DEVELOPMENT CONSTRUCTION SPECIFICATION

C221

PIPE DRAINAGE

Amendment Record for this Specification Part

This Specification is 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
EXAMPLE 1	*Provision for acceptance of nonconformance with deduction in Payment*	*XYZ.00*	*AP*	*KP*	*2/6/97*

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 the specification for 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
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.D3.1	-	Determination of the pH value of a soil - Standard method.
AS 1289.D4.1	-	Determination of the electrical resistivity of 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 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 4058	-	Precast concrete pipes
AS 4139	-	Fibre reinforced concrete pipes and fittings.

COMMON REQUIREMENTS

C221.03 GENERAL

1. Pipes and/or pipe arches shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent that cracking load testing, as required by the appropriate Australian Standards and this Specification has been carried out and the representative specimens have satisfied the cracking load test requirements. ***Load Testing***

2. The cost of these tests is deemed to be part of the supply and installation Pay Item C221(a). ***Costs***

3. The Contractor 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***

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

5. 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. The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with the Specification for SUBSURFACE DRAINAGE. ***Subsurface Drain***

6. Backfilling for culverts shall be undertaken in a safe manner and in accordance with all statutory requirements. ***Safety***

7. Where the Contractor proposes 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 the Superintendent 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 as recommended by the manufacturer. ***Joints***

C221.05 CONDITIONS OF INSTALLATION

1. Unless otherwise indicated on the Drawings or approved by the Superintendent, 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 and AS3725 and AS3725 Supplement 1 for Type HS3 support.

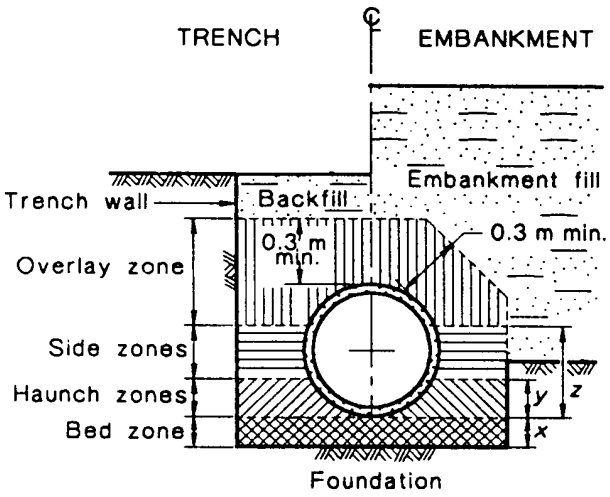
3. For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified below. The trench shall not be excavated wider than 1.4 times the external diameter of the pipe plus 300mm. ***Normal Trench Conditions***

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***

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***

Sieve size mm	Weight passing %
19.0	100
2.36	50 - 100
0.60	20 - 90
0.30	10 - 60
0.15	0 - 25
0.075	0 - 10

Table C221.2
Bedding Material Grading Limits

4. The Contractor shall advise the Superintendent of the source of bedding material. ***Source***

5. Bedding material in the bed and haunch zones shall be placed and compacted in accordance with the Specification for STORMWATER DRAINAGE - GENERAL. If the bedding material is cohesionless it shall be compacted to a minimum density index of 70 per cent as determined by AS 1289.E6.1. The top of the bedding material shall be shaped accurately to house the pipe. ***Compaction Requirements***

6. Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is considered by the Superintendent to be a likely problem, the Superintendent may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones. ***Cementitious Stabilisation***

C221.07 INSTALLATION

(a) General

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. ***Positioning of Pipes***

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. ***Stiffening of Culverts***

3. Lifting holes in all pipes shall be sealed with a 3:1 sand: cement mortar before the commencement of backfilling. ***Seal Lifting Holes***

(b) Joints in Reinforced Concrete Pipes

(i) Rubber Ringed Joints

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. ***Clean and Dry Material***

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 the Superintendent. ***Procedure***

3. The joint shall be tested to ensure that the rubber ring has rolled evenly into place. ***Joint Test***

(ii) Flush or Butt Joints

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. ***Jointing***

(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.

