of Sampling

1. For the testing of production mix, two 1.5kg representative samples of bituminous slurry shall be taken from each lot at random intervals. The samples shall be taken from the discharge to the paving unit and the sample containers immediately sealed. **Mix Samples**

2. For the testing of the binder, two 2L samples of bitumen emulsion shall be taken from each bulk delivery in accordance with AS 1160. **Bitumen Emulsion**

(d) Testing

1. The samples of bituminous slurry shall be treated and tested at a NATA registered laboratory to confirm compliance with Table C255.4. Prior to testing for Residual Binder Content and Aggregate Gradation, as determined by AS 2891.3.1, the samples shall be dried to constant weight in an oven at 60°C for a minimum of 15 hours. **Mix Tests**

2. Each delivery of emulsion shall be tested for residual binder content or accompanied by a certification of specification compliance traceable to the relevant batch at the supplier's storage tank. If testing is required, then one sample of bituminous emulsion shall be tested for Residue from Evaporation in accordance with AS 1160 Appendix D, and the second sample retained as a referee sample. **Emulsion Tests**

C255.21 SHAPE AND LEVELS

1. The finished surface level shall not vary from the design level at any point by more than ± 10mm. Additionally immediately adjacent to any kerb and/or gutter the finished surface level shall not be below nor more than 10mm above the level of the lip of the adjacent gutter. **Level Tolerances**

2. Notwithstanding the above, the deviation from a 3m long straight edge placed anywhere on the top of the finished surface shall not exceed 10mm. **3m Straight Edge**

C255.22 NON-CONFORMANCE OF MATERIALS AND FINISHED SURFACING

1. If any materials supplied fail to conform to the requirements in this Specification or if any section of bituminous microsurfacing fails to conform to the requirements of this Specification - whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted - then such failure or failures shall constitute a 'Non-conformance' under the Contract. Such nonconforming sections of bituminous microsurfacing work shall be either replaced or corrected. **Non-conformance Conditions**

BITUMINOUS MICROSURFACING

2. Materials removed from the site by the Contractor shall be replaced with materials that conform to this Specification.

***Replacement
Materials***

3. The cost of rectifying non-conformances, including any restoration work to any underlying or adjacent surface or structure which becomes necessary as a result of such replacement or correction, shall be borne by the Contractor. Materials removed from the site by the Contractor shall be replaced with materials which conform to this Specification.

***Contractor's
Cost***

LIMITS AND TOLERANCES

C255.23 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C255.5 below.

Item	Activity	Tolerances	Spec Clause
1.	Mineral Aggregate	As per Table C255.1	C255.05
2.	Combined Aggregate/filler	As per Table C255.2	C255.05
3.	Mineral Filler	> 85% passing a 75µm Sieve	C255.06
4.	Mix Properties		
	a) Design properties	As per Table C255.3	C255.10
	b) Permitted variations	As per Table C255.4	C255.13
5.	Surface Preparation	Sweeping shall extend at least 300mm beyond edge of area to be surfaced	C255.15
6.	Weather Limitations	Microsurfacing shall not commence if both air and surface temperature is below 10°C, and shall only commence if both air and surface temperature is above 10°C	C255.16
7.	Shape and Levels		
	a) Finished Levels	Shall not vary at any point by more than + 10mm from design levels. Immediately adjacent to kerb and/or gutters, levels shall not be not more than 10mm from design level	C255.21
	b) Finished Shape	Deviation from the bottom of a 3m straight edge shall not vary by more than 10mm	C255.21

Table C255.5 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C255.24 NOTIFICATION AND PROTECTION OF SERVICES AND ROAD FIXTURES

1. Before commencing site operations, the Contractor shall notify all affected residents, businesses and the Council's Supervising Engineer of the scheduled works.
2. Such notification shall consist of two parts:
 - a. Written notice delivered at least seven days in advance of proposed work; and
 - b. A further written or verbal confirmation delivered not less than 24 hours prior to commencement of work.
3. Such notices shall detail:
 - intended date of commencement;
 - duration of project;
 - hours of work;
 - name of street(s) affected and limits of work;
 - a contact phone number of Contractor's local representative;
 - description of work; and
 - any precautions to be followed by the public.
4. A sample of the proposed written notification for residents and businesses shall be submitted to the Council's Supervising Engineer for approval prior to use. The contractor shall also advise residents, businesses and agencies of any temporary "no parking" conditions and possible delays to traffic movements during the work.

Contractor to Notify

5. The Contractor shall take all necessary precautions to prevent bituminous microsurfacing or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, bridge or culvert decks and other road fixtures. Immediately after the material has been spread the Contractor shall clean off or remove any such material as directed by Council's Supervising Engineer and leave the services and road fixtures in a condition satisfactory to Council's Supervising Engineer.
6. The contractor shall supply and erect their own signs during the work and also supply, erect and maintain all necessary signs after work and be responsible for all relevant signs continuously for a period of at least two (2) weeks or until practical completion of the work to the satisfaction of Council's Supervising Engineer. The Council may erect or maintain signs or additional signs as may be necessary and the cost incurred shall be borne by the contractor. A separate "Traffic Control Plan" for each area of work must be submitted at least seven (7) days prior to commencement of work.
7. Stick and stumps shall be placed on the centre line after the completion of work.

Contractor's Responsibility

255.25 CONTROL OF TRAFFIC

1. The Contractor shall provide for traffic in accordance with the requirements of the Specification for CONTROL OF TRAFFIC while undertaking the work and shall take all necessary precautions to protect the work from damage until such time as the new work has developed sufficient strength to carry normal traffic without damage.
2. The contractor shall supply and erect its own signs during the work and also supply, erect and maintain all necessary signs after work and be responsible for all relevant signs continuously for a period of at least two (2) weeks or until practical completion of the work to the satisfaction of Council's Supervising Engineer. The Council may erect or maintain signs or additional signs as may be necessary and the cost incurred shall be borne by the contractor. A separate "Traffic Control Plan" for each area of work must be submitted at

Provision for Traffic

Delays

least seven (7) days prior to commencement of work.

3. Stick and stumps shall be placed on the centre line after the completion of work.
4. The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work.

C255.26 RESERVED

C255.27 RESERVED

C255.28 RESERVED

CONSTRUCTION
SPECIFICATION

C261

PAVEMENT MARKINGS

SPECIFICATION C261 : PAVEMENT MARKINGS

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SPECIFICATION C261 : PAVEMENT MARKINGS

GENERAL

C261.01 SCOPE

1. The work to be executed under this Specification consists of the setting out, supply and application of pavement marking paint, thermoplastic pavement marking material, pavement marking tape and raised pavement markers as shown on the Drawings and in accordance with this Specification.

C261.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated..

**Documents
Standards Test
Methods**

(a) Council Specifications

C201 - Control of Traffic

(b) Australian Standards

AS 1742.2 - Traffic control devices for general use.
 AS 1906.3 - Raised pavement markers (retroreflective and non-retroreflective).
 AS 2009 - Glass beads for road-marking materials.
 AS 4049.1 - Solvent-borne paint - For use with drop-on beads.
 AS 4049.2 - Thermoplastic road marking materials.
 AS 4049.3 - Waterborne paint - For use with drop-on beads.

C261.03 TYPE OF MARKINGS

1. Details of the various types of pavement markings are generally in accordance with the requirements of as 1742.2.

Standard

C261.04 TYPES OF MATERIALS TO BE APPLIED

1. The materials shall be applied as follows:

**Locations for
Use**

(a) Pavement Marking Paint

Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified.

(b) Thermoplastic Pavement Marking Material

Permanent markings where explicitly indicated on the Drawings.

(c) Pavement Marking Tape

Temporary markings on final wearing surfaces.

PAVEMENT MARKINGS

- (d) Reflective Glass Beads
To be applied to all painted and thermoplastic markings.

- (e) Raised Pavement Markers
To be installed as permanent and temporary markings as shown on the Drawings.

C261.05 MATERIAL QUALITY

- 1. The Contractor shall submit to the Council's Supervising Engineer NATA Registered Laboratory Test Reports, at least seven days before work is scheduled to commence, on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use. **Contractor's Responsibility**

- 2. Only materials conforming to the requirements of the referenced Specifications/Standards shall be used. **Quality Requirements**

C261.06 SETTING OUT

- 1. The Contractor shall set out the work to ensure that all markings are placed in accordance with the Drawings. **Contractor's Responsibility**

- 2. The locations of pavement markings shall not vary by more than 20mm from the locations shown on the Drawings. **Tolerance**

C261.07 SURFACE PREPARATION

- 1. Pavement markings shall only be applied to clean, dry surfaces. The Contractor shall clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement. **Clean Dry Surface**

- 2. Pavement marking shall not be carried out during wet weather or, if in the opinion of the Council's Supervising Engineer, rain is likely to fall during the process. **Wet Weather**

- 3. Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled. **Scabbling**

C261.08 PROVISION FOR TRAFFIC AND PROTECTION OF WORK

- 1. The Contractor shall provide for traffic, in accordance with Specification C201 - CONTROL OF TRAFFIC, while undertaking the work and shall protect the pavement markings until the material has hardened sufficiently so that traffic will not cause damage. **Contractor's Responsibility**

C261.09 MAINTENANCE OF PAVEMENT MARKINGS

- 1. The Contractor shall be responsible for the maintenance, and replacement if necessary, of raised pavement markers and all pavement markings during the contract period and the contract defects liability period. **Responsibility in Contract Period**

PAVEMENT MARKING PAINT

C261.10 MATERIALS

- 1. Paint shall comply with the requirements of AS 4049.1 or AS 4049.3 as directed by **Paint Quality**

the Council's Supervising Engineer. In this Specification, the term 'paint' shall mean 'pavement marking paint'.

2. Glass beads shall comply with the requirements of AS 2009 for drop-on beads. **Glass Beads Quality`**

C261.11 MIXING OF PAINT

1. All paint shall be thoroughly mixed in its original container before use to produce a smooth uniform product consistent with the freshly manufactured product. **Uniform Product**

C261.12 APPLICATION OF PAINT AND BEADS

1. All longitudinal lines shall be sprayed from an approved self-propelled machine. The two sets of lines forming a one-way or two-way barrier line pattern shall be sprayed concurrently. **Longitudinal Lines**

2. Hand spraying with the use of templates to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons. **Hand Spraying**

3. The paint shall be applied uniformly and the wet film thickness shall be neither less than 0.35 mm nor more than 0.40 mm. **Paint Thickness**

4. Glass beads shall be pressure applied to the surface of all longitudinal lines at a net application rate of 0.30 kilograms per square metre immediately after application of the paint. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line. **Beads for Longitudinal Lines**

5. Glass beads shall be applied to all other paint markings at a net application rate of 0.30 kilograms per square metre immediately after application of the paint by a method approved by the Council's Supervising Engineer. **Beads for other Markings**

6. Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement. **Pavement Marking Finish**

7. The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown on the Drawings. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown on the Drawings. **Longitudinal Line Tolerances**

8. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown on the Drawings. **Transverse Line Tolerance**

9. The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall not vary by more than 10mm from the dimensions shown on the Drawings. Arrows and speed markings shall be placed square with the centreline of the traffic lane. **Arrows, Chevrons Tolerance**

C261.13 FIELD TESTING

1. The thickness of the wet film applied to the road pavement shall be checked by the method described in Annexure C261A. **Paint Application**

2. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in Annexure C261B. **Beads Application**

PAVEMENT MARKINGS

Road Speed km/h	Line Widths			
	75mm	100mm	125mm	150mm
8	371	495	619	742
13	603	804	1006	1207
16	742	990	1238	1484

- NOTE:**
1. Tolerance of +10% shall be permissible when measuring the above volume.
 2. When two or more glass bead dispensers are to be used, each dispenser shall be checked separately to make up the totals shown.
 3. Glass beads weigh approximately 1.53 grams per millilitre.

Table 261.1
Volume of glass beads (ml) required in 10 seconds of operation.

THERMOPLASTIC PAVEMENT MARKING MATERIAL

C261.14 MATERIALS

- | | |
|--|------------------------------|
| 1. Thermoplastic pavement marking material shall comply with the requirements of AS 4049.2. | Thermoplastic Quality |
| 2. In this Specification, the term 'thermoplastic material' shall mean 'thermoplastic pavement marking material'. | Definition |
| 3. Glass beads shall be incorporated in thermoplastic material, in the proportion of 10 per cent of the total mass, as part of the aggregate constituent and shall comply with the requirements of AS 2009, Intermix type. | Glass Bead Proportion |
| 4. Glass beads for surface application shall comply with the requirements of AS 2009, Drop-on beads. | Glass Bead Quality |
| 5. Tack coat material shall be to the manufacturer's specification as approved by the Council's Supervising Engineer. | Tack Coat |

C261.15 PREPARATION OF THERMOPLASTIC MATERIAL ON SITE

- | | |
|---|----------------|
| 1. Immediately before application, the thermoplastic material shall be uniformly heated in a suitable oil bath kettle to the temperature recommended by the manufacturer. The thermoplastic material shall not be heated above the temperature recommended by the manufacturer. The thermoplastic material shall not remain molten for more than six hours for hydrocarbon resins and four hours for wood and gum resins. Should over-heating occur and/or the time limit for molten materials be exceeded, then the thermoplastic material shall be discarded. | Heating |
|---|----------------|

C261.16 APPLICATION OF THERMOPLASTIC MATERIAL AND BEADS

- | | |
|---|--|
| <p>1. Where the wearing surface of the pavement is smooth or polished, a tack coat of material may be required by the Council's Supervising Engineer and shall be applied in accordance with the recommendations of the thermoplastic manufacturer. The tack coat shall be applied immediately before the application of the thermoplastic material in accordance with the directions of the manufacturer of the thermoplastic material and the manufacturer of the tack coat material.</p> | <i>Tack Coat Requirement</i> |
| <p>2. All longitudinal lines shall be sprayed from a self-propelled machine approved by the Council's Supervising Engineer. The two sets of lines forming a one-way or two-way barrier line shall be sprayed concurrently. The thermoplastic material shall be applied uniformly and the cold film thickness shall be 1.0 mm with a tolerance of plus or minus 0.2 mm.</p> | <i>Longitudinal Lines</i> |
| <p>3. Glass beads shall be pressure applied to the surface of all longitudinal lines at a net application rate of 0.30 kilograms per square metre immediately after application of the thermoplastic material. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.</p> | <i>Beads for Longitudinal Lines</i> |
| <p>4. All transverse lines, symbols, legends and arrows shall be screeded. The screeded thermoplastic material shall be applied using a mobile applicator, approved by the Council's Supervising Engineer, and templates to control the pattern.</p> | <i>Screed</i> |
| <p>5. The thermoplastic material shall be applied uniformly and the cold film thickness shall be 4.5 mm with a tolerance of plus or minus 1.5 mm. The surface finish shall be smooth.</p> | <i>Tolerance</i> |
| <p>6. Glass beads shall be applied to screeded markings at a net application rate of 0.30 kilograms per square metre immediately after application of the thermoplastic material by a method approved by the Council's Supervising Engineer.</p> | <i>Beads for Other Markings</i> |
| <p>7. Pavement marking shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement.</p> | <i>Pavement Marking Finish</i> |
| <p>8. The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown on the Drawings. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown on the Drawings.</p> | <i>Tolerance</i> |
| <p>9. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown on the Drawings.</p> | <i>Tolerance</i> |
| <p>10. The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall not vary by more than 10mm from the dimensions shown on the Drawings. Arrows and speed markings shall be placed square with the centreline of the traffic lane.</p> | <i>Tolerance</i> |

C261.17 FIELD TESTING

- | | |
|--|---|
| <p>1. The thickness of the cold film of thermoplastic material applied to the road pavement shall be checked by measurement, using a micrometer, of the thickness of thermoplastic material applied to a metal test plate.</p> | <i>Thickness of Thermoplastic Material</i> |
| <p>2. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in Annexure C261B.</p> | <i>Glass Beads Application Rate</i> |

PAVEMENT MARKING TAPE

C261.18 MATERIALS

1. Pavement marking tape shall be a strippable type of tape, such as 'Staymark - Detour Grade', or equivalent tape approved by the Council's Supervising Engineer. **Brands**

C261.19 APPLICATION OF PAVEMENT MARKING TAPE

1. The method of application of pavement marking tape, including surface preparation, shall be in accordance with the manufacturer's recommendations. **Manufacturer's Recommendation**

C261.20 REMOVAL OF PAVEMENT MARKING TAPE

1. When directed by the Council's Supervising Engineer, the Contractor shall remove pavement marking tape in accordance with the manufacturer's recommendations. **Manufacturer's Recommendation**

RAISED PAVEMENT MARKERS

C261.21 MATERIALS

1. Raised pavement markers, both reflective and non-reflective, shall comply with AS 1906.3 and shall have the dimensions shown on the Drawings. **Standard**
2. The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall be an epoxy resin, such as 'Ciba-Geigy Road Epoxy', of appropriate pot life, a hot-melt bitumen adhesive or an equivalent product approved by the Council's Supervising Engineer. **Epoxy Resin**

