

Development Specifications

C402 SEWERAGE SYSTEM CONSTRUCTION

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SPECIFICATION C402 - SEWERAGE SYSTEM

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SPECIFICATION C402: SEWERAGE SYSTEM

GENERAL

C402.01 SCOPE

1. This Specification applies to the construction of:
- gravitation sewers up to DN600 nominal size;
 - rising mains up to DN600 nominal size;
 - standard appurtenances such as maintenance chambers, shafts and sidelines;
 - pumping stations.

C402.02 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 Specification

- C201 - Control of Traffic
C211 - Control of Erosion and Sedimentation
C271 - Minor Concrete Works
Specification for the Installation of Domestic Sewage Pumping Stations

(b) Australian Standards

- AS 1214 - Hot-dip galvanized coating on threaded fasteners
AS 1260 - Unplasticised PVC (uPVC), pipes and fittings for sewerage applications.
AS 1289.5.7.1 - Compaction control test (Rapid method).
AS 1444 - Wrought alloy steels - Standard and hardenability (H) series.
AS1477 - Unplasticised PVC (uPVC) pipes and fittings for pressure applications
AS 1565 - Copper and copper alloys - Ingots and castings.
AS 1627 - Metal finishing - Preparation and pre-treatment of surfaces
AS 1646 - Elastomeric seals for waterworks purposes.
AS 1650 - Hot-dipped galvanized coatings on ferrous articles.
AS 1741 - Vitrified clay pipes and fittings with flexible joints - Sewer quality.
AS 1830 - Iron castings - Grey cast iron.
AS 1939 - Degrees of protection provided by enclosures for electrical equipment
AS 2032 - Code of practice for installation of uPVC pipe systems.
AS 2129 - Flanges for pipes, valves and fittings.
AS/NZS 2280 - Ductile iron pressure pipe and fittings.
AS 3000 - Electrical installations (SAA Wiring Rules).
AS 3439 - Low-voltage switchgear and control gear assemblies.
AS 3972 - Portland and blended cements.
AS 4060 - Loads on buried vitrified clay pipes.
AS 4198 - Precast concrete access chambers for sewerage applications.

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(c) Other

PWD-EDS E101	General Requirements for Building Services (Electrical Installations)
PWD-B	- General Requirements for Water Supply, Section B
AWSSA	- Australian Water Supply and Sewerage Authorities Specification of Technical Requirement
WSA - 02	Sewerage Code of Australia (Water Services Association of Australia)
WSA - 04	Sewage Pumping Station Code of Australia (Water Services Association of Australia)

MATERIALS

C402.03 UNPLASTICISED PVC

1. Unplasticised PVC (uPVC) pipes and fittings for gravity systems shall be manufactured in accordance with AS1260 suitable for rubber ring joints. **Non-pressure Pipe**
2. Where non-pressure pipe is laid at a depth greater than 3 metres from the finished ground level to pipe invert, class SEH pipe or equivalent shall be used. Class SH or equivalent shall be used elsewhere.
3. Unplasticised PVC (uPVC) pipes and fittings for rising mains and suction pipes shall be manufactured in accordance with AS1477 Class 12 suitable for rubber ring joints. **Pressure Pipe**
4. Rubber rings shall comply with AS1646. **Rubber Rings**

C402.04 DUCTILE IRON

1. Ductile iron (DI) pipes and fittings shall be manufactured in accordance with AS/NZS 2280 Class K9 suitable for the patented "Tyton" type rubber ring joint. **Standard**
2. Flanges shall comply with AS2129 Table D. Bolts and nuts for flanged joints shall be in accordance with AS2129 and galvanised in accordance with AS1214. **Flanges**
3. The type of external corrosion protection of buried pipelines shall be as shown on the Drawings. **Corrosion Protection**

C402.06 PRECAST MAINTENANCE HOLES

1. Precast maintenance hole components shall comply with AS 4198.

C402.07 MAINTENANCE HOLE AND SHAFT COVERS

1. Cast iron maintenance hole covers and frames shall be "Gatic" or approved equivalent suitable for concrete filling. The type shall be as shown on the Drawings. **Cast Iron**

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C402.08 STEELWORK

1. Structural steelwork, ladders, brackets, covers etc shall be abrasive blast cleaned to AS1627 Class 3 and hot dip galvanised to AS1650.

**Corrosion
Protection**

PIPELINE CONSTRUCTION

C402.09 LOCATION

1. The location of the sewers, maintenance holes, rising mains and pumping stations, sizes and grades of sewers and rising mains, the types of maintenance holes and maintenance hole covers and the classes of pipes are shown on the Drawings. Laying of pipelines shall commence at the lower end of the line unless directed otherwise by the Sewer Authority's Representative. The pipelines shall be laid to grades and locations shown on the Drawings.

