



WESTERN AUSTRALIA SPECIFICATION

224

OPEN DRAINS

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
<i>EXAMPLE 1</i>	<i>Provision for acceptance of nonconformance with deduction in Payment</i>	<i>XYZ.00</i>	<i>AP</i>	<i>KP</i>	<i>2/6/97</i>

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SPECIFICATION 224 : OPEN DRAINS

GENERAL

224.01 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 gutters and the construction of rock filled wire mattresses and gabions.

2. This Specification should be read in conjunction with the Specification for STORMWATER DRAINAGE - GENERAL and other drainage Specifications as applicable:

- | | | |
|-----|---|----------------------|
| 221 | - | Pipe Drainage |
| 222 | - | Precast Box Culverts |
| 223 | - | Drainage Structures |

3. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the Specification Part for Quality Requirements.

Quality

224.02 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, grated drains, and gutters.

Definition

224.03 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

- | | | |
|-----|---|--------------------------------------|
| 211 | - | Control of Erosion and Sedimentation |
| 220 | - | Stormwater Drainage - General |
| 221 | - | Pipe Drainage |
| 222 | - | Precast Box Culverts |
| 223 | - | Drainage Structures |
| 271 | - | Minor Concrete Works |
| 273 | - | 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 2758.4 | - | Aggregate for gabion baskets and wire mattresses. |
| AS 1650 | - | Hot-dipped galvanised coatings on ferrous articles. |

(c) Other

AUSTROADS - Guide to Geotextiles

UNLINED OPEN DRAINS

224.04 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, unless shown on the Drawings or directed otherwise by the Superintendent, shall not have a grade of less than 1 per cent. **Grade**
3. Where trees marked for preservation or rock outcrops occur in the line of a drain, the drain may be neatly diverted if approved by the Superintendent. **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 or directed by the Superintendent. **Open Drains**
5. Open drains shall be located and constructed so as to avoid recharging groundwater encouraging a shallow water table and creating or worsening salinity degradation of adjacent land. **Salinity Prevention**
6. All work shall be undertaken in accordance with the requirements of the Specification for CONTROL OF EROSION AND SEDIMENTATION. **Control of Erosion**

224.05 TYPES

1. Catch drains shall be provided above the tops of cuttings or along the toes of embankments where shown on the Drawings or as directed by the Superintendent before construction of the adjacent roadway. The edges of catchdrains shall be positioned not 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 unless otherwise approved by the Superintendent. **Catch Drains**
2. Minor diversion and contour drains shall be constructed where shown on the Drawings or directed by the Superintendent. 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 stream bed in a regular manner, avoiding disturbance in stream flow. The channel shall be excavated to the full width of the structure but the existing stream bed shall be preserved as far as possible outside the limits of the excavation. **Channels**

224.06 CONSTRUCTION

- | | |
|--|---|
| 1. Material excavated from drains shall be placed on the lower sides of the drains and formed as banks with side slopes not steeper than 4h:1v on the cross section of the bank to increase the capacity of the drains. This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95 per cent for standard compactive effort. | <i>Excavated Material</i> |
| 2. The Contractor shall ensure that none of the activities associated with the work disturbs 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. | <i>Contractor's Responsibility</i> |
| 3. Any excess material shall be disposed of by the Contractor at locations and in a manner approved by the Superintendent. | <i>Excess Material</i> |
| 4. Unlined drains and areas adjacent to open drains shall be revegetated immediately after the drains are complete, in accordance with the Specification for LANDSCAPING. | <i>Revegetation</i> |

LINED OPEN DRAINS**224.07 GENERAL**

- | | |
|--|---|
| 1. Lined open drains shall be formed as for unlined open drains with the inclusion of a lined invert in accordance with the Drawings, or as directed by the Superintendent. | <i>Shape</i> |
| 2. Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain. | <i>Profile</i> |
| 3. Before placing any lining material, the foundation material shall be shaped and compacted to form a firm base for the lining. 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. | <i>Compaction of Foundations</i> |