C261.22 INSTALLATION OF RAISED PAVEMENT MARKERS

1. Raised pavement markers shall be fixed to the wearing surface of the pavement using an epoxy resin type adhesive or a hot-melt bitumen adhesive. Epoxy resin adhesive shall be freshly and thoroughly mixed, shall not have exceeded its working time and shall be used in accordance with the manufacturer's recommendations. Hot-melt bitumen adhesive shall be freshly heated to the Manufacturer's instructions and thoroughly mixed. The adhesive shall not be allowed to cool and be reheated prior to use. **Adhesive Quality**
2. The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10 mm. The raised pavement marker shall be pressed down onto the pavement surface in its correct position and shall be rotated slightly until the adhesive is squeezed out around all edges of the marker. The raised pavement marker shall not be disturbed until the adhesive has set. **Method**
3. On rough surfaces, such as newly laid coarse sprayed bituminous seals, and where directed by the Council's Supervising Engineer, an initial pad of adhesive of diameter 10 mm larger than the diameter of the base of the raised pavement marker, shall be provided. The adhesive shall be applied to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level. The adhesive pad shall be allowed to set. Additional adhesive shall be applied to the underside of the raised pavement marker, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface within the time specified by the adhesive manufacturer to ensure good adhesion. **Rough Surfaces**

REMOVAL OF PAVEMENT MARKINGS

C261.23 GENERAL

- | | |
|---|--------------------------------------|
| 1. The Contractor shall remove pavement markings, no longer required, from the wearing surface of pavements to leave a clean, undamaged pavement with a surface texture and colour comparable to the adjacent pavement surface. | <i>Undamaged
Pavement</i> |
| 2. The Council's Supervising Engineer shall approve the method of removal before commencement of the work. | <i>Removal
Method</i> |

LIMITS AND TOLERANCES

C261.24 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses of this Specification are as follows:

Item	Activity	Tolerances	Spec Clause
1.	Location of Markings	± 20mm from specified location	C261.06
2.	Longitudinal Lines		C261.12
	(a) Length	± 20mm from lengths shown on the Drawings	C261.16
	(b) Width	± 10mm from widths shown on the Drawings	C261.12 C261.16
3.	Transverse Lines		
	(a) Length)	± 10mm from lengths and widths shown on the Drawings	C261.12
	(b) Width)		C261.16
4.	Arrows, Chevrons, Painted Medians, Speed Markings etc.	± 10mm from the dimensions shown on the Drawings	C261.12 C261.16
5.	Application of Paint		
	(a) Film Thickness	>0.35mm <0.40mm	C261.12
6.	Application of Thermoplastic		
	(a) Longitudinal Lines - Cold Film Thickness	1.0mm ± 0.2mm	C261.16
	(b) Transverse Lines, Symbols, Arrows etc. Cold Film Thickness	4.5mm ± 1.5mm	C261.16
7.	Glass Beads		
	(a) Volume used in operation	0.30 kg/sq m + 10%	C261.12 C261.16

Table C261.2 - Summary of Limits and Tolerances

SPECIAL REQUIREMENTS

C261.25 RESERVED

C261.26 RESERVED

C261.27 RESERVED

ANNEXURE C261A

**PROCEDURE FOR MEASUREMENT
OF WET FILM THICKNESS OF PAINT**

1. SCOPE

The following procedure shall be adopted for measuring Wet Film Thickness of paint by means of a wet paint film thickness comb gauge, with measuring range 50 to 500 microns.

2. MATERIAL

The paint shall be a commercial pavement marking paint conforming to the requirements of AS 4049.1 or AS 4049.3.

3. MEASUREMENT

The method of measurement shall be as follows:

- (a) Place the gauge carefully and vertically into the wet film immediately after the wet film has been sprayed or applied onto a metal test panel, of approximate dimension 75mm x 200mm.
- (b) Hold the gauge firmly for between five and ten seconds in the wet film and then withdraw the gauge vertically.
- (c) Determine which of the prongs have been covered with paint. For correct wet film thickness, the paint shall touch the prong of the gauge marked with the specified thickness of paint but shall not touch the prong marked with the next higher thickness.
- (d) Repeat the measurement at 3 locations on the test panel, and calculate the average wet film thickness in microns.

**PROCEDURE FOR MEASUREMENT OF
RATE OF APPLICATION OF SPHERICAL GLASS BEADS**

1. SCOPE

The following procedure shall be adopted for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

2. SPHERICAL GLASS BEADS

The glass beads shall comply with AS 2009.

3. MEASUREMENT

The method of field measurement shall be as follows:

- (a) Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.
- (b) Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level but do not compact the glass beads in the cylinder.
- (c) Compare the volume of glass beads collected with the correct figure given in Table C261.1.

Table C261.1 shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.30 kilograms per square metre for different line widths and road speeds. The glass bead volume figures given in Table C261.1 are calculated for an actual application rate of 0.34 kilograms per square metre. These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line and the volume is measured with beads not compacted.

CONSTRUCTION SPECIFICATION

C262

SIGNPOSTING

SPECIFICATION C262 : SIGNPOSTING

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SPECIFICATION C262 : SIGNPOSTING

GENERAL

C262.01 SCOPE

1. The work to be executed under this Specification consists of:
 - (a) the supply and erection of the Regulatory, Warning, Guide, Information and Direction signs as described in AS 1742, AS 1743, AS 1744 and current RTA Signs and Line Markings Guidelines.
 - (b) the supply and erection of sign support structures to support the signs, and
 - (c) the adjustment of existing signs and sign support structures.

C262.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Council Specifications

C201	-	Control of Traffic
C271	-	Minor Concrete Works
SD119		Street Name Signs

(b) Australian Standards

AS 1163	-	Structural steel hollow sections
AS 1214	-	Hot-dip galvanised coatings on threaded fasteners
AS 1250	-	The use of steel in structures (SAA Steel Structures Code)
AS 1379	-	The specification and manufacture of concrete
AS/NZS 1554.1		Welding of steel structures
AS/NZS 1580.602.2		Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°
AS 1580.108.2	-	Dry film thickness – Paint inspection gauge
AS 1650	-	Hot dipped galvanised coatings on ferrous articles
AS 1734	-	Aluminium and aluminium alloys - flat sheet, coiled sheet and plate
AS 1742	-	Manual of uniform traffic control devices
AS 1743	-	Road Signs - Specifications
AS 1744	-	Forms of letters and numerals for road signs
AS 1866	-	Aluminium and aluminium alloys - extruded rod, bar, solid and hollow shapes
AS 2700	-	Colour standards for general purposes
AS 3678	-	Structural steel - hot-rolled plates, floorplates and slabs
AS 3679.1	-	Structural steel - hot-rolled bars and sections

C262.03 PROVISION FOR TRAFFIC

1. The Contractor shall provide for traffic in accordance with the requirements of Specification C201 - CONTROL OF TRAFFIC while undertaking the work and shall organise the work to avoid or minimise delays and inconvenience to traffic.

**Minimise
Inconvenience**

2. Where a sign is erected before its intended use by traffic and is visible to traffic, the face of the sign shall be completely and securely wrapped in black plastic sheeting or other

**Premature Sign
Exposure**

SIGNPOSTING

opaque covering, until Council's Supervising Engineer directs that the sign shall be uncovered.

MATERIALS

C262.04 GENERAL

1. The Contractor shall advise the names of the proposed suppliers of signs and sign support structures for the concurrence of Council's Supervising Engineer. Only suppliers who have previously established or can now establish their competence to carry out the work in accordance with this Specification shall be used. **Approved Supplier**
2. The Contractor shall supply documentary evidence, satisfactory to Council's Supervising Engineer that all materials and parts proposed for use comply with the requirements of the appropriate Australian Standard(s). **Proof of Quality**
3. Details of the signs and sign support structures to be provided under the Contract shall be as shown on the Drawings. **Details**
4. The dimensions, legend and background for each sign shall be in accordance with this Specification and the Drawings. **Dimensions Legend and Background**
5. Street name signs shall be manufactured and installed in every respect in accordance with the current issue of standard drawing WSC.D1.14 **Street Name Signs**

C262.05 SIGN BLANKS

1. Sign blanks shall be 1.6 mm thick aluminium sheet alloy. The aluminium alloy shall be Type 5251 or Type 5052 and Temper H38 or Temper H36 in accordance with AS 1734. **Aluminium Quality**
2. Sign blanks shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth. The dimensions of the sign blank shall be within plus or minus 1.5 mm of the dimensions specified and the finished sign shall be flat within a maximum allowable bow of 0.5 per cent of the maximum dimension of the sign blank in any direction. **Dimension Tolerances**
3. Sign blanks shall be one piece except where the sign is of such a size as to require more than one full sheet of aluminium in which case a multipiece sign shall be allowed. **Sign Blank**
4. A multipiece sign shall be made up of the minimum number of pieces practical and sheets of the multipiece sign shall be butted together with a maximum gap of 1 mm at any point along the joint. **Multipiece Sign**
5. A backing strip shall cover all joints. The backing strip shall be riveted to each sheet with rivets coloured to match the background material on the face of the sign, at spacings not exceeding 200 mm. Backing strips shall be of the same material and colour as used for the sign blank and shall have a minimum width of 50 mm over the full length of the joint. **Joint Backing Strips**
6. The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements. **Aluminium Extrusion as Backing Strip**
7. The face of each sign blank shall be chemically cleaned and etched or mechanically abraded. Where the sign blank is to receive a paint background, the face shall be spray painted with a compatible etch primer. **Face Treatment**
8. The back of each sign blank shall be uncoated and the surface finish shall be rendered dull and non-reflective either by mechanical or chemical means and shall be free of scratches and blemishes. **Back Treatment**

9. Signs shall be supplied with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the Drawings. *Mounting*

C262.06 ALUMINIUM EXTRUSION BACKING

1. The signs shall include special aluminium extruded sections for mounting purposes. The aluminium shall be Type 6063-T5 in accordance with AS 1866. *Design Section*

2. The aluminium extrusion shall be fixed at the centre spacings as shown on the Drawings and shall be riveted to the sign blank with correctly coloured rivets at a spacing not exceeding 200mm. *Fixing*

C262.07 RETRO-REFLECTIVE MATERIAL FOR BACKGROUND AND LEGEND

1. The retro-reflective material shall be 'Scotchlite', 'Seibulite', 'Kiwalite' or approved equivalent. The background and legend material shall be compatible both in application and durability. *Brand Names*

2. Retro-reflective material shall conform in colour and class to the requirements of AS 1743 for Class 1, Class 2 and Class 2A materials. Unless shown otherwise on the Drawings, the material shall be Class 2. *Standard*

C262.08 NON-REFLECTIVE BACKGROUND MATERIAL

- (a) **Background Paint** *Quality*

1. Background paint shall be an approved long life industrial quality, two-compound polyurethane paint. The paint shall exhibit high standards of adhesion, abrasion resistance, resistance to weathering and colour fastness under widely varying conditions of exposure. The paint shall be compatible with the etch primer used on the sign blank.

2. The paint shall be applied using conventional air spray application to give a uniform cover free of blemishes. A minimum dry film thickness of 38 microns is required when tested in accordance with AS 1580.108.2. *Application*

3. Background paint shall be as specified from one of the following colours: *Colours*

- (i) White - Gloss
- (ii) 'Dark' Green - Matt Colour No G61 as specified in AS 2700.
- (iii) 'Tourist' Brown - Matt Colour No X65, Dark Brown, as specified in AS 2700.
- (iv) 'Dark Grey' - Matt Colour No N64, Dark Grey as specified in AS2700.

4. Exact colorimetric values are set out in AS 2700. *Gloss Levels*

- (i) For matt coatings, the gloss level, determined by AS/NZS 1580.602.2, using an 85° head shall be neither less than 12 per cent of gloss nor more than 15 per cent of gloss.
- (ii) For gloss coatings, the gloss level, determined by AS/NZS 1580.602.2 using a 20° head shall be neither less than 85 per cent of gloss nor more than 95 per cent of gloss.

SIGNPOSTING

(b) Background Sheet Material

Quality

1. Adhesive cast vinyl sheet material such as 'Scotchcal' or other equivalent material approved by Council's Supervising Engineer may be used in place of background paint. The material shall be of uniform density and compatible with the material used for the legend both in application and durability.

2. The colours and gloss levels shall be uniform and conform to the requirements of Clause C262.08 (a).

Colours and Gloss

C262.09 NON-REFLECTIVE MATERIAL FOR LEGEND

(a) Legend Screening Ink

1. Screening ink shall be a high quality, full gloss, non-fade, non-bleed and scratch resistant type of ink compatible with the material to which it is applied. Screening ink shall have durability at least equal to the material to which the screening ink is applied.

Quality

(b) Legend Sheet Material

1. Adhesive cast vinyl sheet material such as 'Scotchcal' or other equivalent material approved by Council's Supervising Engineer may be used in place of screening ink. The material shall be of uniform density and compatible with the material used for the background both in application and durability.

Quality

(c) Colours and Finish

1. The requirements of Clause C262.08 (a) shall also apply to non-reflective materials for legends but additional colours complying with AS 2700 may be specified.

Colours and Gloss

C262.10 RIVETS

1. Each rivet shall consist of a domed head and shank made of aluminium alloy and a steel mandrel, which is discarded after securing the rivet.

Head and Shank

2. A paint coating shall be applied to the domed head so that when the rivet is in position it will show the same colour as the material to which it is attached. Paint may cover the shank of the rivet, providing the coating thickness does not restrict the insertion of the shank into the standard drilled hole for that rivet.

Painted Head

3. The paint shall be alkyd enamel, which shall be applied after an appropriate treatment of the shank of the rivet to ensure long lasting adhesion.

Paint Application

C262.11 REFERENCE MARKINGS

1. All signs shall be clearly and permanently stamped or engraved with an identification coding. The coding shall appear in ciphers of height neither less than 6 mm nor more than 10 mm on the rear of the sign and shall be carried out in such a manner that the front face of the sign is not damaged.

Identification Code

2. For rectangular signs, the coding shall appear as near as practicable to the bottom rear left hand corner. For other shaped signs, the coding shall be positioned on or below the horizontal centre line and as near as practicable to the left hand rear edge.

Location

3. Manufacturers shall include coding information in the following format:-

Information Shown

Manufacturer's Name
Month and Year of Manufacture
Manufacturer and Class of Retro-Reflective Material

C262.12 SIGN SUPPORT STRUCTURES**(a) General**

- | | |
|---|-------------------------|
| 1. Sign support structures shall be fabricated from steel sections, which shall comply with the requirements of AS 1163, AS 3678 and AS 3679.1. | Standards |
| 2. Signs support structures shall be standard round galvanised posts of 50, 65 or 80 mm nominal bore or purpose-designed steel structures as shown on the Drawings and manufactured in accordance with the requirements of AS 1250. | Size |
| 3. Splices in members shall be restricted to a maximum of one splice per member. Splices shall be full penetration butt welds. | Splices |
| 4. All welding shall be as shown on the Drawings and in accordance with the requirements of AS 1554.1, Category GP. | Welding Standard |

(b) Protective Treatment

- | | |
|---|----------------------------|
| 1. Except for standard galvanised posts, all steel components including brackets shall be protected by hot-dip galvanising after all fabrication processes are completed. | Hot-Dip Galvanising |
| 2. The steel components shall be finished by hot-dip galvanising in accordance with AS 1650 to provide a minimum thickness of 100 microns and a bright finished surface free from white rust and stains. | Finish |
| 3. Bolts, nuts and washers and brackets shall be galvanised in accordance with AS 1214. | Bolts, Nuts etc. |
| 4. Splices in standard galvanised posts shall be painted by using a zinc-rich paint in accordance with Appendix G of AS 1650 to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer. | Splices |
| 5. Scratched and slightly damaged surfaces of galvanised coatings shall be renovated by using zinc-rich paint in accordance with Appendix G of AS 1650 to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer. This method of renovation shall be restricted to areas not exceeding 2500 square millimetres. Any structure with totally-damaged coating areas exceeding 2500 square millimetres shall be regalvanised by the Contractor. | Damaged Surfaces |
| 6. The cost of regalvanising such damaged coating areas shall be borne by the Contractor. | Contractor's Costs |

(c) Attachment of Signs

- | | |
|--|------------------------------------|
| 1. Posts and other components shall be provided with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the Drawings. Sign panels shall be attached to each supporting member at each extrusion section or bolt hole in the sign panel. | Typical Systems |
| 2. The Contractor shall submit details of the proposed attachment systems for the approval of Council's Supervising Engineer. | Contractor's Responsibility |

ERECTION OF NEW SIGNS

C262.13 SETTING OUT

1. The location of signs shall be as shown on the Drawings or as directed by Council's Supervising Engineer. The Contractor shall set out the work to ensure that all signs and support structures are placed in accordance with the Drawings or as directed by Council's Supervising Engineer.

Location

2. Signs shall be aligned approximately at right angles to the direction of the traffic they are intended to serve. On curved alignments, the angle of placement should be determined by the course of approaching traffic rather than the orientation of the road at the point where the sign is located.

Alignment

3. The Contractor shall submit details of and set out, for Council's Supervising Engineer's inspection and approval, the proposed location and alignment of each sign support structure.

Contractor's Responsibility

4. Work on the foundations of the sign support structure shall not commence until Council's Supervising Engineer has approved the location and alignment of the sign support structure.