General

C402.10 COVER OVER PIPELINES

1. The minimum depth of cover to be provided for rising mains shall be as follows:

**Minimum
Cover**

LOCATION OF PIPE	GRAVITATION SEWERS ALL PIPES	RISING MAINS	
		uPVC	DI
1. Areas not subject to vehicular loading:	450mm	450mm	450mm
2. Areas subject to vehicular loading:			
a) not in roadway	600mm	600mm	600mm
b) in sealed roadway	750mm	600mm	600mm
c) in unsealed roadway	750mm	750mm	600mm

2. Lesser covers may be permitted where special protection of the pipelines has been specified.

**Special
Protection**

C402.11 CROSSINGS

1. Where a pipeline crosses a road, creek or involves features under the control of any Authority, the affected work shall be carried out in accordance with the requirements of that Authority. The Developer shall obtain approval from the Authority concerned for the work and complete written notification to the Authority of the intention to carry out the work.

**Contractor's
Responsibility**

C402.12 EARTHWORKS

1. All excavations for structures and pipelines shall be to the lines, grades and forms shown on the Drawings within the specified tolerances.

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2. The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of spoil banks. No excavated materials shall be stacked against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.

***Excavated
Material***

3. At completion of work each day, safety fencing shall be installed along edges of open excavations to isolate them from the public. Where necessary, fenced walkways and vehicular crossways shall be provided across trenches to maintain access from carriageway to individual properties or within individual properties. All such installations shall be of adequate size and strength and satisfactorily illuminated.

Public Safety

Excavations over 1.2m in depth are to be covered if fencing is not man proof.

4. The connection of new works to existing sewerage systems shall be undertaken by experienced Contractors in compliance with a Safe Work Method Statement and Occupational Health and Safety requirements or by Council at the Applicants cost.

***Connection to
existing
sewers***

The decision as to who will make the connection to live sewers constitutes a Hold Point.

Hold Point

5. If the Contractor elects to undertake the connection to the existing system, fourteen days prior to connection of new works to existing sewers the Contractor is to provide a copy of their Safe Work Method Statement to the Sewer Authority. The Safe Work Method Statement shall be prepared by a responsible person, experienced in this type of work and conform with the requirements of the current Occupational Health and Safety Regulations. A copy of the Work Method Statement shall be kept on site at all times and be available for inspection by the Sewer Authority's Representative. Council will not approve the Contractors Safe Work Method Statement, but reserves the right to require modifications prior to implementation.

***Work Method
Statement***

6. If the Applicant or Contractor nominates Council to undertake the connection to the existing system, the request is to be made in writing, accompanied by adequate plans identifying the location and type of connection required and payment of the required fee.

***Application for
Council to
undertake
connection***

7. The Developer shall provide traffic control in compliance with Section C201 of Councils place based DCP.

Traffic Control

8. The Sewer Authority will not be liable for any claims (including delays) from the Developer or Contractor or other personnel for non-inspection or re-inspection due to apparent non-compliance with any requirements, whether or not that non-compliance is subsequently proved or not.

Claims

C402.13 MINIMUM TRENCH WIDTH FOR PIPELINES

1. The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table C402.1.

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NOMINAL SIZE OF PIPE (DN)	MINIMUM CLEAR WIDTH OF TRENCH (mm) (inside timbering or sheet piling, if any)	
	PIPE OTHER THAN uPVC	uPVC PIPE
80	400	350
100	400	350
150	450	400
200	500	450
225	550	500
250	550	500
300	600	550
375	700	
400	700	
450	750	
500	850	
525	850	
600	950	

Table C402.1

2. Where a trench is excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut by saw cutting, or other approved means, so as to provide a neat straight line free from broken ragged edges

C402.14 MAXIMUM TRENCH WIDTH

1. For gravitation sewers or rising mains of pipe materials other than uPVC, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table C402.2.

Pipes other than uPVC

2. The Sewer Authority may, however, restrict the width of trench due to local conditions. The Sewer Authority shall not restrict the width of trench to less than shown in column (iii) of Table C402.2.

Width Restrictions

3. Where the depth to invert exceeds that shown in column (ii) of Table C402.2, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in column (iii) of Table C402.2.