C221.08 BACKFILL

1. Backfill to the side and overlay zones shall consist of Selected Backfill as defined in the Specification for EARTHWORKS. It shall be placed around the pipe to the dimensions shown in Figure C221.1 and compacted in accordance with the requirements in the Specification for STORMWATER DRAINAGE - GENERAL. The remainder of the trench to the underside of the selected material zone as specified in the Specification for EARTHWORKS shall be backfilled with material satisfying the requirements for embankment material as defined in the Specification for 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 the Specification for EARTHWORKS. ***Procedure***

2. Backfilling on both sides of the culvert and both sides of the wingwalls shall be carried out simultaneously. Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement. ***Sequence***

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. ***Specification***

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. ***Specification***

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

1. Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and AS 2042. ***Specification***

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. ***Engineer's Certification***

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. ***Corrosion***

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 if necessary so as to represent the condition and grading when compacted and in service.

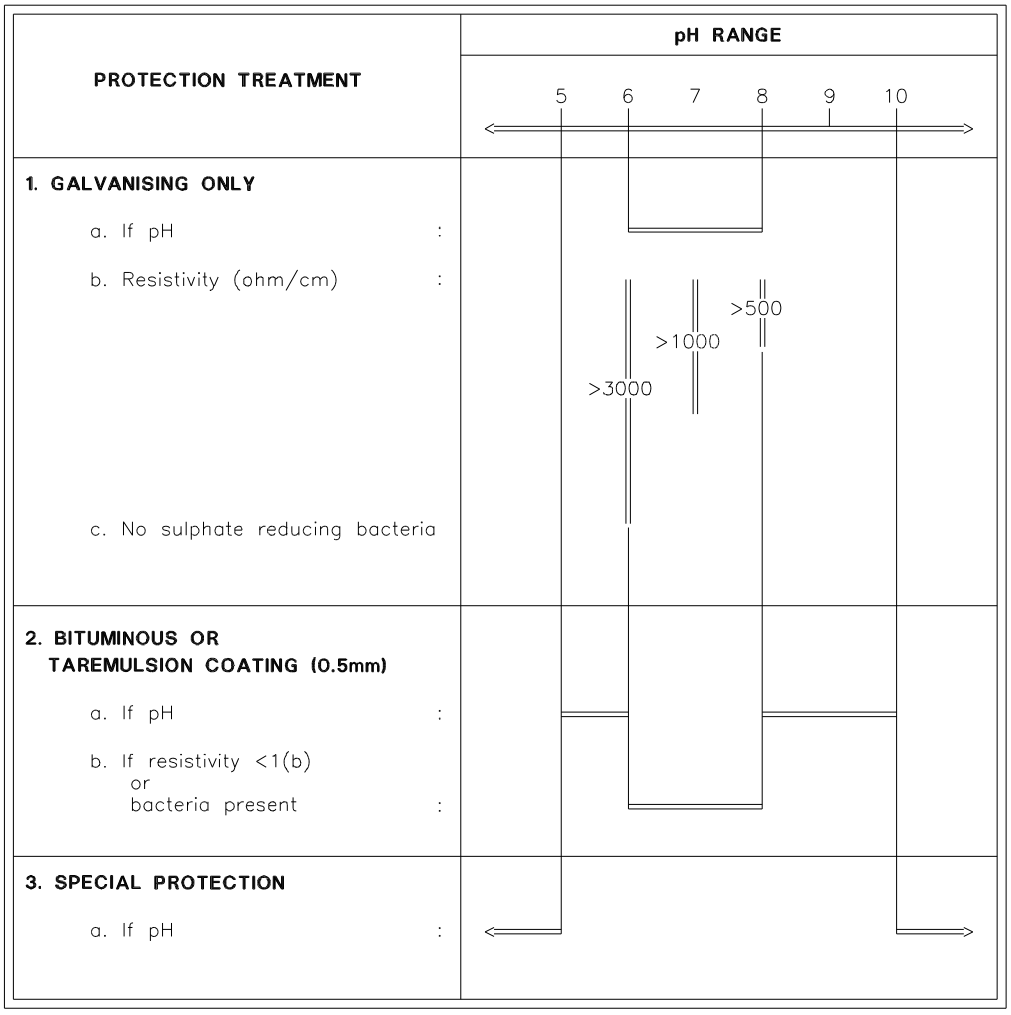


Figure C221.2
CORROSION PROTECTION REQUIREMENTS FOR STEEL STRUCTURES

C221.14 FOUNDATION PREPARATION

1. Foundation preparation shall be in accordance with this Specification together with AS 1762 or AS 2042, as appropriate. ***Specification***