Approval of Council's Engineer

C262.14 CLEARING

1. Any trees and undergrowth within three metres of the sign support structure and along a motorist's line of sight to the front of the sign shall be cleared and removed.

Extent of Work

C262.15 SIGN STRUCTURE FOUNDATIONS

1. The foundations for a simple pipe support or the foundations for each post of a purpose-designed sign support structure shall be constructed in accordance with the Drawings or as directed by Council's Supervising Engineer.

Details

2. The foundation footings shall be neatly excavated to the depth and width shown on the Drawings. The material from the foundation excavation shall be disposed of in a responsible and legal manner.

Excavation

3. When anchor bolt assemblies are specified they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure baseplates to allow adjustment of the structure after installation.

Anchor Bolt Assemblies

4. Steel reinforcement shall be placed as shown on the Drawings.

Steel Reinforcement

5. Concrete in the footings of sign support structures shall comply with Specification C271 - MINOR CONCRETE WORKS and have a minimum compressive strength at 28 days of 20MPa for pipe support footings and 32MPa for purpose-designed support footings.

Concrete Quality

6. If ready mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.

Ready Mixed Concrete

C262.16 ERECTION

- | | | |
|----|---|--|
| 1. | All components shall be accurately positioned and supported during erection. | <i>Position and Support</i> |
| 2. | The top of each post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs. The top of each post shall be below the top edge of the sign panel. | <i>Top of Post Level</i> |
| 3. | For multi-post installations, the tops of the posts shall be at the same level except where the sign shape or the arrangement of sign panels dictates otherwise. | <i>Multi-Post Installation</i> |
| 4. | During erection, sign panels shall be suitably supported and braced and the sign face protected from damage. Signs damaged during erection shall be repaired to a standard equivalent to the original sign or replaced by the Contractor at the Contractor's cost. | <i>Sign Damage</i>
<i>Contractor's Cost</i> |
| 5. | Galvanised coatings which are scratched or slightly damaged during erection shall be renovated by using a zinc-rich paint in accordance with Appendix G of AS 1650 to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer. This method of renovation shall be restricted to areas not exceeding 2500 square millimetres. Any structure with totally-damaged coating areas exceeding 2500 square millimetres shall be regalvanised. | <i>Treatment of Damaged Areas</i> |
| 6. | The cost of regalvanising such damaged coating areas shall be borne by the Contractor. | <i>Contractor's Costs</i> |
| 7. | The Contractor shall advise Council's Supervising Engineer of the date, time and location of each regulatory sign to be placed. | <i>Regulatory Signs</i> |

ADJUSTMENT OF EXISTING SIGNS AND SUPPORT STRUCTURES**C262.17 GENERAL**

- | | | |
|----|---|------------------------------|
| 1. | Where shown on the Drawings and where directed by Council's Supervising Engineer, the Contractor shall adjust existing sign panels and sign support structures. The work shall include minor adjustments of existing sign panels and/or sign support structures or the work may extend to the dismantling of signs and sign support structures, relocation or replacement of sign support structures including foundations and re-erection of signs including all fittings. | <i>Extent of Work</i> |
|----|---|------------------------------|

SPECIAL REQUIREMENTS**C262.18 RESERVED****C262.19 RESERVED****C262.20 RESERVED****C262.21 RESERVED**

LIMITS AND TOLERANCES

C262.22 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	Sign Blanks		
	(a) Dimensions	± 1.50mm	C262.05
	(b) Bow	< 0.5% of maximum dimension	C262.05
	(c) Butt gap in multipiece sign	< 1mm	C262.05
	(d) Rivet spacing in backing strip	< 200mm	C262.05
	(e) Backing strip width	>50mm	C262.05
2.	Extrusion Backing		
	(a) Rivet Spacing	<200mm	C262.06
3.	Background Paint		
	(a) For matt coatings, gloss level	>12% and <15%	C262.08
	(b) For gloss coatings, gloss level	>85% and <95%	C262.08
4.	Reference Marking		
	(a) Height of Coding	>6mm and <10mm	C262.11
5.	Sign Support Structures		
	(a) Protective Treatment thickness	>100 microns	C262.12b
	(b) Paint coating over Splices in standard galvanised posts	>100 microns	C262.12b
	(c) Damaged Surface of galvanised surfaces:		
	(i) Coating with zinc rich paint	Area <2500 sq. mm	C262.12b
	(ii) Regalvanise	Area >2500 sq. mm	C262.12b
6.	Clearing		
	(a) Trees and Undergrowth to be cleared	<3 metres from sign support structure	C262.14
7.	Concrete in Foundations of Sign Support Structures		
	(a) Strength	>25 MPa at 28 days	C262.15

Table C262.1 - Limits and Tolerances

CONSTRUCTION SPECIFICATION

C263

GUIDEPOSTS

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SPECIFICATION C263 : GUIDEPOSTS

GENERAL

C263.01 SCOPE

1. The work to be executed under this Specification consists of the setting out, supply of all materials and erection of guideposts at the locations shown on the Drawings or as directed by Council's Supervising Engineer in areas where streetlighting is not provided.

C263.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Council Specifications

C201 - Control of Traffic

(b) Australian Standards

- AS 1143 - High temperature creosote for the preservation of timber.
- AS 1580 - Paints and related materials - Methods of test.
- AS 1580.101.1 - Air drying conditions.
- AS 1580.481.1.11 Exposed to weathering - Degree of chalking.
- AS 1580.481.1.12 Exposed to weathering - Degree of colour change.
- AS 1580.483.1 - Resistance to artificial weathering (carbon-arc type instruments)
- AS 1580.602.2 - Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°.
- AS 1906.2 - Retroreflective devices (non-pavement application).
- AS 2082 - Visually stress-graded hardwood for structural purposes.

C263.03 MATERIALS

(a) General

1. Guideposts shall be of timber or a flexible (driveable or non-driveable) post conforming to the requirements of this specification. The Contractor shall supply details of the proposed flexible guidepost including the manufacturer's recommended installation procedure, technical specifications and test certificates for consideration by Council's Supervising Engineer.

Posts

(b) Timber Posts

1. Timber posts shall be cut from Select Grade hardwood and conform to AS 2082. All surfaces shall be smooth and free from obvious saw marks.

Quality

2. The posts shall be of rectangular cross-section having dimensions of 100mm x 50mm and shall be 1,400mm in length. The tops of the guideposts shall be sloped so that one 100mm edge is 10mm lower than the opposite edge.

Dimensions

(c) Flexible Posts

1. Flexible guideposts shall be made to a design, and from a material, which provides the properties of strength, flexibility, impact resistance and durability. The material shall be mould resistant, solvent resistant, heat resistant and fire retardant.

Properties

2. The surface of the posts shall have a gloss or semi-gloss white finish. The surface shall be smooth and easily cleaned. **Surface Finish**

3. The flexible posts shall be 1400mm in length and shall have one face of 100mm width. **Dimensions**

4. Flexible posts shall have the following physical properties and performance characteristics when subjected to the referenced tests:

- The composition of the posts shall not vary beyond commercially accepted limits from the composition stated by the manufacturer at the time of tendering. Testing, in accordance with AS 1580.101.1, shall be carried out under standard ambient conditions of temperature $23 \pm 2^{\circ}\text{C}$ and relative humidity 45 per cent to 75 per cent.
- The mass of any individual post shall not vary more than ± 3 per cent from the mass of 20 sample posts.
- Resistance to accelerated weathering - when tested in accordance with AS 1580.483.1, shall be free from crazing and blistering. The degree of chalking and colour change shall not fall below a rating of 6 when tested in accordance with AS 1580.481.1.11 and 12, and the loss of gloss shall not exceed 20 gloss units (egg shell gloss) when evaluated in accordance with AS 1580.602.2.
- Resistance to heat - the post shall be conditioned at $60^{\circ}\text{C} \pm 1\text{C}$ for 2 hours in an oven. The conditioned post shall be bent 180° at the midpoint four times within 2 minutes of removal from oven. The deflection of the top of the post shall be no greater than 50mm, 30 seconds after the fourth bend.
- Resistance to impacts after accelerated ageing - after treatments for a period of 28 days in accordance with Test Method T 1550 the post shall show no evidence of fracture, cracking or splitting, when tested according to Test Method T 1551.
- Resistance to vehicle impacts - the posts shall be manufactured from an impact resistant material and be so designed that an installed post is capable of returning to its original shape and remaining serviceable after being subjected to the following series of direct impacts by a typical passenger sedan at temperatures between 15°C and 30°C :

Posts shall be capable of withstanding a series of 10 bumper bar impacts at 60km/h and 5 bumper bar impacts at 100km/h directed at 90° to the front face of the guidepost. The impacting vehicle shall suffer little or no damage during the impact test series.

The posts to be tested shall be installed in accordance with the recommendations of the manufacturer, and shall be furnished complete with attached delineators.

(d) Metal Posts **Quality**

1. Metal Posts shall be constructed in accordance with the relevant Australian Standard. Guideposts shall be hot dipped galvanised or plastic coated and installed in accordance with the manufacturer's specification.

(e) Delineators **Standard**

1. Corner-cubed delineators, conforming to AS 1906.2 shall be attached to each post.

2. The delineators shall be neither less than 80mm nor more than 85mm diameter. **Diameter**

CONSTRUCTION**C263.04 GENERAL**

1. The Contractor shall at all times conform to the requirements of Specification C201 - CONTROL OF TRAFFIC. **Traffic Control**
2. Where the shoulder is in embankment or at natural surface level, the guideposts shall be placed near the outer edge of the shoulder and at a uniform distance, minimum 1 metre, from the pavement edge. Where the shoulder is located in a cutting, the guideposts shall be placed on the outer side of the table drain, and minimum 1 metre from the pavement edge line, in such a manner as not to impede the flow of water in the drain. **Positioning**
3. Guideposts shall be erected at the locations shown on the Drawings or as directed by Council's Supervising Engineer. **Location**
4. Underground services laid in proximity to the guideposts shall be located prior to erection of posts, and all care shall be taken to not damage such services. **Location of Services**

C263.05 PROTECTIVE TREATMENT OF TIMBER GUIDEPOSTS

1. The portion of the guidepost below ground level shall be dipped in creosote, conforming to AS 1143, heated to 90°C for a minimum period of one hour. **Creosote**
2. All timber above ground level shall be painted with pink primer and any holes, cracks, or other surface imperfections in the timber, shall be stopped with white putty. Painting with a white undercoat and a white enamel-finishing coat shall follow this work. **Painting**
3. Painted surfaces shall be thoroughly dry before a further coat is applied. Paints shall be handled and applied in accordance with the manufacturer's directions. **Dry Surfaces**
4. All paints shall be of the best quality, durable and suitable for exterior application on timber surfaces. **Paint Quality**

C263.06 ERECTION OF GUIDEPOSTS

1. Guideposts shall be set vertically in the ground to a depth of approximately 500mm. In order to offset shoulder irregularities this depth shall be varied so as to give uniform display of guideposts to a height of approximately 900mm above ground level, with the tops evenly graded. Each guidepost shall be erected with the 100mm axis at right angles to the centre line of the road. **Details**
2. Allowance shall be made in the height of guideposts above the ground for the effects of superelevation and other road geometry in order to keep the guideposts within the range of the beam of vehicle headlights. **Vertical Alignment**
3. Backfilling shall be compacted in layers of depth not more than 150mm for the full depth of the guideposts up to ground level. The density of the compacted backfilling shall not be less than that of the adjacent undisturbed ground. Guideposts shall be firm in the ground to the satisfaction of Council's Supervising Engineer. **Backfilling**
4. Flexible guideposts, when installed in the ground in accordance with the recommendations of the manufacturer, shall resist overturning, twisting and displacement from wind and impact forces. **Flexible Guideposts**
5. All necessary steps shall be taken to prevent people and stock from stepping into the post holes during the erection of the guideposts. **Contractor's Responsibility**

C263.07 DELINEATORS

1. 'Corner Cubed' delineators, complying with AS 1906.2, shall be attached to each guidepost using one way, anti-theft screws. In the case of Flexible posts, the delineators shall be glued or otherwise fastened to the post in such a manner that they are not dislodged or rendered inactive under vehicular impact. ***Fixing***
2. The delineators shall be mounted so that the top of the reflector is 50mm below the top of the guidepost. ***Position***
3. The delineators shall be so arranged that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side. ***Arrangement***

SPECIAL REQUIREMENTS**C263.08 RESERVED****C263.09 RESERVED****C263.10 RESERVED**

CONSTRUCTION SPECIFICATION

C264

GUARDFENCE

SPECIFICATION C264 : GUARDFENCE

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SPECIFICATION C264 : GUARDFENCE

GENERAL

C264.01 SCOPE

1. The work to be executed under this Specification consists of the setting out, supply of all materials and erection of guardfence at the locations shown on the Drawings or as directed by Council's Supervising Engineer.

C264.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

C201	-	Control of Traffic
C271	-	Minor Concrete Works

(b) Australian Standards

AS/NZS 1110	-	ISO metric precision hexagon bolts and Screws.
AS 1111	-	ISO metric hexagon commercial bolts and screws.
AS 1143	-	High temperature creosote for the preservation of timber.
AS 1214	-	Hot-dip galvanised coatings on threaded fasteners.
AS 1365	-	Tolerances for flat-rolled steel products.
AS 1391	-	Method for tensile testing of metals.
AS 1594	-	Hot-rolled steel flat products.
AS 1627.1	-	Cleaning using liquid solvents and alkaline solutions.
AS 1627.4	-	Abrasive blast cleaning.
AS 1650	-	Hot-dipped galvanised coatings on ferrous articles.
AS 1906.2	-	Retroreflective devices (non-pavement application).
AS 2082	-	Visually stress-graded hardwood for structural purposes.

Other Standards

Austrroads	-	Guide to Road Design – Part 6 Roadside Design, Safety Barriers
TD 32/89	-	British Department of Transport, Highways and Traffic, Departmental Standard; Wire Rope Safety Fence

MATERIALS

C264.03 STEEL COMPONENTS

1. Posts and blocking pieces shall be mild steel conforming to AS 1594, minimum Grade HU1, to the dimensions as detailed on the drawings. ***Posts***
2. Rail elements and terminal pieces shall be mild steel conforming to AS 1594, minimum Grade HA250, to the dimensions as detailed on the drawings. ***Rails***
3. The mechanical properties of the rail elements and terminal pieces, when tested in accordance with AS 1391, shall conform to the following requirements: ***Tests***

GUARDFENCE

Yield Stress, typical	272 MPa
Ultimate Tensile Stress, typical	372 MPa
Elongation in 80mm, typical	31%

4. The rail elements shall comply with AS 1365 to the following tolerances: **Tolerances**

Metal thickness	2.6mm ± 0.21mm
Mill tolerance on strip width	+2.50mm, -0.0
Mill camber tolerance on 2000mm length	4.0mm max

5. All guardfence components are to be hot-dip galvanised after fabrication in accordance with AS 1650 to Class Z 600. Prior to galvanising, the surfaces shall be treated in accordance with AS 1627.1 and AS 1627.4. **Protection**

6. Splice and post bolts shall comply with AS/NZS 1110 Grade 8.8 and other bolts to AS 1111 Grade 4.6. All bolts, nuts and washers shall be hot-dip galvanised in accordance with AS 1214. **Bolts**

C264.04 TIMBER POSTS

1. Timber posts are to be used only in end panels, as detailed on the drawings. Timber posts and blocking pieces shall be cut from Select Grade hardwood and conform to structural Grade No. 1 of AS 2082. All surfaces shall be smooth and free from obvious saw marks. **Timber**

CONSTRUCTION

C264.05 GENERAL

1. The Contractor shall at all times conform to the requirements of Specification C201-CONTROL OF TRAFFIC. **Traffic Control**

2. Guardfence is to be erected after construction of base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved by Council's Supervising Engineer. **Timing of Construction**

C264.06 ERECTION OF STEEL POSTS

1. Underground cables and ducts laid in the guardfence area shall be located prior to the erection of posts and all care must be taken not to damage such cables and ducts. **Cables and Ducts**

2. Steel posts are to be erected by driving, with the open section pointing in the same direction as adjacent traffic. **Orientation**

3. The face of guardfence posts are to be located 285mm from the edge of shoulder and the top of the post 700mm above the edge or ground level, unless otherwise shown on the Drawings. **Positioning of Posts**

4. Posts shall stand vertical and the spacing shall be such that when the guardfence is erected no post movement is necessary in order to align holes or for any other reason. **Spacing**

5. The posts should be driven to the full depth shown on the Drawings. If this is not possible due to the presence of an underground obstruction, an alternative method of setting the posts, as approved by Council's Supervising Engineer, shall be used. **Underground Obstruction**

6. When erected in position the posts shall be on a smooth line both horizontally and vertically at a height of 530mm (± 10mm) from the nominal level of the pavement at the shoulder line to the centre of the guardfence attachment bolts. On flared ends the level of **Tolerances**

the posts shall be such as to conform to the extended crossfall of the main pavement.