Depth

Nominal Size of Pipe (mm)	Maximum Depth to Invert, Unlimited Width Trench (m)	Maximum Trench Width, Depths Greater than in Column (ii) (mm)
(i)	(ii)	(iii)
150	8.0	750
225	6.5	825
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

Table C402.2

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4. For gravitation sewers or rising mains of uPVC pipe the maximum width of trench from the trench base to a height of 150mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580mm plus the outside diameter of the pipe barrel. ***uPVC Pipe***

C402.15 EXCAVATION DEPTH

1. For gravitation sewers to be laid on other than rock foundation (other than uPVC pipe), excavation shall be carried out to a depth of not less than 75mm below the underside of the pipe barrel and socket or coupling. ***Other than Rock Foundations***

2. For gravitation sewers to be laid on rock foundation (other than uPVC pipe), excavation shall be carried out to a depth of not less than 100mm below the underside of the pipe barrel and socket or coupling. ***Rock Foundation***

3. For all uPVC gravitation sewers and rising mains, irrespective of foundation, excavation shall be carried out to a depth of not less than 75mm below the underside of the pipe barrel and socket or coupling. ***uPVC Pipe***

4. For rising mains to be laid on other than rock foundation (other than uPVC pipe), excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel. Holes shall be excavated beneath joints to enable jointing and inspection of the joints to be carried out and to ensure that each pipe is supported on the barrel and not on the joint. ***Other than Rock Foundations***

5. For rising mains to be laid on rock foundation (other than uPVC pipe), excavation shall be carried out to a depth of not less than 100mm below the underside of the pipe barrel and socket or coupling. ***Rock Foundation***

C402.16 SUPPORT OF EXCAVATION

1. The Contractor shall adequately support all excavations as the works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls by means of intermediate shoring, planking or props. Backfilling shall be performed simultaneously with the withdrawal of supports. ***Precaution Against Slips or Falls***

2. The Sewer Authority's Representative may order timber to be left in place where in his opinion its removal may endanger structures in the vicinity of the excavation. ***Timber Left in Place***

C402.17 PIPE BEDDING

1. Pipes for gravitation sewers (excluding uPVC pipes), shall be bedded on 5mm aggregate. Pipe bedding shall consist of a non-cohesive granular material and its grading shall fall within the following limits shown in Table C402.3: - ***Gravity Sewers Pipes other than uPVC***

Sieve Size Aperture Width (AS1152)	Equivalent BS Sieve Size (BS410)	Percentage Passing
22.4 mm	1 inch	100
6.7 mm	¼ inch	90 - 100
425 mm	No. 36	40 - 90
75 mm	No. 200	0 - 10

Table C402.3

2. Pipes for rising mains (excluding uPVC pipes) may be laid directly on other than ***Rising Mains***

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rock foundation. The Contractor shall ensure solid and uniform support for the whole length of the barrel with chases provided for joints. Where rock or other hard material occurs in the bottom of the trench or where specified or directed by the Sewer Authority's Representative, non-cohesive granular bedding having a minimum thickness of 100mm below the barrel and socket of the pipe shall be provided.

Pipes other than uPVC

3. For uPVC pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 75mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150mm above the top of the pipe) as specified in Figure 5.1 in AS2032 shall be in sand or other approved non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits shown in Table C402.4. In water charged ground, pipes shall be bedded on 5mm to 7mm blue metal.

uPVC Pipes

Sieve Size Aperture Width (AS1152)	Equivalent BS Sieve Size (BS410)	Percentage Passing
9.5 mm	— inch	100
6.7 mm	¼ inch	90 - 100
425 mm	No. 36	40 - 90
150 mm	No. 100	0 - 10

Table C402.4

4. UPVC gravitation sewers laid in impermeable material such as rock and clay, the material used for pipe bedding (underlay, side support and overlay to a depth of 150mm over the top of the pipe) shall be 5mm to 7mm blue metal.

uPVC Gravity Sewers

5. The material shall be placed and satisfactorily compacted as specified in AS2032. Where such graded aggregate is being used, the installation of trench stops shall not be required.

Standard

6. All gravitation sewers laid on grades of 15 percent to 50 percent shall be bedded on Grade 20 concrete complying with Specification C271 - MINOR CONCRETE WORKS. Such concrete bedding shall have a thickness of at least 75mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe and a width across the trench not less than the minimum width specified in Table C402.1.

15-50% Grades

7. All gravitation pipelines and rising mains laid on grades steeper than 50 percent shall be encased in concrete as detailed on the Drawings.

Grades Greater Than 50%

C402.18 LAYING AND JOINTING OF PIPES

1. Before being laid, all pipes, fittings, valves, etc shall be cleaned and examined by the Contractor and, if required by the Sewer Authority, the Contractor shall suspend each one in a sling to enable the Sewer Authority to inspect it. If directed by the Sewer Authority, the Contractor shall oil valves and repack valve glands.

Examination

2. The Contractor shall provide and use approved drag scrapers or "detectors" to ensure that the interior of the pipeline is clean and free from obstructions. Approved plugs shall be used to prevent foreign matter entering sections of pipeline that are left uncompleted overnight.

Cleaning

3. The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

Flotation

4. Joints in pipelines shall be flexible rubber ring joints (either roll-on rubber ring or

Joint Type

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skid type) or mechanical joints (either fixed flange or bolted gland type).