224.08 CONCRETE LINING

- | | |
|---|----------------------------------|
| 1. Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed in accordance with the Specification for MINOR CONCRETE WORKS. Weepholes shall be provided in the concrete at intervals of 2m or as determined by the Superintendent. | <i>Method</i> |
| 2. The top of the finished lining shall be true to line and of uniform width, free from humps, sags or other irregularities. | <i>Finish</i> |
| 3. The level at any point on the surface of the lining shall be within ± 20 mm of design levels. When a straight edge 3m long is laid on top of the lining parallel to the direction of flow, the surface shall not vary more than 10mm from the edge of the straight edge. | <i>Tolerances</i> |
| 4. Unless shown otherwise on the Drawings, contraction joints shall be formed every 3m of lining length for a minimum of 50 per cent of cross sectional area. The joint shall be tooled a minimum of 20mm in depth to form a neat groove of 5mm minimum width. | <i>Contraction Joints</i> |
| 5. Unless shown otherwise on the Drawings, expansion joints, 15mm in width for the full depth of the concrete lining, shall be constructed at intervals not exceeding 15m. | <i>Expansion Joints</i> |

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Expansion joints shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

224.09 STONE PITCHING

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.

Rock Quality and Placing

224.10 BATTER DRAINS

1. Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the Drawings.

Type

2. The units shall be installed in carefully excavated and template controlled trench to produce an even top edge of batter drain of +0mm to -50mm from the batter line at the underside of topsoil.

Installation

3. Any over excavation and undulations in the batter line shall be backfilled and both sides of the drain compacted over the full length to form a firm shoulder against the top edge of the batter drain.

Compaction

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 the Specification for LANDSCAPING.

Topsoil and Turfing

224.11 PROPRIETARY PRODUCTS

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

Manufacturer's Instructions

224.12 RESERVED

224.13 RESERVED

ROCK FILLED WIRE MATTRESSES AND GABIONS

224.14 GENERAL

1. Rock-filled wire mattresses and gabions shall be placed at the locations shown on the Drawings. Installation shall be in accordance with the manufacturer's instructions. A geotextile, as shown on the Drawings, shall be placed between the wire cage and the material being protected.

Location and Geotextile

2. Before installation of rock-filled wire mattresses, the foundation material shall be excavated such that the mattresses finish flush with the surrounding ground. Where mattresses are used to line open drains, the foundation material shall be shaped and compacted, in accordance with AS 1289.5.4.1 and shall not be less than 95 per cent for standard compactive effort, to form a uniform channel cross-section prior to installation of mattresses.

Foundation Material

224.15 MATERIALS

1. 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) Wire Mattresses

1. Unless otherwise specified or shown on the Drawings, the wire mattresses shall be supplied in units having dimensions of 6m x 2m x 230mm, and shall be cut to suit areas as shown on the Drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600mm. Unless otherwise specified, they 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 60mm x 80mm and body wire shall be a minimum diameter of 2.0mm heavily galvanised with an additional minimum thickness of 0.4mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7mm and 2.2mm respectively.

***Wire
Dimensions***

(b) 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.

***Gabion
Dimensions***

2. Gabions shall have a nominal mesh size of 80mm x 100mm and body wire shall be a minimum diameter of 2.7mm heavily galvanised with an additional thickness of 0.4mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4mm and 2.2mm 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 AUSTROADS Guide to Geotextiles, shall be used.

Type

2. Samples, manufacturer's specification and instructions on installation shall be submitted to the Superintendent seven days before the intended use of geotextile. This action shall constitute a **HOLD POINT**. The Superintendent's approval to the quality test documentation and procedure is required prior to the release of the hold point.

Sample

HP

(d) Rock Fill Material

1. The rock fill shall consist of clean hard rock complying with the requirements of AS 2758.4.

Rock Quality

2. Rock fill for wire mattresses shall have particle sizes between 75mm and two-thirds of the mattress thickness, or 250mm, whichever is the lesser. 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 by 25mm to 50mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

***For Wire
Mattresses***

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3. Rock fill for gabions shall have particle sizes between 100mm and 250mm and preferably not greater than 200mm. Rock fill material may be placed by hand or suitable mechanical device to ensure fill is 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

224.16 ASSEMBLY AND ERECTION

1. Before laying out the wire mattresses or gabions, geotextile 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

SPECIAL REQUIREMENTS

224.17 RESERVED

224.18 RESERVED

LIMITS AND TOLERANCES

224.19 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table 224.1 below.