- | | | |
|----|--|---------------------------------|
| 7. | The posts are to be firm in the ground to the satisfaction of Council's Supervising Engineer. | <i>Firmness</i> |
| 8. | The posts shall not have any obvious deformation as a result of driving. Any damage, which occurs to the posts, is to be repaired within 24 hours using an approved cold galvanising compound. | <i>Damage to Posts</i> |
| 9. | Any post, which has been excessively damaged, will be rejected and shall be replaced by the Contractor at its own expense.. | <i>Contractor's Cost</i> |

C264.07 ERECTION OF TIMBER POSTS

- | | | |
|----|--|-----------------------------------|
| 1. | Timber posts shall be cut to the dimensions shown on the Drawings. | <i>Dimensions of Posts</i> |
| 2. | The surface area of the posts that will be in the ground shall be painted with creosote, conforming to AS 1143, prior to erection. | <i>Creosote Treatment</i> |
| 3. | The section of the timber posts in the ground shall be wrapped in 6mm thick polystyrene foam sheeting before being cast into a reinforced concrete footing. | <i>Polystyrene Foam</i> |
| 4. | Concrete used in the footings for timber posts shall have a minimum compressive strength of 20MPa at 28 days and shall conform to the requirements of Specification C271 - MINOR CONCRETE WORKS. | <i>Concrete</i> |
| 5. | Concrete footings shall be 500mm diameter, and shall have tolerances of minus zero or plus 50mm. Overbreak and excessive depth shall be filled with 20MPa concrete at no cost to the Principal. | <i>Footing Size</i> |
| 6. | Wire fabric reinforcing shall be as detailed on the Drawings. | <i>Reinforcing Fabric</i> |
| 7. | The surface area of the posts that will be above ground shall be painted with two coats of grey acrylic paint. | <i>Painting</i> |

C264.08 ERECTION OF GUARDFENCE PANELS

- | | | |
|----|--|---|
| 1. | Steel blocking pieces are to be erected with the open section pointing in the same direction as adjacent traffic. | <i>Orientation</i> |
| 2. | All rail laps shall be in the same direction as adjacent traffic. | <i>Rail Laps</i> |
| 3. | Backing/stiffening pieces, 300mm long, shall be used on intermediate posts. | <i>Backing Pieces</i> |
| 4. | Guardfence panels and steel blocking pieces are to be handled and erected in such a manner that no damage occurs to the galvanising. Any minor damage occasioned to the galvanising shall be repaired within 24 hours using an approved cold galvanising compound. | <i>Minor Damage to Galvanising</i> |
| 5. | Any guardfence panels or steel blocking pieces that have been excessively damaged shall be rejected and shall be replaced by the Contractor at its own expense.. | <i>Contractor's Cost</i> |
| 6. | Guardfence attachment bolts and splice bolts are to be tightened initially such that the fence can be erected. Adjustments are then to be made to the rails using the slotted holes provided to produce a smooth regular line, free of any kicks or bumps. The overall line of the top of the guardfence panels is to visually conform to the vertical alignment of the road pavement. | <i>Erection Procedure</i> |

GUARDFENCE

7. When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head (not the shoulder) should be in full bearing with the rail. The recess in the nut should face the bolt shoulder; otherwise the splice will not be tight. **Splices**

C264.09 END TREATMENT OF GUARDFENCE

1. For undivided carriageways, both approach and departure ends of the guardfence shall be flared and end anchorage panels with terminal sections Type A shall be constructed as detailed on the Drawings. **Undivided Carriageway**
2. For divided carriageways, the approach end of the guardfence shall be flared and end anchorage panels with terminal sections constructed. The departure end of the guardfence shall be as specified in the R.T.A. Road Design Guide and as detailed on the Approved Drawings. **Divided Carriageway**
3. The approach and departure ends of double sided guardfences shall have end panels as specified in the R.T.A. Road Design Guide and as detailed on the Approved Drawings. **Double Sided Guardfence**

C264.10 DELINEATORS

1. Where shown on the Drawings, delineator brackets shall be attached to the centre of the guardfence under the special washer of the post bolt of the first post and then in accordance with the following table: - **Spacing**

<u>Radius of Curve</u>	<u>Spacing of Reflectors on Guardfence</u>
m	every
30 - 90	3rd post
90 - 180	5th post
180 - 275	8th post
275 - 365	11th post
over 365	16th post

(including straight road)

2. Circular corner cube delineators, complying with AS 1906.2 shall be fixed to the brackets.
3. The delineators shall be so arranged that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.

WIRE ROPE SAFETY FENCE

C264.11 GENERAL

1. Wire rope safety fence may be used in selected applications with the prior approval of the Council's Supervising Engineer. **Locations**

C264.12 EXCAVATION

1. Excavations for concrete post foundations and anchor blocks shall have vertical sides and be formed to the line and level described in the Drawings.

C264.13 POST FOUNDATIONS AND ANCHOR BLOCKS

- | | |
|--|--|
| <p>1. Precast concrete post foundations shall be installed on a firm level base. Any lateral overbreak of the excavation shall be filled with concrete in accordance with specification C271 - MINOR CONCRETE WORKS</p> | <p>Precast Post Foundations</p> |
| <p>2. In-situ concrete post foundations and anchor blocks shall be constructed using concrete in accordance with specification C271 - MINOR CONCRETE WORKS. Temporary formwork shall be used where the sides of excavations cannot be kept vertical for in-situ concrete post foundations and anchor blocks. The formwork shall be installed immediately after excavation. Any lateral overbreak of the excavation shall be filled with concrete in accordance with specification C271 - MINOR CONCRETE WORKS</p> | <p>In situ Post Foundations</p> |
| <p>3. All anchor frames, check posts, posts, sockets and reinforcing rings shall be positioned to the line and levels described in the Drawings and they shall be secured against displacement during placing of the concrete.</p> | <p>Positioning</p> |
| <p>4. Concrete shall be compacted using internal vibration and shall be thoroughly worked around any embedded metal and into corners of formwork or excavations to produce a dense mass substantially free from voids and in such a manner as to prevent segregation. Immediately on completion of compaction exposed surfaces shall be covered for a minimum period of 7 days (unless the Council's Supervising Engineer agrees a shorter period) by covering with impermeable sheeting set to prohibit excess loss of moisture. The sheeting shall be removed at the end of the curing period. Formwork shall be struck without damage to the concrete not less than 7 days after placing the concrete. Formed and unformed surfaces shall be free from voids, honeycombing or other defects. Small blemishes caused by entrapped air or water are acceptable.</p> | <p>Concrete Placement</p> |

C264.14 POSTS

- | | |
|--|--------------------------------------|
| <p>1. Posts shall be installed so that:</p> <ul style="list-style-type: none"> a. The alignment on plan of the completed fence does not deviate by more than ± 30mm at any point from that detailed in the Drawings; b. The alignment in elevation of the tops of the fence posts does not deviate in any 10m length by more than ± 10mm from that detailed in the Drawings c. The radiused edges of posts are presented to the direction of traffic flow | <p>Installation Alignment</p> |
| <p>2. Driven line posts shall be installed to the levels detailed in the Drawings without damage to the slot in the top of the post</p> | <p>Driven Posts</p> |
| <p>3. Surface mounted posts shall be installed in accordance with the details given in the Drawings.</p> | <p>Surface Mounted Posts</p> |
| <p>4. No drilling, cutting or welding of posts shall be permitted without the prior approval of the Council's Supervising Engineer. Excluders shall be fitted on all line posts installed in sockets.</p> | <p>No Post Modifications</p> |

C264.15 LOADING TEST OF POST FOUNDATIONS

- | | |
|--|---|
| <p>1. Where directed by the Council's Supervising Engineer, the Council's Supervising Engineer will carry out loading tests of post foundations installed by the Contractor for this purpose. Details of the locations where testing will be required, the foundation type and the number of foundations to be tested shall be advised by the Council's Supervising Engineer.</p> | <p>Requirement</p> |
| <p>2. Unless otherwise agreed by the Council's Supervising Engineer, the Contractor shall install the posts and foundations required for tests prior to installation of the relevant length of safety fence and after completion of all earthworks. On completion of the tests, the Contractor shall remove the test posts and foundations and reinstate the earthworks unless otherwise directed by the Council's Supervising Engineer.</p> | <p>Testing and Reinstatement</p> |

GUARDFENCE

3. The Contractor shall make available to the Council's Supervising Engineer a vehicle of not less than 5 tonnes for the Council's Supervising Engineer's use while carrying out the loading tests. The Contractor shall establish and maintain all necessary traffic management procedures and safety measures during installation, test loading and removal of the test posts and foundations.

Test Vehicle

4. All costs associated with the installation, testing and removal of test posts and foundations shall be at the Contractor's expense

Contractor's Cost

C264.16 ROPES

1. The ropes shall be installed to the layouts shown on the contract drawings, also to TD32/89 Drawings WR/01, WR/07, WR/11, WR/12, WR/13 and to the following requirements:

Rope installation

- a. The two lower line ropes shall be placed on the hooks of each deflection post, interwoven between successive line posts and finally positioned on the hooks of each line post;
- b. The two upper line ropes shall be placed in the slot of each post;
- c. Ropes shall be joined by rigging screws with a thread engagement of not less than 25mm;
- d. One end of each tail rope shall be connected to an anchor frame in the anchor block and shall be fitted with a safety check rope which shall be connected to the attachment plate;
- e. The length of line rope between any anchors shall be not greater than 627m;
- f. Two ropes, one upper and one lower, shall be terminated at each intermediate anchor.

C264.17 TENSIONING

1. All rigging screws on each line rope shall be adjusted equally to achieve the tension given in Table C264.1 appropriate to the ambient temperature which shall be agreed with the Council's Supervising Engineer. The tension in each rope shall not deviate along its length by more than $\pm 0.5\text{kN}$ from the agreed tension, at the time of installation measured using a tension indicating device approved by the Council's Supervising Engineer.

Temperature Correction

2. Prior to putting the safety fence into service the tension in each rope shall be checked and shall be retensioned if necessary to comply with the requirements of Table C264.1.

Tension to be Checked

Ambient Temperature °C	Rope Tension kN
-10	36.0
-5	33.25
0	30.5
5	27.75
10	25.0
15	22.25
20	19.5
25	16.75
30	14.0

Table C264.1 - Relationship Between Rope Tension and Ambient Temperature

LIMITS AND TOLERANCES

C264.18 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	Vertical Alignment (a) Nominal shoulder line level to centre of guardfence attachment bolts	530mm ± 10mm	C264.06
2.	Concrete Footings (a) Diameter	500mm -0mm or +50mm	C264.07
3.	Wire Rope Posts (a) Plan alignment (b) Vertical alignment of post tops	± 30mm ± 10mm in any 10m length	C264.14

Table C264.2 - Limits and Tolerances

SPECIAL REQUIREMENTS

C264.19 RESERVED

C264.20 RESERVED

C264.21 RESERVED

CONSTRUCTION SPECIFICATION

C265

BOUNDARY FENCING

SPECIFICATION C265 : BOUNDARY FENCING

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SPECIFICATION C265 : BOUNDARY FENCING

GENERAL

C265.01 SCOPE

1. The work to be executed under this Specification includes setting out, clearing of fence line, supply of material and erection of boundary fencing and gates, in accordance with the Drawings or as directed by Council's Supervising Engineer.

C265.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents
Standards Test
Methods***

(a) Council Specifications

- C212 - Clearing and Grubbing
- C271 - Minor Concrete Works

(b) Australian Standards

- AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio
- AS 1725 - Galvanised Rail-less Chainwire Security Fences and Gates
- AS 1742.2 - Traffic Control Devices for General Use
- AS 2423 - Galvanised Wire Fencing Products

MATERIALS

C265.03 GENERAL

1. All materials shall conform to AS 2423, shall be supplied by the Contractor and shall be of dimensions, manufacture and quality in accordance with the requirements of this Specification.

***Dimensions
and Quality***

2. For each type of material to be supplied, the Contractor shall submit to Council's Supervising Engineer for approval the source, manufacturer and also the type if applicable.

***Details to be
Provided***

3. No materials shall be used until approved by Council's Supervising Engineer.

***Approved
Materials***

C265.04 GALVANISED POSTS AND BRACES

1. All posts and bracing shall be galvanised iron pipe in accordance with AS 1725. The pipes shall be to the dimensions shown on the Drawings.

Dimensions

2. All pipe joints shall be welded. All welds shall be satisfactorily cleaned and painted with a cold galvanising compound to the satisfaction of Council's Supervising Engineer.

Welded Joints

BOUNDARY FENCING

C265.05 CHAIN WIRE

1. Galvanised chain wire mesh, 1,450mm wide (1830mm wide for Manproof Fencing) shall be of 3.15mm diameter wire woven to a 50 x 50mm square mesh. The selvedge edges of the chain wire shall be left barbed, and it shall be supplied in lengths of not less than 30m. The zinc coating shall be uniform, continuous, free from imperfections and thoroughly adherent. The coating shall be applied to the wire before the mesh is woven. The weight of the zinc coating shall not be less than 290 grams per square metre of wire surface.

**Dimensions
and Zinc
Coating**

C265.06 WIRE NETTING

1. Wire netting shall be standard quality galvanised 1.40mm diameter wire, 40mm mesh, 1.05m wide for normal use and 1.60mm diameter wire, 50mm mesh, 0.90m wide where used in creek crossings.

Dimensions

C265.07 GATES

1. Gates shall be of galvanised tubular steel construction, 3.6 metres in width by 1.5 metres or 1.2 metres (as specified) in height, and shall be fitted with substantial hinges, catch, drop bolts and locking chains unless otherwise shown on the Drawings or directed by Council's Supervising Engineer.

**Dimensions
and Fittings**

2. Where required, gates shall have stout and well supported, rabbit-proof mesh, to a height of at least 900mm above ground level.

**Rabbit
Proofing**

C265.08 REINFORCED CONCRETE POSTS

(a) Strainer Posts

Dimensions

1. Concrete strainer posts shall be approximately 150 x 150 square in section. Each post shall be provided with 12mm diameter holes to suit the spacing of the wires as shown on the Drawings for the particular type(s) of fencing to be erected.

2. The posts shall be reinforced longitudinally with not less than four reinforcing bars each 12mm diameter. All posts shall have suitable stirrup reinforcement to control diagonal cracking. Longitudinal reinforcement shall have 25mm minimum cover. End cover on reinforcement shall be 25mm.

**Reinforcing
Steel**

3. The concrete shall have a minimum 28-day compressive strength of 20MPa.

**Concrete
Strength**

(b) Intermediate Posts

1. Intermediate Posts shall generally conform to the requirements for Strainer Posts, except that the longitudinal reinforcing bars may be 9mm diameter.

Quality

C265.09 PRESTRESSED CONCRETE POSTS

(a) Strainer Posts

1. At least four longitudinal high carbon deformed high tensile strands (or equivalent) of 5mm diameter, shall be provided. The strands shall be tensioned to a stress of 800MPa minimum prior to placing concrete. Cross sectional dimensions of the posts shall be as shown on the Drawings.