5. For pipes with roll-on rubber ring joints, spigots and sockets shall be clean and dry. After making the joint, a feeler gauge shall be used to check that the rubber ring has rolled in evenly, and if not, the pipe shall be withdrawn and the joint remade. **Roll-on Rubber Ring**
6. For pipes with skid type rubber ring joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. When the joint is made, the witness mark shall at no point be more than 1mm from the end of the socket. **Skid Rubber Ring**
7. Pipes may be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting. **Cut Pipes**
8. For field cuts, only an approved mechanical pipe cutter shall be used, except that uPVC pipes may be cut using a power saw or a fine toothed handsaw and mitre box. **Pipe Cutting**
9. Any pipes cut in the field shall have their ends prepared in accordance with the manufacturer's written instructions. **End Preparation**
10. Where pipes are cut in the field, a witness mark shall be made on the pipe at the length specified by the manufacturer from the end of the pipe. Scoring of uPVC pipes shall not be permitted. Where the same manufacturer does not make spigots and sockets, reference shall be made to the socket manufacturer for the correct marking depth. **Witness Mark**
11. Where uPVC pipes are to be joined to pipes of another material, the joints shall be made as follows: **Jointing Different Material**
- (a) For jointing uPVC spigot to VC socket or uPVC socket to VC spigot, an approved uPVC adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS1646.
 - (b) For jointing uPVC to ductile iron, a suitable gasket shall be fitted to the socket and the joint then made with an approved epoxy resin. Alternatively, an approved rubber ring joint may be used with an approved adaptor coupling.
12. Gravitation pipelines shall be constructed to the tolerances specified hereafter: **Tolerance**
- (a) The maximum horizontal deviations to either side from the design axis of a pipeline shall be 50mm for all sizes of pipes.
 - (b) For vertical deviations from the design grade of pipelines of any diameter and grade, the following requirements shall be the governing criteria:
 - (i) Any one pipe in a length between two maintenance holes or a dead-end and a maintenance hole, shall be placed so as to have a fall from the higher to the lower maintenance hole or from the dead-end to the maintenance hole or may be placed horizontally.
 - (ii) No horizontal section shall be more than 6m long.
 - (iii) The invert level shall not deviate from the design grade line by more than 10mm.
13. Flexibly jointed pipelines for rising mains with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The manufacturer's written recommendations in respect of maximum deflection for each joint shall be complied with provided that no joint shall be deflected to such an extent as to impair its effectiveness. **Joint Deflection**
14. Unless otherwise directed by the Sewer Authority, pipes for rising mains shall be laid on continuously rising grades from scour valve to air release valve, notwithstanding any **Rising Main Grade**

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minor irregularities in the ground surface.

C402.19 CONNECTIONS TO MAINTENANCE HOLES AND STRUCTURES

1. Pipelines shall be connected to maintenance holes, structures or embedded concrete by means of 600mm long pipes such that two flexible joints are provided, the first joint being at or within 150mm of the face of the structure. Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300mm of the position shown on the drawings.

Flexible Joints

2. The positions of maintenance holes shown on the drawings are subject to final approval by the Sewer Authority immediately prior to construction. They may be varied to suit changes, such as erection of structures, growth of flora and installation of services. Once the final position of a maintenance hole has been approved, construction shall be subject to the following requirements:

Maintenance Hole Location

(a) For deviations from the design levels of maintenance holes as shown on the drawings, the following tolerances shall apply:

(i) Where the difference in levels between the inlet pipe and the outlet pipe in a maintenance structure is 100mm or less:

<u>Pipe</u>	<u>Tolerance</u>
Inlet	- nil; + 25mm
Outlet	- 25mm; + nil

(ii) Where the difference in levels, as above, is greater than 100mm:

<u>Pipe</u>	<u>Tolerance</u>
Inlet	- 22mm; + 25mm
Outlet	- 25mm; + 25mm

(b) Allowable lateral deviations from the final design position of maintenance holes shall be in accordance with the tolerances for horizontal deviations of pipelines as specified. Longitudinal deviations from that position shall not exceed 300mm.

C402.20 JUNCTIONS AND SIDELINES

1. Junctions for dead ends and sidelines or risers to properties to serve existing and future dwellings shall be provided in accordance with this Specification. Such junctions shall be inserted along pipelines in locations shown on the Drawings or directed by the Sewer Authority.

Location

2. Junctions for risers shall be encased in Grade 20 concrete complying with Specification C271 - MINOR CONCRETE WORKS.

Concrete Encasement

3. Except where concrete encasement is specified or required by the Sewer Authority, backfill around risers shall be 5mm aggregate compacted to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500mm upstream and downstream of the riser.

Backfill

4. Unless approval is granted by the Sewer Authority, Council will undertake all junction cut-ins on live mains. Applicant to submit request and pay appropriate fee.

