



Construction Specification for Civil Works

C221 – Pipe Drainage

TABLE OF CONTENTS

CLAUSE	CONTENTS	PAGE
	REVISIONS: C221 - Pipe Drainage	2
GENERAL		3
C221.01	SCOPE.....	3
C221.02	DEFINITIONS	3
C221.03	REFERENCE DOCUMENTS.....	3
C221.04	GENERAL	5
C221.05	PIPES.....	6
C221.06	EXCAVATION	6
C221.07	BEDDING, HAUNCH, SIDE ZONE AND OVERLAY MATERIALS.....	6
C221.08	COMPACTION.....	7
C221.09	INSTALLATION.....	8
C221.10	BACKFILL	9
LIMITS AND TOLERANCES		10
C221.11	SUMMARY OF LIMITS AND TOLERANCES	10

ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on AUS-SPEC - Development Construction Specification C221 – Pipe Drainage. Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Armidale Regional Council Specification for Civil Works. The parts of the AUS-SPEC document that remain are still subject to the original copyright.

This document has been developed for use with the construction of civil works within the Armidale Regional Council local government area.

This is not a controlled document. A full copy of the latest version of this document can be found on the Armidale Regional Council Internet website: <https://www.armidaleregional.nsw.gov.au/development/planning-controls-guidelines/construction-specifications/construction-specifications>

REVISIONS: C221 - Pipe Drainage

REVISION	CLAUSES AMENDED	AMENDMENT DETAILS	DATE
0		Original Issue	25/09/2023

GENERAL

C221.01 SCOPE

This Specification covers the supply and installation of pipe culverts for stormwater drainage. **Scope**

This Specification is to be read in conjunction with *C220 - Stormwater Drainage*. **Associated Specifications**

The work to be executed under this Specification consists of supply of pipes, bedding, installation and backfilling. **Extent of Work**

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements Sub-Annexure B2*. **Quality**

C221.02 DEFINITIONS

The Works – Defined as follows: **The Works**

- **Developer Infrastructure Works** - work includes subdivisions and any public infrastructure work associated with an approved Development in the ARC local government area requiring a construction certificate.
- **Contracted Works** – infrastructure work undertaken by a Principal Contractor or subcontractor formally appointed by ARC and supervised by ARC.
- **Internal Works** - infrastructure work undertaken by ARC's day labour workforce.

Constructor – Defined as the organisation responsible for construction of the Works and the Principal Contractor as defined in the *Work Health and Safety Act 2011*. **Constructor**

ARC Representative – Defined as follows: **ARC Representative**

- **Developer Infrastructure Works** – Nominated ARC officer(s) for the approved Development.
- **For Contracted Works** – the Superintendent.
- **For Internal Works** – ARC Asset Owner

Constructor's Representative – Defined as follows: **Constructor's Representative**

- **Contracted Works** – the Principal Contractor's nominated representative as per the relevant contract.
- **Internal Works** – ARC officer responsible for delivery.

Developer's Representative– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of Developer Infrastructure Works. **Developer's Representative**

C221.03 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**

Where not otherwise specified in the relevant Armidale Regional Council (ARC) Construction Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the ARC Construction Specifications at the time of the Works approval. **Currency**

(a) Armidale Regional Council (ARC) Specifications

C220 - Stormwater Drainage.

C230 - Subsurface Drainage.

C241 – Stabilisation.

ARC Specifications

CQC - Quality Control Requirements.

(b) Australian Standards

References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.

Australian Standards

- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1141.51 - Unconfined compressive strength of compacted materials.
- 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 1289.5.4.1 - Compaction control test - Dry density ratio, moisture variation and moisture ratio.
- AS 1289.4.3.1 - Determination of the pH value of a soil - Electrometric method.
- AS 1289.4.4.1 - Determination of the electrical resistivity of a soil - Sands and granular materials.
- AS 1289.E6.1 - Compaction control test - Density index method for a cohesionless material.
- AS 1397 - Steel sheet and strip - Hot dipped zinc coated or aluminium/zinc coated.
- AS 1646 - Elastomeric seals for waterworks purposes.
- AS 3725 - Loads on buried concrete pipes.
- AS 4058 - Precast concrete pipes (pressure and non-pressure).
- AS 4139 - Fibre-reinforced concrete pipes and fittings.
- AS 5065 - Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.
- AS/NZS ISO 9002 - Quality systems - Model for quality assurance in production, installation and servicing.