Tendons

2. Concrete shall have a minimum compressive strength of 32MPa at 24 hours.

Concrete

3. In lieu of holes for wires, grooves may be provided to suit the spacing of the wires shown on the appropriate Drawings for the particular types of fencing to be erected. The grooves shall be at least 5mm deep and 5mm wide at the surface of the post. **Grooves for Wire**

(b) Intermediate Posts

1. Intermediate posts and strainer stays shall generally conform to the requirements for Strainer Posts except that two only high tensile, high carbon deformed strands shall be required. **Quality**

2. Cross sectional dimensions shall be as shown on the Drawings. **Dimensions**

C265.10 STEEL POSTS (RURAL FENCING)

1. Steel posts shall be "STAR" pattern. Posts shall be drilled to suit the spacing of the wires shown on the Drawing(s), and shall be black varnished or galvanised. **Type**

2. The total weight of 300 posts each 1.65m long shall be at least one (1) tonne. **Weight**

C265.11 GALVANISED PIPE POSTS (RURAL FENCING)

1. Galvanised pipe posts shall be used where shown on the Drawings. The pipes shall be of the dimensions shown on the Drawings and shall be of first grade quality in accordance with AS 1725. **Dimensions and Quality**

C265.12 WIRES

(a) Plain Wire

1. Plain wire shall be standard galvanised drawn annealed steel wire of diameters shown on the Drawings. **Type**

(b) High Tensile Plain Wire

1. High Tensile wire shall be galvanised. **Type**

(c) Barbed Wire

1. Barbed wire including barbs shall be 2.5mm diameter galvanised drawn annealed steel wire, with clusters of four barbs spaced at 90mm maximum. Alternatively barbed wire may be of 1.6mm diameter high tensile steel wire, with clusters of barbs spaced at 90mm maximum. **Type and Dimensions**

(d) Cable Wire

1. Cable wire shall consist of three pairs of 2 x 3.15mm galvanised iron wire tightly twisted around posts and located as shown in the Drawings. **Type and Dimensions**

(e) Tie Wire

1. The wire shall be 2 mm diameter galvanised wire. **Type and Dimensions**

BOUNDARY FENCING

C265.13 CONCRETE BACKFILLING

1. All concrete backfilling of post holes specified on the Drawings shall be of minimum 20MPa 28-day compressive strength and shall conform to the requirements of Specification C271 - MINOR CONCRETE WORKS. **Specification**

CONSTRUCTION

C265.14 GENERAL

1. Boundary fencing shall be erected prior to the commencement of other work on a particular section of the work, unless directed otherwise by Council's Supervising Engineer. **Construction Priority**
2. All fencing shall be erected in a workmanlike manner, and when completed shall be sound, strong and of neat appearance. **Quality**
3. For a clear width of one metre on either side of the fence line, and for the full length of the line, all logs, boulders, stumps, roots, undergrowth and rubbish shall be removed and disposed of by the contractor in accordance with Specification C212 - CLEARING AND GRUBBING. Trees within this area shall be removed only as directed and approved by Council's Supervising Engineer. **Clearing**
4. If trees on or adjacent to the fence line are to be retained the arrangement of the fencing at the trees shall be as directed by Council's Supervising Engineer. **Trees Retained**
5. Wire shall not be strained around or against any trees to be left in the fence line, and strainer posts are to be provided on both sides of each tree. **Trees on Fence Line**
6. Where minor irregularities occur in the ground the vertical alignment of the fence shall not follow these irregularities, but shall be aligned to a uniform grade between definite changes in the natural slope of the ground. **Uniform Grade**
7. All survey pegs shall be left undisturbed and the post spacing shall be altered slightly where necessary to avoid pegs. **Survey Pegs**
8. The Contractor shall maintain the fencing at all times in a condition secure against the ingress or egress of stock, and shall take such precautions as are necessary to prevent people or stock from stepping into holes excavated for the construction of fencing. **Stock Proof**
9. Where old fencing is to be replaced by new fencing, all holes left after removal of the old fencing shall be backfilled and rammed firmly in layers of maximum depth 150mm. **Backfilling of Old Holes**
10. The Contractor shall be held responsible for any loss, damage or injury to buildings, goods, crops, livestock, and property of any kind or to persons due to negligence on his part. **Contractor's Responsibility**

C265.15 CHAIN LINK FENCING

(a) Erection of Posts

1. All posts shall be erected vertically and set in concrete blocks approximately 250mm diameter and 600mm deep except for end, corner, strainer and gate posts which shall be set in concrete blocks approximately 250mm diameter and 900mm deep unless otherwise shown on the Drawings. Concrete shall have a minimum compressive strength of 20MPa at 28 days and shall conform to the requirements of Specification C271 - MINOR CONCRETE WORKS. **Concrete Blocks and Quality**
2. Galvanised weather caps shall be fitted to all galvanised posts. **Weather Caps**

3. Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. Distances between strainer posts shall not exceed 120 metres.

Strainer Posts

(b) Erection of Wire

1. All wire shall be spaced as shown in the Drawings. Wire shall be securely fastened and strained to an even tension between strainer posts.

Fasten and Strain

2. Where specified, or shown on the Drawings, chain wire mesh shall be erected on the outside of the posts and fastened with two turns of the wire to each cable wire on both sides of each post and at intervals of not more than 900mm between posts and to each post midway between cable wires.

Chain Wire Mesh

C265.16 STOCK-PROOF FENCING

(a) Erection of Posts

1. All posts shall be erected vertically. Reinforced concrete posts shall be erected in neatly cut holes sunk in earth or in rock where rock is encountered. Steel posts, except where placed in rock, shall be driven with suitable driving equipment. Care shall be taken not to damage the tops of the posts during driving.

Method

2. Where prestressed posts are proposed for use, they shall be either erected as for reinforced concrete posts or shall be driven. Where driven, the Contractor shall use a suitable post driver which shall be equipped with two (2) sets of guiding rollers, to hold the post vertical and in position during driving.

Driving Prestressed Posts

3. A steel cap with a plywood cushion shall be used to protect the top of the post during driving.

Protection Cap

4. If the post cannot be driven for the full depth specified, or if it becomes significantly damaged, or cannot be driven vertically, it shall be removed. The same post if undamaged, or a new post, shall be erected as described for reinforced concrete posts.

Removal of Posts

5. Posts shall be sunk to the depths shown in Table C265.1.

Type of Post	Depth	
	Earth	Rock
Concrete Corner Posts & Strain Posts	900	*600
Concrete Intermediate Posts	600	*450
Steel Posts	450	450
Note* Permitted only in cases where posts of the correct length are provided (see below), otherwise the depth of sinking shall be the same as for earth.		

Table C265.1 - Post Depth in Ground

BOUNDARY FENCING

6. Cutting of concrete posts will not be permitted, and in order to take advantage of the lesser depth of sinking permitted in rock, it will be necessary to use posts manufactured in lengths to suit the depth of sinking. Where rock is met, steel posts shall be sunk in drill holes of sufficient diameter to permit them to be refilled with cement mortar consisting of one part of cement to two parts of clean sand. **Variations to Post Length**
7. Earth shall be backfilled around intermediate posts in layers of maximum depth 150mm for the full depth of the hole and up to ground level. The relative compaction of the rammed material shall be not less than that of the original undisturbed ground. **Backfilling at Intermediate Posts**
8. Where concrete posts are placed in rock, the space around the posts shall be tightly filled with cement mortar consisting of one part of cement to two parts of sand, or concrete where this is available. **Mortar Backfill**
9. Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. These posts shall be backfilled with approved concrete to their full depth. **Strainer Posts**
10. Distances between strainer posts shall not exceed 120m in the case of fencing using steel intermediate posts, and 90m in the case of fencing for the retention of cattle (for which only concrete posts are permitted). Junctions with existing fencing shall be made in an approved manner. **Spacing of Posts**
- (b) Erection of Wires**
1. All wire shall be placed as shown on the Drawings. Wires shall be securely fastened and strained to an even tension between strainer posts with an approved wire strainer. Where barbed wire is to be used, it shall be tied in position at the top of intermediate posts, and where additional barbed wires are called for they shall be secured to the sides of the posts as shown on the Drawings. **Fastening and Straining**
2. Where concrete posts are used and the barbed wires are secured either to the tops or sides of the posts by tie wire, the tie wire shall be stretched tight and shall fit snugly against the sides of the posts to prevent movement of the barbed wire. **Barbed Wire**
3. Where prestressed posts are used, wires shall be securely tied so that they seat firmly in the grooves. **Prestressed Posts**
4. All joints in wires shall be as shown on the Drawings. **Wire Joints**

C265.17 RABBIT-PROOF FENCING

(a) General

1. Wire netting shall be erected on the side of the fence remote from the roadway in the case of road reserve boundary fences. In other cases netting shall be erected on the side which Council's Supervising Engineer shall direct. **Netting Position**
2. The netting shall be erected so that there is a 200mm lap laid on the ground surface, or trenched 215mm into the ground as shown on the Drawings for the type of fence to be erected. **Lap/Trench**
3. Netting shall be tied with tie wire or fixing clips. The Contractor shall not proceed with tying netting until Council's Supervising Engineer approves the proposed method of tying, and the materials to be used. **Fixing of Netting**
4. The netting shall be loosely tied to fence wires then carefully strained without disturbing or breaking the mesh, and shall then be tied to the wires immediately on each side of the post and at intervals not exceeding 1.00m. **Straining and Tying**

5. At each strainer post strut, additional netting shall be attached to the fence adjacent to the strainer post, to a height of 450mm above the strut. ***Additional Netting***

C265.18 CROSSING OF WATERCOURSES AND DEPRESSIONS

1. The crossing of all watercourses and depressions shall be made secure by longer posts, suitably strutted as directed by Council's Supervising Engineer. Additional cable wire and chain wire/wire netting shall be provided as necessary to make the fence stock proof. ***Marsupial Proof***
2. The fence shall allow the passage of floodwater without the accumulation of debris. If directed by Council's Supervising Engineer, floodgates shall be provided in accordance with Clause C265.20. ***Floodwater***

C265.19 CONNECTIONS TO EXISTING FENCES

1. Existing cross fences shall be connected to the new fence using a strainer post with braces in each direction of strain (including cross fence) and the wires in both fences properly fastened to the post. ***Strainer Posts***

C265.20 FLOOD GATES

(a) General

1. Suitable provision for the passage of floodwaters past the fence shall be made at all watercourses. In all cases floodgates shall be of the type indicated on the Drawings, or as directed by Council's Supervising Engineer, and shall be erected so as to prevent the accumulation of flood debris, while remaining stock-proof or rabbit-proof. ***Requirements***

(b) Small Watercourses

1. Flood gates, in accordance with the Drawings, shall be provided in small gullies at the locations indicated on the Drawings or as directed by Council's Supervising Engineer. The opening of each floodgate shall provide a waterway area at least twice that of the culvert opposite to which it is placed, or as otherwise directed by Council's Supervising Engineer. ***Waterway Area***

(c) Large Gullies and Creeks

1. Flood gates, in accordance with the Drawings, shall be provided in gullies and creeks at the locations indicated on the Drawings, or as directed by Council's Supervising Engineer. ***Location***
2. A 9mm galvanised wire rope shall be carried over the gully in one span, threaded through a strainer post and tied back to an anchor at an adjacent concrete intermediate post. Turnbuckles are to be provided at each end to tension the wire rope. Netting shall be suspended from the wire rope and shall be overlapped and securely tied. The netting shall be of sufficient length to lie on the ground for a distance of not less than 1.0m on the downstream side. ***Construction Detail***
3. Ballast, of sound timber securely tied to the netting, shall be provided at the downstream end of the netting. ***Netting Ballast***
4. The sides of the gully shall be trimmed as necessary, to ensure that the floodgate shall be stock-proof or rabbit-proof. The floodgate shall have sufficient movement of the suspended portion under the flow of floodwaters to prevent damage to the fence and the accumulation of debris against it. Each strainer post shall be stayed in three directions, as shown on the Drawings. ***Construction Requirements***

BOUNDARY FENCING

C265.21 ERECTION OF GATES

1. Where gates are specified or shown on the Drawings, or are directed by Council's Supervising Engineer, they shall be erected so that they swing away from the road. Double gates shall be supplied if directed by Council's Supervising Engineer; otherwise a single gate only shall be supplied. ***Swing Away From Road***
2. At the location of gates the surface shall be levelled and shall be nearly horizontal. The area where the gates swing shall be similarly levelled. ***Level Surface***
3. The gates shall be hung as indicated in the Drawings. ***Hanging***

C265.22 REMOVAL OF EXISTING FENCING

1. Where required, existing fencing is to be removed as shown on the Drawings. ***Location***
2. No fencing is to be removed if there is a risk of egress or ingress of stock. If the existing fence is a rabbit-proof fence, then the contractor shall ensure that at night and weekends and other such times when work is not in hand that the whole of the fence is maintained in a rabbit-proof condition, even if temporary fencing is required. No extra payment will be made for this requirement. ***Contractor's Responsibility***
3. All material removed in demolishing existing fencing shall be disposed by the Contractor as provided by Clause C265.23. ***Old Material***

C265.23 REMOVAL AND DISPOSAL OF SURPLUS MATERIAL AND RUBBISH

1. All surplus material, offcuts, timber, roots and other debris resulting from the fencing contract shall be removed or otherwise disposed of to the satisfaction of Council's Supervising Engineer. ***Contractor's Responsibility***
2. The Contractor shall be responsible for any damage that may result from his lighting of fires. ***Fire Damage***

C265.24 GRIDS

1. Where shown on the Drawings, or as directed by Council's Supervising Engineer, grids shall be erected in accordance with the Drawings. ***Standard***
2. The grid shall be evenly bedded on a continuous layer of compacted sand or other granular material approved by Council's Supervising Engineer. The bedding material shall be compacted so that the relative compaction as determined by Test Method T166 is not less than 95 per cent. ***Bedding***
3. Grids shall be installed on raised abutments with approach ramps where possible. Alternatively, a grid may be placed over an excavated pit, in which case adequate drainage shall be provided. ***Raised Abutments***
4. Crossfall for single lane grids shall be level and for two lane grids each section shall have a crossfall conforming to the crossfall of the approach road. ***Crossfall***
5. The grid construction shall include all activities associated with the grid including any adjustments to the fencing as shown on the Drawings. ***Extent of Work***

SPECIAL REQUIREMENTS

C265.25 RESERVED

C265.26 RESERVED

C265.27 RESERVED

C265.28 RESERVED

C265.29 RESERVED

C265.30 RESERVED

CONSTRUCTION
SPECIFICATION

C271

MINOR CONCRETE WORKS

SPECIFICATION C271 : MINOR CONCRETE WORKS

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SPECIFICATION C271 : MINOR CONCRETE WORKS

GENERAL

C271.01 SCOPE

1. The Work to be executed under this Specification consists of the supply and placement of concrete, including sprayed concrete, and ancillary requirements such as excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the Drawings but not having individual Specifications. These include New Jersey type barriers, drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

2. NOT USED

C271.02 REFERENCE DOCUMENTS

Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated:

**Documents
Standards Test
Methods**

(a) Australian Standards

- AS 1012.1 - Sampling fresh concrete
- AS 1012.3 - Determination of properties related to the consistency of concrete
- AS 1012.8 - Making and curing concrete compression, indirect tensile and flexure test specimens in the laboratory or in the field.
- AS 1012.9 - Determination of the compressive strength of concrete specimens.
- AS 1012.14 - Securing and testing cores from hardened concrete for compressive strength.
- AS 1141.14 - Particle shape by proportional caliper.
- AS 1141.21 - Aggregate crushing value.
- AS 1141.23 - Los Angeles value.
- AS 1141.24 - Soundness (by use of sodium sulphate solution).
- AS 1289.3.3.1 - Calculation of the plasticity index of a soil.
- AS 1289.5.1.1 - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
- AS 1289.5.2.1 - Determination of the dry density/moisture content relation of a soil using modified compactive effort.
- AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio.
- AS 1302 - Steel reinforcing bars for concrete.
- AS 1303 - Steel reinforcing wire for concrete.
- AS 1304 - Welded wire reinforcing fabric for concrete.
- AS 1379 - The specification and manufacture of concrete.
- AS 1478 - Chemical admixtures for concrete.
- AS/NZS 1859 - Reconstituted wood-based panels.
- AS 2082 - Visually stress-graded hardwood for structural purposes.
- AS 2271 - Plywood and blockboard for exterior use.
- AS 2758.1 - Concrete aggregates
- AS 3600 - Concrete structures
- AS 3610 - Formwork for concrete.
- AS 3799 - Liquid membrane-forming curing compounds for concrete,
- AS 3972 - Portland and blended cements.

(b) RMS Specification

- 3204 - Prefomed joint fillers for concrete road pavements and structures.

(c) RMS Test Method

- T 166 - Determination of relative compaction.

EXCAVATION AND FOUNDATIONS

C271.03 GENERAL

1. The subgrade or subbase where specified shall be formed at the required depth below the finished surface levels shown on the Drawings. Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned. Soil foundations shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete, or of the subbase material (where specified). **Foundations**
2. All soft, yielding or other unsuitable material shall be replaced with sound material approved by Council's Supervising Engineer, and the subgrade shall be compacted to provide a minimum relative compaction of 100 per cent (standard compaction) as determined by AS 1289.5.4.1. If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed. **Unsuitable Material**
3. The Contractor shall supply all necessary sheeting and bracing to support the excavation in accordance with the Workcover Authority of NSW Regulations. The excavation shall be kept free of water. **Shoring**

C271.04 NEW JERSEY TYPE BARRIERS, DRIVEWAYS AND FOOTPATHS

1. For New Jersey type barriers, driveways and footpaths a subbase of approved quality and of minimum 150mm compacted thickness shall be placed over the subgrade, unless otherwise shown on the Drawings. The surface shall then be checked for uniformity and all irregularities shall be made good. **Subbase**
2. The subbase material shall be compacted to provide a minimum relative compaction as determined by Test Method T166 of 100 per cent for standard compactive effort or 98 per cent for modified compactive effort as appropriate. **Compaction**
3. The finished subbase shall not deviate more than 12mm under a straight edge 3-metres long, subject to any necessary allowance on vertical curves. **Subgrade and Subbase Tolerances**

C271.05 NOT USED

C271.06 RETAINING WALLS, HEADWALLS AND WINGWALLS

1. In the case of rock foundations for retaining walls, headwalls and wingwalls, the excavation shall be carried into the rock for a minimum depth of 150mm. Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be reduced to 100mm. **Rock Foundations**
2. Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a concrete sub-base at least 50mm thick and finished to a uniform surface. No forms or other materials shall be placed upon the sub-base within a period of 48 hours after the concrete has been placed. **Earth Foundations**

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3. Unless otherwise specified, precast concrete wall sections shall be placed on a bed of fresh concrete while it is still in the plastic state. In the case of soil foundations, the concrete shall be not less than 50mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least 50mm above the highest points of rock.

**Pre-Cast
Concrete**

FORMWORK

C271.07 GENERAL

1. Formwork shall be provided in accordance with AS 3610 to produce hardened concrete to the lines, levels and shapes shown on the Drawings or specified elsewhere. It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workmen and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

**Formwork
Requirements**

2. Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between reinforced concrete and the in-situ earth.

Side Forms

3. Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.2 metres or to move concrete along the formwork after deposition.

**Placement of
Concrete**

4. Material used shall be sound and suitable for the purpose intended and surface finish specified.

Material

5. Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the drawings. Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete. The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the Drawings.