Live Sewer Mains

C402.21 MARKING OF JUNCTIONS AND SIDELINES

1. The position of each riser, junction or end of a sideline shall be clearly marked by the Contractor on completion of backfilling, the marking shall be made by one of the following methods but the location of the mark or peg shall be to the approval of the Sewer Authority.

Location

2. Where the position of a riser, junction or the end of a sideline is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50mm high shall be painted thereon. An underground identification tape as specified hereafter shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.

Adjacent to Fence

3. Elsewhere a hardwood peg, 75 x 50 x 125 to 300mm long shall be driven into the ground at that position, and left flush with the surface of the surrounding ground. The length of the peg required will depend upon the ground condition. A length of 300mm shall be required in sandy or other soft ground. The peg shall be connected to an underground identification tape as specified hereafter.

Hardwood Peg

4. The identification tape shall be tied to the junction or end of sideline and held in a vertical position during backfilling. The top end of the tape shall be spiked by the junction peg immediately upon completion of backfilling, or left flush with ground level where no peg is provided.

Tape Position

5. The identification tape shall be 75mm wide red or tan coloured polyethylene tape with the inscription "Caution - buried sewer line", printed in heavy black letters every 200mm (Identoline).

Identification Tape

C402.22 TRENCH STOPS

1. Where a gravitation sewer or rising main (excepting uPVC pipes in trench of rock or other impermeable material) is laid on bedding at a grade of two and one half (2½) percent or steeper, trench stops consisting of either polyethylene bags of minimum thickness 0.25mm filled with clay (of fine even granular size), or other approved material or hessian sand bags filled with 10:1 sand cement mix and sealed in an approved manner, shall be constructed as follows:

Grade 2.5% or Steeper

(a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 50 to 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls to a level of 300mm above the top of the pipe.

(b) The bags shall be placed around and to 300mm above the pipe so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. **Bags shall not be placed onto sand bedding.**

2. The distance between trench stops shall be determined by the following formula:

Spacing

$$D = \frac{30}{G}, \text{ whereby}$$

D = Distance between stops in m,
G = Grade of pipe expressed in percent.

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3. Where uPVC pipes in trenches of rock or other impermeable material are laid on bedding at a grade of one and one half (1½) percent or steeper, trench stops shall be installed at intervals determined by the formula:

Grade 1.5% or greater in impermeable material

$$D = \frac{20}{G}$$

C402.23 CONCRETE BULKHEADS

1. Where a gravitation sewer or rising main is installed at a grade of ten (10) percent or steeper, concrete bulkheads of Grade 20 concrete complying with Specification C271 - MINOR CONCRETE WORKS, 150mm minimum thickness shall be constructed as follows:

Grade 10% or Steeper

(a) Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150mm in other than rock and 75mm in rock. The bulkhead shall extend to 100mm below the surface level.

(b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm in other than rock and 75mm in rock for the full width of trench.

(c) A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel 2 to 10mm in size shall be placed.

2. The distance between concrete bulkheads shall be determined by the following formula:

Spacing

$$D = \frac{100}{G}, \text{ whereby}$$

D = Distance between bulkheads in m
G = Grade of pipe expressed in percent

C402.24 THRUST AND ANCHOR BLOCKS FOR RISING MAINS

1. Thrust and anchor blocks shall be constructed where shown on the Drawings to the dimensions depicted therein, or as otherwise directed by the Sewer Authority. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

Location

2. The Contractor shall provide permanent thrust blocks of Grade 20 concrete complying with Specification C271 - MINOR CONCRETE WORKS such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over a bearing area not less than that shown on the drawings or directed by the Sewer Authority.

Thrust Blocks

3. The Contractor shall provide permanent anchor blocks of Grade 20 concrete complying with Specification C271 - MINOR CONCRETE WORKS of a volume not less than that shown on the drawings or directed by the Sewer Authority.

Anchor Blocks

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4. The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test. **Temporary Anchorage**

C402.25 RISING MAIN FITTINGS

1. Air release valves and inspection pipes shall be installed where shown on the Drawings. **Location**
2. Marking plates bearing the letters "DAV" for double air valves, "SCOUR" for inspection pipes and "SRM" at changes of direction and at such chainages that the location of the main is marked at least once each 75 metres, shall be provided as specified hereinafter. **Marking Plates**
3. Where, in the opinion of the Sewer Authority, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set firmly in the ground a wooden post and shall fix the relevant marking plate with four galvanised screws or clout nails at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1m, shall be permanently die-stamped on the marking place with numbers 10mm high. **Marking Posts**
4. The approved post shall conform to the following requirements: **Post Details**
- (a) The post shall be approved by the Sewer Authority.
 - (b) When installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500mm.
 - (c) Where soft ground is encountered, the post shall be driven into the ground to a minimum depth of:
 - (i) 600mm for posts projecting 1000mm above the surface.
 - (ii) 900mm for posts projecting 1500mm above the ground.
- Where rock or hard ground is encountered, the post shall be potted and concreted to a minimum depth of 300mm in rock and 500mm in hard ground where the post cannot be driven in, irrespective of the height of the post above the ground surface.