(c) Safework NSW Publications

Excavation Work Code of Practice

Safework NSW

(d) ARC Standard Drawings Applicable to this Specification

- 080-028 Precast Components for Kerb Inlet Lintels.
- 080-029 Precast Components for Stormwater Pits.
- 080-031_1 Rear Access Gully Pit Pipes up to DN600.
- 080-031_2 Rear Access Gully Pit Pipes greater than DN600.
- 080-032 Standard Junction Pit.
- 080-033 Standard Grated Gully Pit in Concrete Accessways.
- 080-034 Surface Inlet Pit Concrete Lid.
- 080-035 Standard Grated Kerb Inlet Pit.
- 080-036 Standard Surface Inlet Surcharge Pits.
- 080-037 Standard Pathway Grated Kerb Inlet Pit.
- 080-038 Standard Straight Headwall.
- 080-039 Cast Insitu Grated V Drain Pit For Rollover Kerb or Dish Drain.

ARC Standard Drawings

- 080-040 Precast Stormwater Pit Installation.
- 080-041 Bandage Joint Details.
- 080-042 Sandbag Headwall.
- 080-043 Riprap Outlet Protection DN300 to DN600.
- 080-044 Riprap Outlet Protection DN750 to DN2100.

ARC Standard Drawings shall take precedence over ALL other drawings related to the Works. **Precedence**

Where any ARC Standard Drawings conflicts with this Specification, the requirements of this Specification shall take precedence. Proposals to deviate from this Specification shall constitute a **HOLD POINT**.

HOLD POINT	Hold Point
<p>All proposed deviations from the approved design drawings, ARC Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the ARC Representative with supporting evidence at least five (5) working days prior to the work being undertaken.</p> <p>PROCESS HELD: The lot or element affected by the proposed deviation.</p>	

C221.04 GENERAL

Pipes shall not be placed in position until the Constructor has produced documentary evidence to the ARC Representative that the manufacture of the products to be used in the Works has complied with the Manufacturer's Quality Plan developed in accordance AS/NZS ISO 9002. **Compliance with Quality Plan**

Documentation shall comprise a conformance certificate to AS 4058 or AS 4139 as appropriate for each batch of pipes to be included in the Works. Conformance certificates are to be supplied at least 24 hours in advance of dispatch to the Works site. **Certification**

HOLD POINT	Hold Point
<p>A conformance certificate, accompanied by quality records, detailing that all pipes and associated structures (eg: headwalls) are manufactured in accordance with C221.04, shall be submitted to the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least five (5) working days prior to the proposed installation of pipes.</p> <p>PROCESS HELD: Installation of Pipes.</p>	

Each unit shall be marked at time of manufacture with: **Marking**

- (a) Class and size.
- (b) Manufacturer's name.
- (c) Date of casting.

The Constructor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction. **Excavation Drainage**

Culverts shall be installed within 10mm of the grade line and within 10mm of the horizontal alignment specified on the approved design drawings. The Constructor shall relay any culvert which is not within these tolerances. **Tolerances**

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 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100mm above the invert level of the culvert or headwall.

Subsurface Drain

The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with C230 - *Subsurface Drainage*.

Where the Constructor proposes to travel construction plant in excess of 5 tonnes gross mass over pipes and culverts, the Constructor shall design and provide adequate protective measures at the crossing point for the pipes and culverts and shall submit the proposals to the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works) for approval.

Construction Plant Movement

C221.05 PIPES

Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the approved design drawings.

Precast Reinforced Concrete Pipes

Fibre-reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the approved design drawings.

Fibre-Reinforced Concrete Pipes

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 manufacturer.

Joints

Polyvinyl Chloride (PVC) pipes shall comply with AS 1254 and shall be of the class and size shown on the approved design drawings.

PVC Pipes

Polypropylene pipes and fittings shall comply with AS 5065 and shall be of the class and size shown on the approved design drawings.

Polypropylene Pipes

C221.06 EXCAVATION

Unless otherwise indicated on the approved design drawings or approved by the ARC Representative, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

Formation to Subgrade Level

In undertaking trench excavation, the Constructor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements including the *Safework NSW Excavation Work Code of Practice*. Records documenting compliance with this Code, and other Statutory requirements shall be kept on the Works site.

Safety

C221.07 BEDDING, HAUNCH, SIDE ZONE AND OVERLAY MATERIALS

The materials surrounding the pipe shall be in accordance with this Specification, AS 3725 (including AS 3725 Supplement 1) where proposed deviations from this Specification are deemed appropriate.

Material Conformance

AS 3725 shows the location of each material zone for both embankment and trench applications.

Bedding Dimensions

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 C221.1, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6. Select fill material in the side and overlay zones, for pipe support type HS, shall also comply with Table C221.1.

Material Requirements

Sieve Size (mm)	Weight passing %	
	Bed and Haunch Zones	Select Fill in Side and Overlay Zones
75.0	—	100
19.0	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 C221.1 - Bedding Material Grading Limits

Backfill material, obtained either from the excavation or another source, shall contain less than 20% (by mass) of stones sized between 75mm and 150mm and none larger than 150mm.