**Formwork
Fittings**

6. Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the Drawings.

**Edge
Treatment**

7. Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

**Cleaning and
Inspection**

C271.08 APPROVAL OF FORMWORK DESIGN

1. For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be submitted to Council's Supervising Engineer for concurrence before manufacture of the formwork is commenced.

**Approval to
Design**

C271.09 PROVISION FOR DRAINAGE

1. Where shown on the Drawings, or where directed by Council's Supervising Engineer, weepholes of 50mm diameter shall be provided in retaining walls and wingwalls.

Weep Holes

C271.10 CONSTRUCTION

1. The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.

**Formwork
Material**

- | | |
|---|--|
| <p>2. Timber for formwork shall be well-seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.</p> | <p>Timber Requirements</p> |
| <p>3. Timber forms for exposed surfaces shall be constructed from plywood or particleboard with hardwood or approved softwood studs and wales. The plywood used for forms shall comply with AS 2271, the hardwood shall comply with AS 2082 and the particleboard with AS/NZS 1859.</p> | <p>Timber Standards</p> |
| <p>4. Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1m and uniform lengths of not less than 2m, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists. Where form panels are attached directly to the studding or joists the panel shall be not less than 15mm thick. Form panels less than 15mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20 mm minimum thickness. All form panels shall be placed in a neat, symmetrical pattern.</p> | <p>Formwork Panels for Exposed Surfaces</p> |
| <p>5. Forms for all surfaces, which will be completely enclosed or permanently hidden below the ground, may be constructed from dressed or undressed timber, steel, plywood or particleboard.</p> | <p>Hidden Surfaces</p> |
| <p>6. Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces.</p> | <p>Mild Steel Surfaces</p> |

C271.11 ERECTION

- | | |
|--|--|
| <p>(a) General</p> | <p>Formwork Position Tolerances</p> |
| <p>(i) Dimensions and position of forms shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete. Departure of the forms from the surfaces shown on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.</p> | |
| <p>(ii) Joints as erected shall be mortar tight.</p> | <p>Mortar Tight</p> |
| <p>(iii) The interior surface of the forms shall be treated to ensure non-adhesion of the mortar. Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface. The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete. In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints.</p> | <p>Coating of Internal Surfaces</p> |
| <p>(iv) Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering.</p> | <p>Release Agent</p> |
| <p>(b) Approval by Council's Supervising Engineer</p> | |
| <p>(i) Placing of concrete shall not commence until formwork and the reinforcement has been accepted by Council's Supervising Engineer, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms. Acceptance by Council's Supervising Engineer shall constitute a HOLD POINT.</p> | <p>Concrete Placement</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto; margin-right: auto;"> <p>HP</p> </div> |
| <p>(ii) When an inspection is requested by the Contractor, a notice of not less than 24 hours, excluding Saturdays, Sundays and Public Holidays, shall be given to Council's Supervising Engineer.</p> | <p>Notice of Inspection</p> |

MATERIALS FOR CONCRETE

C271.12 CEMENT

- | | |
|---|-----------------------------------|
| 1. Cement shall be Type GP Portland Cement complying with AS 3972 and shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. | Quality |
| 2. When submitting details of the nominated mix in accordance with Clause C271.17, the Contractor shall nominate the brand and source (including works) of the cement. On approval of the nominated mix by Council's Supervising Engineer, the Contractor shall only use the nominated cement for the work. | Nominated Brand and Source |
| 3. The Contractor shall furnish documentary or other acceptable evidence of the quality of the cement, if required by Council's Supervising Engineer. | Proof of Quality |
| 4. If the Contractor proposes to use cement, which has been stored for a period in excess of 3 months from the date of testing, a re-test shall be required before the cement is used. The retest shall be at the Contractor's expense | Storage Time |
| 5. All cement shall be transported in watertight containers, and shall be protected from moisture until used. Caked or lumpy cement shall not be used. | Transport and Storage |

C271.13 WATER

- | | |
|--|-------------------|
| 1. Water shall be free from injurious amounts of materials harmful to concrete and to its reinforcement and neither salty or brackish. | Quality |
| 2. Water that is not potable for human beings shall not be used in reinforced concrete. | Potability |

C271.14 FINE AGGREGATE

- | | |
|---|-----------------------------|
| 1. Fine aggregates shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent) material finer than 2 micrometres, impurities and reactive materials. | Quality |
| 2. Fine aggregates shall be evenly graded within the absolute limits shown in Table C271.1. | Grading Requirements |

Australian Standard Sieve	Proportion Passing (% of Mass)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	±5
1.18mm	40 - 85	±10
300µm	8 - 30	±10
150µm	2 - 10	±5
75µm	0 - 4	±3

Table C271.1 - Fine Aggregate Grading

C271.15 COARSE AGGREGATE

1. Coarse aggregate shall consist of clean, hard, durable, crushed stone, crushed river gravel, screened river gravel or metallurgical furnace slag. It shall conform to the requirements of AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5 per cent), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this Specification. If required, coarse aggregate shall be washed to satisfy these requirements. **Quality**

2. The percentage of wear shall be determined as per AS 1141.23, and the loss of weight shall not exceed 30 per cent. **Wear Test**

3. When required by Council's Supervising Engineer, coarse aggregate shall be tested for conformance for any or all of the properties set out below: **Additional Tests**

(i) Crushing Value - AS 1141.21
The aggregate crushing value shall not exceed 25 per cent.

(ii) Soundness - AS 1141.24
The loss of mass when tested with sodium sulphate shall not exceed 12 per cent.

(iii) Particle Shape - AS 1141.14
The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35 per cent.

4. Coarse aggregate shall be evenly graded within the absolute limits shown in Table C271.2. **Grading Requirements**

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Australian Standard Sieve (mm)	Proportion Passing (% of Mass)			Deviation Proposed Grading (% of Mass of Sample)
	40mm Nominal	20mm Nominal	Extrusion Concrete	
	For Walls exceeding 150mm thickness	For all other structures		
53.0	100			
37.5	95 - 100			±10
26.5		100		
19.0	30 - 70	95 - 100		±10
13.2			100	
9.50	10 - 35	25 - 35		±5
4.75	0 - 10	0 - 10		±5
2.36	0 - 2	0 - 2		

Table C271.2 - Coarse Aggregate Gradings

C271.16 ADMIXTURES

1. Chemical admixtures and their use shall comply with AS 1478. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used.

Quality and Use

2. During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WR Re) approved by Council's Supervising Engineer shall be used to control slump within the limits stated in Clause C271.21. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS 1478 for Type Re or Type WR Re shall be submitted to Council's Supervising Engineer, together with the proposed 'dosage chart' in accordance with Clause C271.17.

Retarder for Warm Season

3. During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6 per cent reducing sugars (Type WR Re complying with AS 1478) may be used in the mix.

Retarder for Cool Season

C271.17 TESTING OF MATERIALS

1. The Contractor shall submit to Council's Supervising Engineer a copy of a NATA Certified Laboratory Test Report on the quality and gradings of the aggregates proposed in the work.

Contractor's Responsibility

2. The materials shall only be used after receipt of Council's Supervising Engineer's notification of acceptance, and then only so long as the materials accord with the specification.

Use of Material

HANDLING AND TREATMENT OF CONCRETE

C271.18 MEASURING

1. All materials shall be measured by weight, except that: -

Measurement of Material

- (a) Water may be measured by volume with an approved adjustable water-measuring and discharging device, and,
- (b) Cement may be measured by bags as packed by the manufacturer in which case batches shall be proportioned on the basis of one or more unbroken bags of cement and for this purpose one bag of cement shall be assumed to weigh 20kg. Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the components of the batch are discharged from the batching hopper.
- (c) Measurement by volume for smaller works may be undertaken with the prior approval of Council's Supervising Engineer.

C271.19 MEASURING BY WEIGHT, ON-SITE MIXING

1. Where concrete is to be mixed on site, and where mix control is likely to be less efficient than at a central batching plant, the weights of cement, fine and coarse aggregate shown in Table C271.3 may be used as a guide to produce the classes of concrete specified. Small changes in the proportions of fine and coarse aggregate may be required to improve density or workability of the concrete. The use of proportions shown in Table C271.3 shall not relieve the Contractor of his obligation to provide concrete of the specified compressive strength.

Mixing by Weight on Site

MPa	Cement Kg	Fine Aggregates Kg	Coarse Aggregates Kg	Total Aggregates Kg
10	20	65	125	190
15	20	50	95	145
20	20	44	63	107

Table C271.3 - Materials in Batch containing 1 bag (20Kg) Cement

2. The proportions set out in Table C271.3 make allowance for moisture contents of aggregates of 6 per cent for fine aggregates and 1 per cent for coarse aggregates. Where the moisture content of aggregates exceeds 8 per cent or 3 per cent respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

Variation in Aggregate Moisture Content

C271.20 MEASURING BY VOLUME, ON-SITE MIXING

1. Where measurement by volume is approved, the proportions of the materials shall be such as are required to produce a mix free of voids and having the specified strength at 28 days.

Mixing by Volume on Site

2. The nominal proportions given in Table C271.4 may be used as a guide for volume batching.

Volume Batching

MINOR CONCRETE WORKS

MPa	Parts by Volume		
	Cement	Fine Aggregate	Coarse Aggregate
10	1	3	6
15	1	2.25	4.5
20	1	2	3

Table C271.4 - Volume Batching

3. The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins. The aggregates shall be measured loose (i.e. without compaction) in the boxes and shall be struck off level. Measurements by shovels or like methods will not be permitted. Batch proportions shall be so arranged such that each batch contains 1 bag of cement. One 20kg bag of cement shall be assumed to have a volume of 13.75 litres.

Batch Measurement

C271.21 CONSISTENCY

1. A sufficient quantity of water shall be added to the mix so that the consistency of the concrete is such that it can be placed in the forms, compacted and worked into all corners without permitting the ingredients to segregate, or excess free water to collect on the surface. If required by Council’s Supervising Engineer, the Contractor shall determine the consistence of the concrete in accordance with AS 1012.3, Method 1. Except for extruded concrete, the nominated slump shall not exceed 80mm, plus the field tolerance of ±15mm.

Consistency Requirements

2. In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of 10mm to 15mm.

Extruded Concrete Consistence

C271.22 MIXING AND DELIVERY

(a) General

(i) Concrete may be mixed either at the site or at a central mixing plant. All concrete shall be mixed with mechanically operated mixers. In an emergency, hand mixing may be permitted.

Mechanical Mixing

(ii) Any concrete that exhibits signs of segregation shall not be used.

Segregation of Concrete

(b) Machine Mixing at Site

(i) The mixing of concrete shall be done in a batch mixer, which will ensure a uniform distribution of the materials throughout the batch.

Mixer Requirements

(ii) The mixer shall be of such capacity that one or more whole bags of cement may be used per batch of concrete. The volume of the mixed material shall not exceed the manufacturer’s rated capacity of the mixer.

Mixer Capacity

(iii) The mixing time for each batch shall not be less than 1.5 minutes after all ingredients are assembled in the mixer and prior to any portion of the batch being removed.

Mixing Time

(iv) The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.

Total Mix Discharge

(c) Mixing in an Emergency

- (i) In the case of breakdown of the mechanical mixing equipment, hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint is permitted. *Hand Mixing*
- (ii) Hand mixing shall be done on a watertight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10 per cent more than the amount specified for machine mixed concrete. *Hand Mixing Conditions*
- (iii) The fine aggregate and cement shall first be mixed until a uniform colour is obtained, and then spread on the mixing platform in a thin layer. The coarse aggregate, which shall have been previously drenched with water, shall then be spread over the fine aggregate and cement in a uniform layer, and the whole mass turned over as further water is added with a rose sprinkler. After the water is added, the mass shall be turned at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance. Hand-mixed batches shall not exceed 0.25 cubic metres each. *Hand Mixing Procedure*

(d) Ready-Mixed Concrete

- (i) The concrete shall be mixed and delivered in accordance with the requirements of AS 1379 relating to: - *Mixing Standard and Discharge Times*
 - (1) Mixing and Delivery; and
 - (2) Use of Non-Agitating Equipment,

with the exception that in (1) the time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours, and in (2) not more than 30 minutes.
- (ii) The water used for flushing the chutes and for cleaning and any excess concrete shall be discharged in an area acceptable to Council’s Supervising Engineer and in a manner in accordance with the requirements of the Protection of the Environment (Operations) Act 1997. The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms. *Cleansing and Positioning of Chutes*

C271.23 PLACING AND COMPACTING CONCRETE

- 1. Without the approval of Council’s Supervising Engineer, no concrete shall be placed during rain or while the air temperature is, or is likely to be within 24 hours, below 5°C or while the shade temperature exceeds 38°C. *Air Temperature Requirements*
- 2. The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible. Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used. *Placement within Time Limit*
- 3. The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2 metres, or be deposited in large quantities at any point and moved or worked along the forms. Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed. The concrete shall be placed in horizontal layers in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face. The freshly placed concrete shall be compacted by continuous spading, slicing or by vibrator units. Vibrators shall not be left in one position for more than 30 seconds, and shall not be permitted to rest on reinforcement. *Placement in Forms, Vibrating*

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4. Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the Drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted. **Exposed Surfaces**

5. Concrete shall not be moved after it has been in the forms for more than 10 minutes. **Initial Set**

6. In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry comprising two parts of plasterer's sand and one part cement (by volume), together with sufficient water to bring the mixture to a semi-fluid condition, shall be placed in the special receptacle in the machine if the machine is so equipped, and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish. **Slurry for Extruded Concrete**

C271.24 FINISHING OF UNFORMED SURFACES

(a) Surfaces other than Wearing Surfaces

1. Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface. Care shall be taken to drain or otherwise remove promptly any water that comes to the surface. A capping of mortar will not be permitted. **Finish for Unformed Surfaces**

2. All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface. **Future Contact Surfaces**

(b) Wearing Surfaces

1. Where a concrete wearing surface is shown on the drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed. Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall be finished true and uniform and free from any glazed or trowelled finish and shall be finally dressed with a wooden template or float, or by the use of belting in an approved manner. The departure from grade shall not exceed 5mm in any 3-metre length. **Finish for Wearing Surfaces**

2. Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface. **Surface to receive Asphalt**

(c) Finished Levels

1. The finished levels of concrete structures not adjacent to road pavements shall not vary more than 25mm from the specified levels. In the case of barriers, drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10mm from the specified levels and alignment. Barriers, footpaths and similar shall not deviate from level or alignment by more than 5mm from a straight-edge 3 metres long, subject to any necessary allowances on vertical and horizontal curves. **Surface Tolerance**

C271.25 CURING AND PROTECTION

1. All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds for a minimum period of 3 days. During this time the work must be adequately protected from traffic and any other causes likely to damage the concrete. **Curing Requirements**

C271.26 REMOVAL OF FORMS

1. All forms shall remain in place for minimum periods specified hereinafter. Council's Supervising Engineer may extend these periods if the air shade temperature falls below 10°C during the periods specified. **Walls, Sumps etc.**
- | | |
|--|----------|
| Mass retaining walls, headwalls, wingwalls, gully pits, sumps, and similar drainage structures | 48 hours |
| Footpaths, driveways and similar | 48 hours |
| Sides of reinforced concrete walls when height of each day pour is: | |
| (i) under 0.6 metres | 1 day |
| (ii) 0.6m to 3m | 2 days |
| (iii) 3m to 6m | 3 days |
| (iv) 6m to 9m | 5 days |
| Supporting forms under deck slabs of culverts | 10 days |
2. To permit the satisfactory finishing of barriers, forms shall be removed in not less than 12 hours or more than 48 hours after placing concrete, depending upon weather conditions. **Barriers**
3. Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted. **Protection of Concrete**
4. No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70 per cent of the design strength. **Superimposed Load**
5. Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete. **Removal of Hole Formers**

C271.27 TREATMENT OF FORMED SURFACES

1. All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result. **Quality of Surfaces**
2. As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float. **Repair of Defects**
3. Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above. **Removal of the Wires**
4. The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer. **Coating with Bonding Agent**

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C271.28 JOINTS

1. Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures (other than barriers and footpaths) the joints may be made at the base of walls and at other locations in the walls where approved by Council's Supervising Engineer. In order to provide for a bond between the new concrete and the concrete that has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

***Horizontal
Construction
Joint***

2. Retaining walls shall be provided with vertical expansion joints as shown on the Drawings. The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.

***Vertical
Expansion
Joints***

3. Where barriers are extruded or cast in place, narrow transverse vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints shall be at intervals of 3 metres.

***Barrier
Contraction***

4. In barriers, unless shown otherwise on the Drawings, expansion joints, 15mm in width for the full depth of the barrier, shall be constructed at intervals not exceeding 15m and where the barrier abuts against gully pits. Expansion joints shall consist of preformed joint filler complying with RTA Specification 3204.

***Barrier
Expansion***

5. In footpaths, median toppings and driveways, unless otherwise shown on the Drawings, expansion joints, 15mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15m and where the pavement abuts against gutters, pits and structures. Expansion joints shall consist of preformed joint filler complying with RTA Specification 3204.