C402.26 CONCRETE ENCASEMENT

1. Where pipes in gravity sewers or rising mains have less than 450mm of cover above the top of the pipe barrel, they shall be encased in concrete. Concrete shall be of Grade 20 complying with Specification C271 - MINOR CONCRETE WORKS and have the following minimum dimensions: **Location**
- (a) For trenches in other than rock: 150mm minimum under, on both sides and on top of the pipe barrel.
 - (b) For trenches in rock: 100mm minimum under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.

Note the Sewerage Authority may direct the Contractor / Applicant to redesign the main rather than concrete encase.

2. In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12mm thick shall be formed in the concrete encasement at the face of each socket or at one face of each coupling. **Contraction Joint**
3. Reinforcement in concrete encasement shall be as shown on the Drawings. **Reinforcement**

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C402.27 WRAPPING OF PIPELINES

1. Where specified or directed by the Sewer Authority, the Contractor shall enclose a pipeline or a section thereof, in lay flat polyethylene tubing.

2. The materials to be used shall be high impact resistance polyethylene tubing, such as "Zendel E.H.I." and 50mm wide plastic adhesive tape, such as "504 Sellotape", which shall have the ability to bond to metal surfaces and to the polyethylene material.

Material

3. The minimum thickness of the polyethylene film shall be 0.2mm, and the width of the tube when flat shall be in accordance with the manufacturer's written recommendations for the size and type of the pipeline that is to be encased. Where the tube is to be exposed to ultra-violet light (eg sunlight) for more than 48 hours, black pigmented polyethylene shall be used; alternatively, precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Type

4. Application of the polyethylene tubing and plastic adhesive tape shall be in accordance with the manufacturer's written instructions, and the Contractor shall take due care not to damage the tubing during its application or during the backfilling of the trench. Each pipe shall be encased in a length of tubing overlapped for a minimum of 250mm at each field joint, and the ends of each length of tubing shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene tube material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately one-metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene tubing as specified for the pipes. Valves, hydrants and irregular shaped fittings shall be hand wrapped using flat polyethylene sheets secured with plastic adhesive tape to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of tubing.

Application

5. Any damage done to the polyethylene tubing before, during or after backfilling of the trench shall be made good by the Contractor to the satisfaction of the Sewer Authority.

Damage

C402.28 CAST-IN-SITU MAINTENANCE HOLES

1. For all maintenance holes concrete work, the Contractor shall comply with Specification C271 - MINOR CONCRETE WORKS in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below.

2. Cement used in all concrete shall be Type SR to AS 3972.

Cement Type

3. The minimum cement content shall be 360 kg/m³ of concrete and the Water/Cement ratio of the mix shall not be greater than 0.50 by mass.

**Minimum
Cement
Content**

C402.29 COVERS AND SURROUNDS

1. Covers and surrounds shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished by approved methods to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius.

2. Tolerances for the dimensions on the COVER shall be - 3mm + NIL.

**Cover
Tolerance**

3. Tolerances for the dimensions on the SURROUND shall be - 3mm + 3mm.

**Surround
Tolerance**

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4. Maintenance hole covers shall be seated on a layer of "Compriband" mastic or similar approved material, having a cross-section of 25 x 25mm. Alternatively another seating material of a cross-section and composition approved by the Sewer Authority may be used. **Cover Seating**

5. Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces. Elsewhere, covers shall be finished as shown on plan WSA-02 SEW-1317, in a manner designed to avoid as far as possible, the entry of surface water. **Cover Levels**

6. In locations where shown on the drawings or directed by the Sewer Authority, the Contractor shall install Council approved "Gatic" cast iron cover and frame instead of the standard concrete manhole cover. Cast iron covers and surrounds shall be installed and filled with concrete in accordance with the manufacturer's written requirements. **"Gatic" Cover**

C402.30 STEP IRONS AND LADDERS

1. Step irons shall be of plastic material, or cast aluminium. Step irons shall be fixed in formwork prior to placing concrete and shall be provided in maintenance chambers over 1.2m deep.