Item	Activity	Limits/Tolerances	Spec Clause
1.	Unlined Open Drains		
	(a) Grading	Grade >1%	224.04
	(b) Depth	>300mm	224.04
	(c) Waterway Area	>0.2 sq m	224.04
	(d) Catch Drain Location	>2m from top of cuttings or toes of embankments	224.05
	(e) Compaction	> 95% (standard compaction)	224.06
2.	Lined Open Drains		
	(a) Compaction of Foundation	>95% (standard compaction)	224.07
	(b) Level of lining surface	Level $\leq \pm 20$ mm of design level	224.08
	(c) Surface uniformity	Deviation lining surface from 3m straight edge ≤ 10 mm	224.08
3.	Rock Fill for Gabions and Wire Mattresses		
	(a) Compaction of Foundation	>95% (standard compaction)	224.14
	(b) Wet Strength	>100kN	224.15d
	(c) Wet/Dry Strength variation	<45%	224.15d
	(d) Particle size for Wire Mattresses	>75mm <150mm	224.15d
	(e) Particle size for Gabions	>100mm <250mm	224.15d
	(f) Gabion fill Level	>25mm <50mm above top of mesh	224.15d
4.	Erection of Wire Mattresses		
	(a) Star pickets for ties	Depth in ground >900mm Spacing <1m	224.16
	(b) Trench depth for upstream edge	>300mm	224.16

Table 224.1 - Summary of Limits and Tolerances

MEASUREMENT AND PAYMENT

224.20 PAY ITEMS

1. Payment shall be made for all the activities associated with completing the work detailed in this Specification on a Schedule of Rates basis in accordance with Pay Items 224(a) to 224(h) inclusive.
2. A lump sum price for any of these items shall not be accepted.
3. 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.
4. Erosion and sedimentation control measures are measured and paid in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION.
5. Sprayed concrete lining of open drains is measured and paid in accordance with the Specification for MINOR CONCRETE WORKS.
6. Cast-in-situ concrete or other lining of open drains is measured and paid in accordance with this Specification and not with 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.
8. Topsoiling and turfing to sides of batter drains are measured and paid in accordance with the Specification for LANDSCAPING.

Pay Item 224(a) EXCAVATION - CATCH, CONTOUR AND MINOR DIVERSION DRAINS

1. The unit of measurement shall be the linear metre measured along the invert of the drain.
2. The placement and compaction of material excavated from the drains on the lower sides of the drains to form banks shall be included in the excavation rates.
3. The schedule rate for excavation shall allow for excavation of all types of material. Separate rates shall not be included for earth and rock.
4. Any temporary measures for the control of stormwater runoff shall be included in the rate for excavation.

Pay Item 224(b) EXCAVATION - INLET, OUTLET AND DIVERSION CHANNELS

1. The unit of measurement shall be the cubic metre measured from cross sections on the drawings using the end area method, or as "each" where minor work is involved.
2. The disposal of surplus material shall be included in the excavation rates.
3. The schedule rate for excavation shall allow for excavation of all types of material. Separate rates shall not be included for earth and rock.
4. Any temporary measures for the control of stormwater runoff shall be included in the rate for excavation.

Pay Item 224(c) CONCRETE LINING OF OPEN DRAINS

1. The unit of measurement shall be the square metre of concrete in place.
2. The schedule rate under this Pay Item shall include all the operations involved in the surface preparation, supply and placing of concrete, jointing and curing.

Pay Item 224(d) STONE PITCHING OF OPEN DRAINS

1. The unit of measurement shall be the square metre of stone pitching in place.
2. The schedule rate under this Pay Item shall include all the operations in the surface preparation, supply of stone, placing, final trimming and mortar jointing.

Pay Item 224(e) BATTER DRAINS

1. The unit of measurement shall be linear metre along the length of the drain formed by batter drain units.
2. The schedule rate shall include supply of the units, excavation, installation, backfilling and compaction.

Pay Item 224(f) ROCK FILLED GABIONS

1. The unit of measurement shall be the cubic metre of rock filling.
2. The volume shall be taken from the Drawings with appropriate adjustments being made for any authorised changes.
3. The schedule rate shall include the supply and placement of geotextile material behind the gabions, the supply and assembly of the gabions, the supply and placing of the rock fill in the gabions.

Pay Item 224(g) ROCK FILLED WIRE MATTRESSES

1. The unit of measurement shall be the square metre of rock filled mattress complete.
2. The area shall be determined from the actual completed work and shall include the area folded into the trench.
3. The schedule rate shall include the supply and placement of geotextile material, star pickets and ties as specified, together with the supply and assembly of the wire mattresses and the supply and placing of the rock fill.