6. All unreinforced paving shall be provided with narrow vertical grooves, 20mm deep to induce contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form "slabs" no bigger than 2m². The ratio of the longest side to the shortest side shall not exceed 1.6.

C271.29 STRENGTH OF CONCRETE

1. When tested in accordance with AS 1012.9, the concrete shall have a compressive strength not less than that shown on the Drawings or if not shown shall have a compressive strength not less than that specified in Table C271.5 for the particular class of work.

***Strength
Requirement***

2. The strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

***Determination
of Strength***

3. In general, two pairs of test specimens shall be moulded for each 15 cubic metres of concrete, or part thereof, one pair being intended for the 7-day test if required and the other pair for a 28-day test.

***Moulding of
Cylinders***

Use	MPa	Minimum Cement per cu metre	Coarse Aggregate Nominal Size	Cylinder Strength Required	
				7 days	28 days
		Kg	mm	MPa	MPa
Foundations, mass retaining walls	20	330	40	15	20
Mass concrete footings, pitching, linings etc.	20	330	20	15	20
Drainage structures, driveways footpaths, New Jersey barrier, miscellaneous minor concrete work	20	330	20	15	20
Reinforced concrete culverts, headwalls, base slabs, sign structure large footings, retaining walls	32	380	20	24	32
Extruded concrete	20	330	14	15	20

Table C271.5 - Concrete Strength Requirements

4. The strengths specified at 28 days shall be increased by multiplying factors as shown in Table C271.6 for tests at ages in excess of 28 days. **Strength Age Factor**

*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25

*For intermediate ages the factor shall be determined on a pro-rata basis

Table C271.6 - Concrete Age Conversion Factors

5. If the test specimens fail to achieve the specified strength, the Contractor may, with the approval of Council’s Supervising Engineer, arrange for cores to be taken from the work. If the average strength of such cores complies with the specified requirements, the concrete will be accepted. **Cores and Test Acceptance**

6. If cores taken fail to satisfy the strength requirements, the concrete shall be removed. **Failure of Cores**

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C271.30 SAMPLING CONCRETE

1. The Contractor shall provide equipment and facilities for the taking and storage of samples of any materials or concrete being used, or intended to be used in the work. **Contractor's Responsibility**
2. Concrete test specimens shall be cylinders 300mm long and 150mm diameter, moulded concurrently in the presence of Council's Supervising Engineer or his representative, in accordance with AS 1012.8, from samples taken in accordance with AS 1012.1. **Moulding of Test Cylinders**

STEEL REINFORCEMENT FOR CONCRETE

C271.31 MATERIAL

1. Steel reinforcement shall comply with the requirements of the appropriate following Australian Standards: - **Standards**
 - (a) AS 1302 Steel Reinforcing Bars for Concrete.
 - (b) AS 1303 Steel Reinforcing Wire for Concrete.
 - (c) AS 1304 Welded Wire Reinforcing Fabric for Concrete.
2. The type and size of bars shall be as shown on the Drawings. **Type and Size**
3. Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition. **Quality**
4. The Contractor shall supply evidence satisfactory to Council's Supervising Engineer that steel reinforcement complies with AS 1302, AS 1303 or AS 1304, as appropriate. Test certificates shall show the results of mechanical tests and chemical analysis. **Documentary Evidence**
5. Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length. The cost of all samples and tests shall be borne by the Contractor. **Further Sampling Contractor's Cost**
6. Plastic tips for wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at $23 \pm 5^{\circ}\text{C}$ without being pierced by the wire. The Contractor shall demonstrate that the proposed chairs conform to these requirements. **Wire Chairs**

C271.32 BENDING

1. Reinforcement shall be formed to the dimensions and shapes shown on the Drawings. It shall not be bent or straightened in a manner that will injure the material, and bars with kinks or bends not shown on the drawings will not be accepted. Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching. **Cutting and Bending**

C271.33 SPLICING

(a) General

1. All reinforcement shall be furnished in the lengths indicated on the Drawings. If splicing is required, this to be in accordance with the provisions of AS 1302. **Plan Lengths**

2. The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor. **Contractor's Cost**

(b) Lapped Splices

1. Laps in reinforcing bars, wire or fabric shall be as shown on the Drawings. Laps not shown on the Drawings shall be as follows for unhooked bars: - **Lap Dimensions**

Plain bars, Grade 250	40 bar diameters
Deformed bars, Grade 400	35 bar diameters
Hard-drawn wire	50 bar diameters

2. Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus 25mm. **Splice Dimensions**

C271.34 MARKING

1. Bars of identical shape shall be made up in bundles of three and securely tied together by soft iron wire. Each bundle shall have a stout metal label of not less than 40mm diameter attached to it. Each metal label shall be punched with the appropriate marking in accordance with the steel list shown on the drawings. If called for on the Drawings the marking shall incorporate a prefix, and bars with different prefixes shall be stored separately. **Marking Details**

C271.35 STORAGE

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure. **Protection of Reinforcement**

C271.36 DELIVERY AND RECEIPT OF REINFORCEMENT

1. Unless the Contractor elects to have the reinforcement inspected at the site, no reinforcement shall be delivered to the site until all tests and inspections have been satisfactorily completed and Council's Supervising Engineer has granted permission to deliver. **Test Before Delivery**

2. The Contractor shall give 10 working days notice to Council's Supervising Engineer for carrying out inspection and testing. Council's Supervising Engineer will carry out the inspection and testing with reasonable expediency, but the Contractor shall not be entitled to an extra as a result of any delays in this connection. **Notice to Test**

C271.37 PLACING

1. Reinforcement shall be accurately placed as shown on the Drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.5m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25mm. Steel shall not be supported on metal supports, which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate. Reinforcement shall have the minimum cover shown on the Drawings. **Reinforcement Position**

2. Council's Supervising Engineer may approve the use of tack welding instead of wire ties on reinforcing wire. Tack welding of cold-worked and hard grade bars shall not be permitted. **Tack Welding**

3. Council's Supervising Engineer shall approve the reinforcement in each section of the work before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work that may be required. Notice for inspection shall not **Inspection Required**

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be less than twenty-four hours.

4. Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by Council's Supervising Engineer.

Splices

5. Bars forming a lapped splice shall be securely wired together in at least two places, unless welded.

Lapped Splice

6. The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on the Drawings. Where not so indicated it shall be as stated below:

Bar Cover

- (a) Concrete normally in contact only with air
 - (i) Slabs: 40mm
 - (ii) Other than slabs: 45mm
- (b) Concrete in contact with earth or fresh water
 - (i) Slabs of box culverts: 50mm
 - (ii) Other than culverts: 50mm

In no cases shall the cover be less than 1½ times the diameter of the bar.

BACKFILLING

C271.38 GENERAL

1. Backfilling at barriers, paving, etc, and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

2. No filling shall be placed against retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of Council's Supervising Engineer, or when the Contractor can demonstrate that 85 per cent of the design strength of the concrete has been achieved.

Adjacent to Walls

3. Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and from stone larger than 50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS 1289.3.3.1. The material shall be placed in layers not exceeding 150mm and shall be compacted to provide a relative compaction of not less than 95 per cent (standard compaction) as determined by AS 1289.5.4.1.

Selected Backfill

C271.39 TREATMENT AT WEEPHOLES

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

Size & Type of Backfill Material

- (a) The maximum particle dimension shall not exceed 50mm
- (b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.

2. The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.

Extent of Material

3. Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the approval of Council's

Synthetic Membrane

Supervising Engineer'.

SPRAYED CONCRETE

C271.40 GENERAL

- | | | |
|----|--|------------------------------------|
| 1. | Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes. | Definition |
| 2. | The minimum depth of sprayed concrete to be applied shall be 75mm. | Depth |
| 3. | Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour. | Colour |
| 4. | Sprayed concrete shall have a minimum cement content of 380 kg/m ³ as discharged from the nozzle and shall have a minimum compressive strength of 25 MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete. | Strength |
| 5. | Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.9 and AS 1012.14. The Contractor shall provide equipment and facilities for the taking of cores from the work. The Contractor shall engage a NATA registered laboratory to carry out the curing and testing of the cores. Copies of test results shall be forwarded to Council's Supervising Engineer. | Test Cores |
| 6. | The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor. | Contractor's Cost |
| 6. | At least 14 days prior to applying any sprayed concrete the Contractor shall submit to Council's Supervising Engineer details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS 3600. | Contractor's Responsibility |

C271.41 TEST PANELS

- | | | |
|----|--|-----------------------|
| 1. | Not less than 10 days before applying concrete, the Contractor shall prepare at least 3 test panels for each mix proposed, in conditions similar to those in the works and in the presence of Council's Supervising Engineer. The test panels shall be made by applying a 75mm thickness of sprayed concrete to a hardboard panel approximately 750mm square. The sprayed concrete shall be applied to the panels in the same manner, using materials including steel reinforcing fabric; equipment, pressures and curing that will be used in the Works. The panels shall be submitted to Council's Supervising Engineer for examination. | Test Panels |
| 2. | The Contractor shall cut four 75mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed. The cores shall be tested as for cores from in-place sprayed concrete. One core shall be compression tested at 3 days, one core at 7 days and the remaining two cores at 28 days. | Cores |
| 3. | Should any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets or should the test panel exhibit an unacceptable surface finish, the Contractor shall modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection. | Defective Core |
| 4. | Sprayed concrete shall not be applied to the Works until the Contractor produces test panels to the satisfaction of Council's Supervising Engineer. | Approval |

C271.42 SURFACE PREPARATION

- | | | |
|----|--|--------------|
| 1. | Earth surfaces shall be graded, trimmed, compacted, and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to | Earth |
|----|--|--------------|

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prevent erosion when the sprayed concrete is applied.

2. Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete. **Rock**
3. Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter. **Steel Pipes**
4. The Contractor shall remove free water and prevent the flow of water, which could adversely affect the quality of the sprayed concrete. **Water Flow**

C271.43 APPLICATION OF SPRAYED CONCRETE

1. Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed by air jet or other suitable means from the surface as work proceeds and disposed of. **Procedure**
2. Spraying shall be discontinued if wind causes separation of the nozzle stream. **Wind Problem**
3. Concrete shall not be sprayed in air temperatures less than 5°C. **Air Temperature**
4. Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle of between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying. **Construction Joints**
5. When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement. **Spraying around Reinforcement**
6. Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds. **Protection of Adjoining Surfaces**

C271.44 CURING

1. Curing shall commence within one hour of the application of sprayed concrete and may be by means of water or by colourless wax emulsion curing compound complying with AS 3799 and applied in accordance with the manufacturer's specifications. **Commencement**
2. In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven days. **Water Curing**

LIMITS AND TOLERANCES

C271.45 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in Table C271.7 below:

Item	Activity	Tolerances	Spec Clause
1.	Subgrade		
	(a) Relative Compaction	≥95% (standard compactive effort)	C271.03
2.	Barriers, Footpaths etc.		
	(a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 12mm under a straight-edge 3 metres long.	C271.04
	(b) Relative Compaction of Subbase	≥98% (modified compactive effort) ≥100% (standard compactive effort)	C271.04
3.	Formwork		C271.11
	(a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the Drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.	
4.	Fine Aggregate		
	(a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table C271.1.	C271.14
5.	Coarse Aggregate		
	(a) Percentage of wear	Loss of weight shall not exceed 30%	C271.15
	(b) Crushing Value	Crushing value shall not exceed 25%	C271.15
	(c) Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	C271.15
	(d) Particle Shape	The proportion of misshapen particles (2:1 ratio) shall not exceed 35%	C271.15
	(e) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table C271.2.	C271.15

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Item	Activity	Tolerances	Spec Clause
6.	Aggregate Moisture Content	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	C271.19
7.	Consistency	In accordance with AS 1012.3, Method 1 the slump shall not exceed the nominated slump ± 15 mm. In the case of concrete placed by extrusion machine, the slump will be between 10mm and 15mm.	C271.21 C271.21
8.	Ready-Mixed Concrete (a) Mixing & Delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours. Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	C271.22
9.	Placing & Compacting of Concrete	Concrete shall not be placed without the approval of Council's Supervising Engineer if the air temperature within 24 hours is likely to be below 5°C or the shade temperature is likely to exceed 38°C.	C271.23
10.	Finishing of Unformed Concrete Surfaces (a) Wearing Surface	To be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3 metre length.	C271.24
	(b) Finished Level	The finished levels of concrete structures not adjacent to road pavements shall not vary more than 25mm from the specified levels. In the case of drainage pits and other structures adjacent to road pavements the finished concrete level shall not vary more than 10mm from the specified level and alignment.	C271.24 C271.24

Table C271.7 - Summary of Limits and Tolerances

CONSTRUCTION SPECIFICATION

C273

LANDSCAPING

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

Details are provided below outlining the clauses amended from the Wollondilly Shire Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Landscape Plan requirements	C273.12	A	BG	1/3/16

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ANNEXURE C273.A 142

SPECIFICATION C273 : LANDSCAPING

GENERAL

C273.01 SCOPE

1. The work to be executed under this Specification consists of:
 - (a) The vegetation of cut and fill batters, median areas, open drains, footways and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, sowing of seed and may include surface protection works, hydroseeding, hydromulching, straw mulching and turfing.
 - (b) The supply of plants, planting at locations as shown on the Drawings, fertilising, mulching, staking, watering and maintenance of plants.

C273.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

(a) Council Specifications

- C211 - Control of Erosion and Sedimentation.
- C213 - Earthworks.

(b) Australian Standards

- AS 1160 - Bitumen emulsion for construction and maintenance of pavements.
- AS 2507 - The storage and handling of pesticides.
- AS 4419 (Int) - Soils for landscaping and garden use.
- AS 4454 - Composts, soil conditioners and mulches.

VEGETATION OF SLOPES AND DRAINS

C273.03 EXECUTION AND TIMING OF WORK

1. In association with the work to be executed under this Specification, the Contractor shall implement effective erosion and sedimentation control measures in accordance with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION.

**Contractor's
Responsibility**

2. The work to be executed under this Vegetation of Slopes and Drains includes the vegetation of cut and fill batters, footpaths, median areas, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising and either sowing of seed or turfing as shown on the Drawings.

Vegetation

3. Exposed ground shall be vegetated as quickly as possible, but in any case before the area exceeds one hectare.

**Exposed
Ground**

C273.04 MATERIALS

(a) Topsoil

1. The Contractor shall use topsoil stockpiled on site under Specification C213 - EARTHWORKS. Where imported topsoil is required it shall comply with AS 4419 (Int) and shall: -

Quality

- be of a friable, porous nature;
- be free of weeds and weed seeds, bulbs, corms and vegetable propagules;
- contain no refuse or materials toxic to plant growth;
- contain no stumps, roots, clay lumps or stones larger than 50mm in size;
- have an organic content of at least 3 per cent by mass;
- have a pH neither less than 5.5 nor more than 7.5;
- have a soluble salt content not exceeding 0.06 per cent by mass.

(b) Herbicide

1. Herbicide used shall be a glyphosate-based herbicide such as 'Roundup'. Council's Supervising Engineer may approve other glyphosate-based herbicides provided that an equivalent concentration of the active ingredient glyphosate is applied.

(c) Seed**Seed Type and Supplier**

1. All seed used shall be of the species and varieties listed in Annexure C273A and shall be sown at the application rates shown therein. The Contractor shall submit to Council's Supervising Engineer the name/s of the proposed seed supplier/s if requested by the Council's Supervising Engineer.

2. The Contractor's attention is drawn to the lead-time that may be required to procure some native seed species. The native seed shall be delivered to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

Lead Time for Native Seed

3. A "Certificate of Authenticity" must accompany all seed, which shall be furnished by the Contractor to Council's Supervising Engineer upon request at any stage of the work. Grass and clover seed shall be pre-packed commercially with an accompanying certificate of germination.

Certification

4. The Contractor shall not take possession of the seed more than seven days before sowing is to occur. The seed shall be stored in clean, airtight containers and kept away from direct sunlight. It shall not be exposed to the elements at any stage during storage.

Storage

5. The Contractor shall replace any exotic seed batch found not true to type. The cost of replacement shall be borne by the Contractor.

Contractor's Cost**(d) Turf**

1. Turf shall consist of 25mm depth of dense, well rooted, vigorous grass growth with 25mm depth of topsoil. The type of grass turf to be used will be indicated on the Drawings. Kikuyu grass shall not be used unless approved by the Council's Supervising Engineer. Turf shall be free of weeds, soil pests and diseases. The turf shall be supplied as rolls in long lengths of uniform width of not less than 300mm, and shall be in sound unbroken condition. Turf shall be obtained from a local supplier.

(e) Fertiliser

1. Fertiliser used shall be an organic type such as 'Dynamic Lifter-Nitro' with Nitrogen: Phosphorus: Potassium (N:P:K) ratios of 8:3.6:2 or an equivalent fertiliser approved by Council's Supervising Engineer.

Type

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(f) Vegetable Mulch

1. Vegetable mulch used in hydromulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded to a maximum dimension of 10 mm. Meadow hay or weeds shall not be used and paper pulp if used shall not exceed 50 per cent by mass of the total mulch.

Composition

(g) Water

1. Water used shall be potable.

Quality

(h) Binder

1. The binder used in hydromulching and strawmulching shall be Grade ASS, slow setting anionic bitumen emulsion, complying with AS 1160.