C402.31 PRECAST MAINTENANCE HOLE SYSTEMS

1. If approved by the Sewer Authority, precast maintenance hole systems complying with AS4198, may be used in lieu of cast in-situ maintenance holes. **Approval**

2. The Sewer Authority may reject any component which is unsuitable for making a watertight maintenance structure or which has an unsatisfactory surface finish. **Component Quality**

3. Generally, precast maintenance holes shall be made up with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, a cone section, cover and surround. Make-up Rings may be used between cone sections and surrounds to make up height differentials. Make-up rings shall not be used for heights in excess of 600mm. The wall thickness of any reinforced component below the surround shall not be less than 84mm. **Component Length**

4. The installation of all precast maintenance hole components shall be in accordance with the manufacturers' recommended procedures and requirements. **Manufacturers' Procedures**

5. Backfill for all precast maintenance holes shall be placed and compacted evenly around the maintenance hole to a level 300mm above the top of the highest incoming pipe and for the full width of the excavation. If necessary, the Contractor shall import and compact non-cohesive granular material. **Backfill**

6. Construction of maintenance shafts and terminal maintenance shafts shall be as detailed in the text and standard drawings of WSA-02 2002. **Maintenance Shafts and Terminal Maintenance Shafts**

PIPELINE TESTING AND RESTORATION

C402.32 GENERAL

1. All sewers maintenance holes and maintenance shafts shall be subject to an initial test as soon as practicable after construction and before backfilling is commenced. An acceptance test shall be carried out before the issue of the Subdivision Certificate and not earlier than one month after completion of construction of all sewers and maintenance structures in a section. Sewers or maintenance structures failing any test shall be repaired **Initial Test Before Backfill**

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and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained.

2. All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing. **Cleaning**

C402.33 INITIAL TEST OF GRAVITATION SEWERS

1. The initial testing of gravitation sewers shall be a visual inspection and shall be made by the Sewer Authority. . Before the initial test is performed, all pipe laying on the section shall be completed, backfill shall be compacted to the level of the centre of the pipe barrel and the Sewer Authority notified. **Visual Inspection**

2. Inspection by the Sewer Authority of bedding, trench stops, bulkheads, etc is required prior to backfilling and shall constitute a Hold Point. **HOLD POINT**

4. Any fault detected shall be rectified and a satisfactory test obtained before the remainder of backfill is placed. **Rectification**

C402.34 INITIAL TEST OF MAINTENANCE STRUCTURES

C402.35 ACCEPTANCE TEST OF GRAVITATION SEWERS AND MAINTENANCE STRUCTURES

1. The acceptance test on all components in the section of the sewer shall consist of a visual test and a compressed air or vacuum test. **As for Initial Test**

2. As an alternative to compressed air testing for acceptance of gravitation pipelines, the Sewer Authority's Representative may permit hydrostatic testing. **Alternative**

3. A satisfactory test is required prior to connection to Councils existing sewer mains and prior to connection of any internal drainage. **Testing Prior to Connection to Existing Sewer**

4. All air, vacuum and CCTV testing is to be undertaken by a NATA registered company independently operated from the Contractor, Developer, Applicant or their interests. **Independent Testing Company**

5. Results of air and vacuum testing are to be documented and supplied to Council and a Permit to Connect obtained from Council prior to any connection to existing sewer mains Documentation is to be submitted to Council. Issuing of a Permit to Connect shall constitute a Hold Point. **Documentation**
HOLD POINT

1. The acceptance testing of gravitation sewers shall be made with compressed air in accordance with Clause 402.36. **Compressed Air**

2. The acceptance test shall be carried out on the risers and sidelines as soon as they are completed in conjunction with the sewers and maintenance structures. **Risers and Sidelines**

3. Where the Sewer Authority's Representative approves the construction of pipelines in other than full lengths between maintenance structures, each length of pipeline shall be tested together with the downstream portion of the maintenance structure length under construction. **Other Than Full Lengths**

3. Notwithstanding that acceptance testing, by any method may produce satisfactory test results, the Sewer Authority's Representative may reject any pipeline or maintenance structure in which there is visible or detectable leakage. **Rejection**

C402.36 TESTING WITH COMPRESSED AIR

1. All necessary equipment shall be supplied by the Testing Company and kept in a condition acceptable to the Sewer Authority's Representative. **Equipment**

2. Pressure gauges shall be tested prior to use by static water column. At least one spare gauge per test rig shall be kept on the job at all times. **Pressure Gauges**

3. Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m³/minute at 35kPa. The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 28kPa ± 4kPa. The air shall then pass through an airtight line fitted with a 150mm Bourdon type pressure gauge reading from 0 to 50 kPa, a pressure relief valve that shall be set to blow off at 28kPa ± 4kPa and a gate valve to the pipeline to be tested. **Compressed Air**