C221.15 BEDDING

1. Bedding material for the bed and haunch zones shall meet the requirements of Clauses C221.05 and C221.06. The bedding shaping shall be wide enough to ensure efficient compaction of material under the haunches of the pipe. ***Bedding Width and Compaction***

2. A uniform blanket of loose sand or other fine granular material approved by the Superintendent shall be placed on the shaped, compacted bedding to a depth sufficient to allow the corrugations to become filled with the material. ***Corrugations to be filled***

C221.16 INSTALLATION

(a) General ***Manufacturer's Recommen-dations***

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 the Superintendent before assembly or laying of the culverts is commenced.

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. ***Temporary Bracing***

(b) Joints

1. Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2042. ***Method***

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. ***Ends to be Rerolled***

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. The fabric used shall be 'Bidim U14' or an equivalent fabric approved by the Superintendent. ***Filter Fabric Cover Material***

C221.17 BACKFILL

1. Selected backfill material as defined in the Specification for EARTHWORKS shall be placed around the steel pipe or structure to a minimum dimension of 500mm beyond the maximum pipe width on both sides and in accordance with the provisions of Clause C221.08 except that the maximum size of any particle shall not exceed 25mm. ***Specification***

2. The Contractor shall check the shape of the culvert during backfilling 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 or plus or minus 4 per cent for 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 a 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 by non-metallic supports. ***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***

UPVC PIPES

C221.19 CULVERT MATERIALS

1. Unplasticised PVC (UPVC) Pipes and Fittings shall be manufactured in accordance with AS 1254. ***Specification***

C221.20 INSTALLATION

1. The materials utilised, the excavation requirements, bedding, backfill and jointing requirements for UPVC pipes are those set out in Section 7 of AS 2032. Installation of all UPVC pipes shall comply with the requirements of this Australian Standard.

SPECIAL REQUIREMENTS

C221.21 RESERVED

C221.22 RESERVED

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) Compacted Layers	< 150mm	C221.06
3.	**Installation**		
	(a) Normal Trench (i) Trench Width	<1.4 x External Diameter + 300mm	C221.05
	(b) Pipe Length	> 1.2m	C221.07a
	(c) Strut Stiffening (i) Timber Size	> 100mm x 100mm	C221.07a
	(ii) Spacing	< 1200mm	C221.07a
4.	**Sprayed Concrete** (a) Over crest of corrugations over bottom third of pipe circumference	> 100mm	C221.18

Table C221.2 - Limits and Tolerances

MEASUREMENT AND PAYMENT

C221.27 PAY ITEMS

1. Payment shall be made for all activities associated with completing the work detailed in this Specification on a Schedule of Rates basis in accordance with Pay Item C221(a).

2. If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

3. Pipe tested to destruction and complying with the ultimate load requirements shall be paid for at the factory supply rate only.

4. Subsoil drains at pits and headwalls are measured and paid in accordance with this Specification and not in the Specification for SUBSURFACE DRAINAGE - GENERAL.

5. Selected material around pipes and trench backfill in embankment material to the underside of the selected material zone is measured and paid in accordance with this Specification and not in the Specification for EARTHWORKS.

6. Sprayed concrete invert protection is measured and paid in accordance with this Specification and not in the Specification for MINOR CONCRETE WORKS.

7. Miscellaneous minor concrete work not included in the pay items in this specification shall be in accordance with pay items described in the Specification for MINOR CONCRETE WORKS.

Pay Item C221(a) PIPE CULVERTS

1. The unit of measurement shall be the linear metre measured along the centreline of each particular type, class and size of stormwater drainage pipe culvert and shall be the plan length between centres of gully pits or faces of headwalls.

2. The schedule rate shall include:

- Supply
- Survey and setting out
- Bedding
- Jointing (including connections)
- Subsoil drains at pits and headwalls
- Temporary bracing and strutting
- Bituminous painting
- Sprayed concrete lining and other protective measures
- Selected material backfilling
- Embankment material trench backfilling
- Quality testing.

SPECIFICATION C221 - PIPE DRAINAGE