Type

(i) Wetting Agent

1. The soil wetting agent added in hydromulching or hydroseeding shall be 'Aquasoil' applied at a rate of one litre per 1,000 litres of mix water or an equivalent soil wetting agent approved by Council's Supervising Engineer.

Application Rate

(j) Pesticide

1. Pesticide used shall be Lorsban 500EC or Lorsban 250W or an equivalent pesticide approved by Council's Supervising Engineer. The storage and handling of pesticides shall be in accordance with AS 2507.

Type

C273.05 VEGETATION OF SLOPES 3 TO 1 OR FLATTER

(a) Preparation of Surface

1. Slopes shall be sprayed with the glyphosate based herbicide 'Roundup' applied at a rate of 9 litres of Roundup diluted in 200 litres of water per hectare of surface sprayed to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks.

Herbicide Treatment

2. The surface shall then be tined to a depth of 200 mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

Preparation

(b) Topsoiling

1. Topsoil shall be uniformly applied to provide an average compacted thickness of 50mm with a minimum compacted thickness of 30mm at any location. The topsoiled area shall be cultivated to a depth of 50mm to provide a roughened surface with soil lumps not exceeding 50mm dimension.

Application

(c) Mixing of Seed

1. The Contractor shall give Council's Supervising Engineer two days' notice before each sowing operation. Seed shall be sown on the day of mixing with insecticide.

Notice

(d) Incorporation of Pesticide

1. Immediately before sowing, all grass and native seed shall be treated with pesticide. The pesticide shall be thoroughly mixed as a dry powder with the seed at a rate of 10 kilograms of insecticide to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with Annexure C273A.

Application Rate

(e) Sowing

1. Sowing shall be carried out with an appropriate mechanical seeder. Where practicable, passes shall follow finished surface contours. Seed shall be sown at a depth of 5mm or shall be raked or harrowed to provide 5mm cover.

Seeder

2. Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in Annexure C273A. Fertiliser shall be applied concurrently with the seeding operation.

Sowing Rate**(f) Turfing**

1. Turf shall be placed on the prepared topsoiled surface. Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow. Turf seams shall then be topdressed with topsoil.

Placing

2. Four to six weeks after placement, the turf shall be lightly topdressed with loam to correct any undulations or unevenness in the established turf.

Topdressing**(g) Watering**

1. The Contractor shall water areas to be sown to a moist condition and shall rewater areas to a moist condition without surface runoff on a daily basis for a minimum of 15 days after sowing, or as otherwise directed by Council's Supervising Engineer, to promote and maintain growth.

C273.06 VEGETATION OF SLOPES STEEPER THAN 3 TO 1**(a) General**

1. Where shown on the Drawings or directed by Council's Supervising Engineer, slopes shall be vegetated by one of the following methods:

Method

- (i) Topsoiling and hydromulching;
- (ii) Topsoiling, hydroseeding and straw mulching;
- (iii) Hydroseeding.

(b) Preparation of Surface

1. Weeds shall be killed by spraying with herbicide as specified under Clause C273.05 (a).

Herbicide Treatment

2. No more than seven days before seeding, all loose material shall be removed from fill batters and cut batters, which are not stepped, by dragging a heavy steel chain of minimum weight of 30 kilograms per metre of length or by other methods approved by Council's Supervising Engineer.

Preparation**(c) Topsoiling**

1. Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 50mm with a minimum compacted thickness of 30mm at any location.

Application Rate**(d) Hydromulching or Hydroseeding**

1. The hydromulch or hydroseed shall comprise the materials shown in Table C273.1. The materials shall be applied at the application rates shown in Table C273.1.

Application Rate

LANDSCAPING

2. Dry surfaces shall be watered by a fine spray of water before the application of the hydromulch. **Watering**
3. The mixing and treatment of seed shall be carried out in accordance with Clause C273.05(c). **Treatment of Seed**
4. During preparation of the hydromulch or hydroseed slurry, 'Lorsban 500EC' insecticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of insecticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface in accordance with Table C273.1. **Insecticide**
5. Storage tanks, containers and equipment to be used in hydromulching or hydroseeding of slopes shall be clean and free of contamination from previous operations. **Equipment**
6. A slurry mixture shall be produced by addition of the specified materials in the tank and agitated to maintain a uniform consistency during application. It shall be applied uniformly over the whole surface. **Uniform Mix**
7. Hydromulch or hydroseed shall not be applied under the following weather conditions at the site: **Weather Conditions**
- when temperature is higher than 35°C
 - when winds exceed 15 km/hr;
 - where, in the opinion of Council's Supervising Engineer, the surface is too wet or
 - during rain periods or when rain appears imminent.
8. Application rates shall be in accordance with Table C273.1

Material	Application Rate per Hectare	
	Hydro-Mulching	Hydro-Seeding
i. Vegetable Mulch (kg)	2,500	Nil
ii. Water (l)	35,000	20,000
iii. Binder (l)	700	Nil
iv. Fertiliser	See Annexure C273A	
v. Seed	See Annexure C273A	
vi. Wetting Agent (l)	35	20
vii. Insecticide (l)	5	5

Table C273.1 - MATERIALS AND APPLICATION RATES

(e) Straw Mulching

1. The mulch to be applied after hydroseeding shall comprise a matrix of straw and an anionic slow setting bitumen emulsion binder. Meadow hay shall not be used. The straw mulch shall be uniformly applied by a suitable blower unit at a rate of 250 bales (each of 20 kilograms) of straw per hectare of surface. The bitumen emulsion shall be incorporated as a spray into the air stream of the mulch blower at a rate of not less than 2,500 litres of bitumen emulsion per hectare of surface. The finished straw mat shall have a minimum thickness of 20 mm at any location. **Method**

C273.07 VEGETATION OF OPEN DRAINS**(a) Preparation of Surface**

1. The Contractor shall so execute the work that the excavation of open drains to the specified profiles is followed within seven days by the vegetation of the surface as specified in this Clause. Topsoil shall be spread to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

**Profile and
Topsoil****(b) Sowing**

1. Before sowing, the surface shall be watered. Seed and fertiliser shall then be applied uniformly at the rates specified in Annexure C273A by one of the following procedures as directed by Council's Supervising Engineer:

Procedure

- (i) Mechanical sowing.
- (ii) Hydromulching or hydroseeding.
- (iii) By hand.

(c) Surface Protection

1. Where shown on the Drawings or directed by Council's Supervising Engineer, one of the following protective treatments shall be applied immediately to all or part of the sown surface.

Methods

- (i) Spraying with Bitumen Emulsion

An anionic slow setting bitumen emulsion, conforming with Grade ASS of AS 1160, shall be sprayed over the surface at a rate of 1 litre of bitumen emulsion per square metre of surface.

**Application
Rate**

- (ii) Lining with Organic Fibre Mat

The channel surface shall be lined with an organic fibre mat such as 'Sta-Firma (light grade)' or an equivalent organic fibre mat approved by Council's Supervising Engineer. The runs of matting shall be laid along the direction of water flow. The matting shall be laid loosely on the soil surface and not stretched.

Laying

The upstream end of the matting shall be slotted into a trench 150 mm wide by 150 mm deep and pinned to the base of the trench at 200 mm centres. The trench shall be backfilled with soil and compacted by foot.

Anchorage

The pins shall be 'U' shaped, 4 mm gauge wire, 50 mm wide and 150 mm long legs.

Pins

Adjacent runs of matting shall be overlapped 100 mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500 mm centres and along the middle of each run at 1-metre centres. End overlaps shall be 150 mm wide with the higher run end lapped over the start of the lower run and pinned at 200 mm centres.

Lapping

- (iii) Turfing

Turf shall be as specified under Clause C273.04 (d).

Quality

Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow in the drain, and pinned into position at 500mm centres.

Placing

Seams of turf shall be topdressed with topsoil.

Topdressing

LANDSCAPING

(d) Watering

Water

1. The Contractor shall water treated areas in order to promote and maintain growth as specified under Clause C273.05 (g).

LANDSCAPE PLANTING

C273.08 EXECUTION AND TIMING OF WORK

1. The work to be executed includes the ground preparation, the supply of plants, planting as shown on the Drawings, fertilising, mulching, staking, watering and maintenance of plants.

Extent of Work

2. The Contractor shall give Council's Supervising Engineer a minimum of two days' notice of commencement of planting. Landscape planting shall not be carried out in extreme weather conditions (above 35°C or below 10 °C).

Notice of Commencement

C273.09 MATERIALS

(a) Topsoil

1. Topsoil shall comply with the requirements of Clause C273.04 (a).

(b) Herbicide

1. Herbicide shall comply with the requirements of Clause C273.04 (b).

(c) Fertiliser

1. Fertiliser shall be a slow-release type in pellet form with a nine months' release period and having Nitrogen:Phosphorus:Potassium (N:P:K) ratios of 6.3:1.8:2.8. 'Kokei' fertiliser pellets or an equivalent fertiliser approved by Council's Supervising Engineer shall be used.

Quality

(d) Mulch

1. Mulch used for landscape planting shall comply with AS 4454 and the following requirements:

Quality

(i) the material shall comprise hardwood chips;

(ii) fines shall not exceed 5 per cent by volume;

(iii) the average size of the woodchip shall be approximately 20 mm wide by 5 mm thick by 30 mm long and the maximum length of chip shall not exceed 50 mm; and

(iv) the material shall be free of soil, weeds, stones and other foreign material.

2. Composted organic mulch as approved by Council's Supervising Engineer may be used in lieu of woodchip mulch.

3. A 10 kilogram sample of mulch proposed by the Contractor shall be submitted for approval to Council's Supervising Engineer two weeks before its intended use. The mulch subsequently used shall be consistent in every respect with the sample approved by Council's Supervising Engineer.

Sample

	Type or Stock				
	50mm Tube	Gro-Tube	Semi Advanced	Advanced Stock	Super Advanced
Plant Container: dia (mm)	50	75	150	200	300
depth (mm)	75	100	150	200	300
Plant Height (mm) (leaf & stem)	200 min 300 max	300 min 400 max	300 min 400 max	300 min 500 max	500 min 750 max
Planting Holes: side (mm)	300	200	300	400	600
depth (mm)	300	200	300	400	600
Number of Fertilizer Pellets	2	3	5	5	7

Table C273.2 - PLANT STOCK

(e) Plant Material

1. The Contractor shall obtain all plants from a nursery located in an area having a climate similar to the site of the Works.

Source

2. There shall be no substitution of any species without the approval of Council's Supervising Engineer. All plant material shall be true to species and sizes. Plants shall be healthy, of good form, not soft or forced and with large robust root systems. They shall not be rootbound and shall be free from disease and insect pests. All container soil mix shall contain between 20 per cent and 25 per cent clay by volume. Trees shall have a single leading shoot. For hardening off purposes, all plants shall be delivered to a site within the locality of the Subdivision at least four weeks before planting out. Plant root systems shall be maintained moist at all times with particular attention being paid to watering during the on-site period before and during planting. Plant stock shall be classified as indicated in Table C273.2, and planted in accordance with the Drawings.

Quality

(f) Stakes

1. All stakes shall be 25mm square by 1,500mm long hardwood and sharpened at one end.

Size

C273.10 PLANTING

(a) Mass Planting in Mulched Bed

1. The mulched area shall be sprayed with herbicide, as specified under Clause C273.05 (a), to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks.

Herbicide Treatment

2. The surface shall be ripped at 500mm centres to a depth of 300mm and the top 200mm of the planting bed broken up by cultivation to a maximum size of 50mm. Mulch, 100mm thick, shall be spread over the planting bed. After removal of the localised mulch, planting holes shall be excavated to the square dimensions and depths as shown in Table C273.2 and the material removed.

Surface Preparation

3. The specified number of fertilizer pellets as shown in Table C273.2 shall be placed beside the rootball of each plant.

Fertilizer Pellets

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4. The planting hole shall be backfilled with topsoil complying with Clause C273.04 (a) and compacted by foot up to surface level, care being taken to avoid mixing mulch with topsoil. A stake shall be driven 300mm deep and 200mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50mm wide hessian webbing. **Backfill and Staking**
5. Each backfilled hole shall receive 10 litres of water before the mulch is respread over the disturbed area. The mulch shall be left just clear of the plant stem. **Watering and Mulching**
- (b) Individual Planting**
1. A planting area 600 mm square shall be loosened to a depth of 400 mm. Planting holes shall be excavated to dimensions and depths as shown in Table C273.2 and the material spread evenly around each hole **Planting Holes**
2. The specified number of fertiliser pellets, as shown in Table C273.2, shall be placed beside the rootball of each plant. **Fertilizer Pellets**
3. The planting hole shall be backfilled with topsoil complying with Clause C273.04 (a) and compacted by foot up to surface level. A stake shall be driven 300mm deep and 200mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50mm wide hessian webbing. **Backfill and Staking**
4. Each backfilled hole shall receive 10 litres of water. **Watering**
5. Weed infestation for a distance of 800 mm surrounding each proposed planting shall be killed by spraying with herbicide as specified in Clause C273.05 (a). All due care shall be taken to avoid damage caused by contact between the herbicide and the plant by means of spray drift etc. **Herbicide Spray**
6. Immediately after planting, mulch 100 mm thick, starting just clear of the plant stem, shall be spread over an area of 600 mm radius surrounding the plant. **Mulch**
- C273.11 CARE OF LANDSCAPE PLANTING**
1. The Contractor shall water all plants, from the time of planting, at the rate of 10 litres per plant every third day for the first twelve weeks. **Watering**
2. Missing or dead plants and plants nominated by Council's Supervising Engineer as unhealthy shall be replaced by the Contractor. Replacement plants shall be of similar size and quality and of identical species and variety to the plant being replaced. The cost of replacement shall be borne by the Contractor. **Replacement Plants Contractor's Cost**
3. Weed and grass growth in mulched areas shall be killed by treatment with 'Roundup' or other herbicide approved by Council's Supervising Engineer, in accordance with the manufacturer's instructions at monthly intervals during the construction period and contract maintenance period. Contact of the herbicide with the new plants shall be avoided and any damage repaired or damaged plant material replaced by the Contractor at no cost to the Principal. **Weed Control Contractor's Cost**
- C273.12 LANDSCAPE DESIGN AND PLANS**
1. Where landscape plans are required for developments, the plans shall be prepared by a suitably qualified Landscape Architect or Landscape designer.
2. Street trees shall be located to have minimal impact on access to any new lots within a development and minimal impact on drainage infrastructure.

SPECIAL REQUIREMENTS

C273.13 RESERVED

C273.14 RESERVED

C273.15 RESERVED

C273.16 RESERVED

LIMITS AND TOLERANCES

C273.17 SUMMARY OF TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	Topsoil		
	a) Organic Content	>3% by mass	C273.04 (a)
	b) pH	>5.5 <7.5	C273.04 (a)
	c) Soluble Salt	<0.06% by mass	C273.04 (a)
2.	Turf	Widths >300 mm.	C273.04 (d)
3.	Vegetable Mulch		
	a) Material	Maximum size < 10 mm	C273.04 (f)
	b) Paper Pulp	<50% by mass of total mulch	C273.04(f)
4.	Topsoiling	Minimum compacted thickness at any location of 30 mm	C273.05 (b) C273.06 (c) C273.07 (a)
5.	Straw Mulching		
	a) Straw Mat	Finished thickness >20 mm.	C273.06 (e)
6.	Landscape Planting		
	a) Temperature	Planting not to be undertaken when temperatures >35°C or <10°C.	C273.08
7.	Mulch		
	a) Fines	Shall not exceed 5% by volume.	C273.09 (d)
	b) Woodchip	Maximum size <50 mm.	C273.09 (d)
8.	Plant Material		
	a) Container Soil Mix	Contain >20% and <25% by volume of clay.	C273.09 (e)

Table C273.3 - SUMMARY OF LIMITS AND TOLERANCES

ANNEXURE C273.A

**GRASS AND NATIVE SEED MIXTURES
FOR SEEDING AND FERTILISING OF MEDIAN AND ROADSIDE AREAS**

		MINIMUM APPLICATION RATE (Kilograms or grams of seed or fertiliser per hectare of surface)
GRASS SEED	Rye Corn (April- August) or	60 kg/ha
	Japanese Millet (Sept-March)	60 kg/ha
	Hulled Couch	5 kg/ha
	Red Clover (Inoculated)	5 kg/ha
	White Clover (Inoculated)	5 kg/ha
	'Elka' Perennial Rye	5 kg/ha
NATIVE SEED	Acacia dealbata	4 kg/ha
	Acacia buxifolia	1 kg/ha
	Acacia decurrens	1 kg/ha
	Acacia pravissima	1 kg/ha
	Leptospermum lanigerum	1 kg/ha
	Hardenbergia violacea	500 g/ha
	Kennedia prostrata	500 g/ha
	Acacia implexa	200 g/ha
	Banksia marginata	200 g/ha
	Bursaria spinosa	200 g/ha
	Callistemon pallidus	200 g/ha
	Dodonaea viscosa	200 g/ha
ORGANIC FERTILISER	Dynamic Lifter 'Nitro' or Equivalent	1000 kg/ha