All material shall be compacted in layers not exceeding 150mm compacted thickness for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Source

HOLD POINT

The Constructor shall nominate all materials for each zone and shall provide suitable evidence of compliance to the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least five (5) working days prior to placement.

PROCESS HELD: Placement of Nominated Material(s)

Hold Point

C221.08 COMPACTION

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 ARC Representative, is neither less than 60% nor more than 90% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Layers

Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table C221.2 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

Moisture Content

Compaction shall be undertaken in a manner that minimises the risk of damage to the pipe structure(s). Vibratory rollers exceeding 1 tonne in weight shall not be used within 2m of the pipe structure(s). The Constructor shall be responsible for rectifying any damaged pipes, or related infrastructure, resulting from the use of unsuitable compaction methods or devices.

Compaction Requirements

		Pipe Support Type						
		U	H1	H2	H3	HS1	HS2	HS3
Minimum Relative Compaction %	Bed and Haunch Zones	—	50	60	Concrete	50	60	70
AS 1289.5.4.1 (Standard Compaction)	Side Zones: Cohesionless	—	—	—	—	50	60	70
	Cohesive	—	—	—	—	85	90	95

Table C221.2 - Bedding Material Compaction Requirements

The top 0.1Dmm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is probable the bedding material shall be stabilised in accordance with *C241 - Stabilisation*.

Cementitious Stabilisation

C221.09 INSTALLATION

(a) General

All pipes and other structures shall be stored, handled and installed in accordance with the manufacturer’s recommendations.

Manufacturer’s Recommendations

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.

Positioning of Pipes

In the case of pipes 1200mm 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 Constructor 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, then at a spacing not greater than 1200mm. 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.

Stiffening of Culverts

Removal of Struts

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the ARC Representative or a 3:1 sand:cement mortar before the commencement of backfilling.

Seal Lifting Holes

Bulkheads shall be constructed in accordance with the approved design drawings on all lines where the pipe gradient exceeds 6% at 15m spacings. Anchor blocks shall be installed at 3m spacings, or at bends or junctions, where the pipe gradient exceeds 20%.

Bulkheads

WITNESS POINT

The Constructor shall notify the ARC Representative at least two (2) days prior to the placement of concrete for concrete bulkheads and anchor blocks for inspection and approval by the ARC Representative.

Process Held: Placement of Concrete.

Witness Point

The Constructor shall present the laid and jointed pipes for inspection by the ARC Representative prior to commencement of trench backfilling.

Inspection

WITNESS POINT

Inspection of laid and jointed pipes by the ARC Representative at least three (3) days prior to the placement of backfill. Evidence that the pipes have been laid within the specified tolerances shall be made available to the ARC Representative on request.

PROCESS HELD: Commencement of backfilling.

Witness Point

(b) Joints in Reinforced Concrete Pipes

(i) Rubber Ringed Joints

Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

Clean and Dry Material

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 the ARC Representative.

Procedure for Rolling Rubber Rings

The joint shall be tested to ensure the rubber ring has rolled evenly into place.

Joint Test

Where wedge shaped "skid" rubber rings are prescribed the Manufacturer's instructions, which include the use of lubricants, shall be followed.

"Skid" Rings

(c) Joints in Fibre-Reinforced Cement Pipes

(i) New Pipes

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 C221.08(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

Direct side connections to other pipes shall be as detailed on the approved design drawings.

C221.10 BACKFILL

The remainder of the trench to the underside of pavement, or topsoil, shall be classified as backfill. Where excavation is approved through the selected material zone (SMZ), the section of trench within the SMZ shall be backfilled with selected material.

Trench Backfill

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

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 is neither less than 60% nor more than 90% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Moisture Content

When compacted adjacent to other infrastructure, the Constructor shall adopt compaction methods which will not cause damage or misalignment. Any damage caused shall be rectified, and all costs of such rectification shall be borne by the Constructor. Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

Precautions

Constructor's Cost

LIMITS AND TOLERANCES

C221.11 SUMMARY OF LIMITS AND TOLERANCES

The limits and tolerances for materials and product performance related to the various clauses in this Specification are summarised in Table C221.3 below.

Item	Activity	Limits/Tolerances	Spec Clause
1	Culvert Position		
	(a) Grade Line	± 10mm	C221.04
	(b) Horizontal Alignment	± 10mm	C221.04
2	Bedding		
	(a) Material Requirements	Table C221.1	C221.07
	(b) Bed and Haunch Zone Compaction	Table C221.2	C221.08
3	Backfill - Concrete Pipes		
	(a) Side and Overlay Zone Compaction	Table C221.2	C221.10
	(b) Layer Thickness	< 150mm	C221.10

Table C221.3 - Summary of Limits and Tolerances

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