4. The method of setting up and carrying out the test shall be as follows: **Method**
 - (a) Insert a blank plug at one end and a disc with air-hose connection at the other end of the line. Care shall be taken to ensure that the force due to pressure on the disc is not taken by pipe joints, but is taken by struts bearing on the disc or on the end pipe in the line.
 - (b) Couple test equipment to line under test and compressor or air line.
 - (c) Slowly increase the air pressure in the line from 0 to 28 kPa (over one minute approximately).
 - (d) Hold air pressure at 28 kPa for three minutes for stabilising temperature.
 - (e) Close gate valve to shut off air supply to test equipment.
 - (f) Measure the time it takes for the pressure to drop from 25 kPa to 18 kPa. If this time is less than that permitted or if the line cannot be pressurised to 28 kPa, then the test is unsatisfactory and the pipeline shall be checked for leaks.
 - (g) To check pipelines for leaks:
 - (i) Open the gate valve from the air supply sufficiently to maintain a pressure of 14 to 23 kPa in the pipeline.
 - (ii) Move along the pipeline coating it with detergent solution. Bubbles will indicate a point of leakage. Special attention should be paid to joints, discs and horns of junctions.
 - (h) If leaks are detected, they shall be repaired to the satisfaction of the Sewer Authority's Representative.
 - (i) Re-test as above until the time taken for the pressure to drop is greater than that shown below.

5. The time taken for the pressure to drop from 25 kPa and 18 kPa shall be greater than: **Allowable Pressure Drop Times**
 - 100mm pipe - 1 minute
 - 150mm pipe - 2 minutes
 - 225mm pipe - 4 minutes
 - 300mm pipe - 6 minutes
 - 375mm pipe - 8 minutes
 - 400mm pipe - 11 minutes
 - 525mm pipe - 14 minutes
 - 600mm pipe - 17 minutes

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6. Pressure drop times, which are less than these, may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes shall be thoroughly saturated with water before testing or a hydrostatic test applied.

Saturation with Water

7. In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, a hydrostatic test is to be applied.

Hydrostatic Test

C402.37 HYDROSTATIC TESTING OF MAINTENANCE STRUCTURES

1. Each maintenance structure shall be tested for leakage, as soon as practicable after the maintenance structure is constructed and the maintenance structure cover surround fitted.

Leakage

2. The test shall be made by plugging all pipe openings in the walls and by filling the maintenance structure with water to the lowest point on the top of the maintenance structure cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance structure.

Method

3. After allowing an interval for absorption, to be determined by the Sewer Authority's Representative, the maintenance structure shall be refilled and the loss of water during the following 30 minutes measured. The test on the maintenance structure will be considered satisfactory provided the water lost is less than 3mm depth in the top section of the maintenance structure for each 1m depth of maintenance structure. The depth of maintenance structure is to be taken from the bottom of the maintenance structure cover recess in the cover surround to the invert of the outlet from the maintenance structure. The plug of the outlet shall be fitted with a suitable release for emptying the maintenance structure on satisfactory completion of the test.

Duration

C402.38 HYDROSTATIC TESTING OF PIPELINES

1. The hydrostatic test shall be carried out by connecting to the pipeline or section thereof under test, a pipe or hose terminating in a 150mm diameter container not less than 100mm deep. All other open ends of the pipeline shall be plugged.

Pipe Connection

2. The pipeline under test, and the pipe or hose with container, shall be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below.

Water

3. The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:

Test Container

(a) (i) For initial test when no sidelines or risers are constructed - a minimum head of 2 metres above the pipe invert at the upstream end of the line under test, or

(ii) For initial test where sidelines and/or risers are constructed - a minimum head of 2 metres above the highest invert in the line under test, including its risers and sidelines.

(b) For acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and sidelines, or above the free standing level of ground-water in the vicinity whichever is the higher.

(c) Such other lesser head as the Sewer Authority's Representative may direct.

4. The free standing level of ground water shall be determined by the Contractor at his own expense by a method acceptable to the Sewer Authority's Representative.

Ground-Water

5. After allowing an interval for absorption, to be determined by the Sewer Authority's Representative, the maintenance structure shall be refilled and the loss of water during the following 30 minutes measured. The test on the maintenance structure will be considered satisfactory provided the water lost is less than 3mm depth in the top section of the maintenance structure for each 1m depth of maintenance structure. The depth of maintenance structure is to be taken from the bottom of the maintenance structure cover recess in the cover surround to the invert of the outlet from the maintenance structure. The plug of the outlet shall be fitted with a suitable release for emptying the maintenance structure on satisfactory completion of the test.

Extra Water

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Representative, any fall of the free water surface shall be made good by adding extra water to the container. The fall in water level during ten minutes thereafter shall be measured.

6. The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25mm for each standard test length of the pipeline under test including sidelines and/or risers.

Results

7. A standard test length in metres is defined as 1370m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. Where the pipeline under test has sidelines and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.

Test Length

C402.39 VISUAL INSPECTION AND MEASUREMENT OF INFILTRATION

1. Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500mm or more above the soffit of the sewer main provided that groundwater is at least 150mm above any sideline included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration.

Head of Groundwater

2. In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured.

Method

3. If the Sewer Authority's Representative at their discretion approves of an inspection and infiltration test being performed for the purposes of acceptance, the Sewer Authority's Representative shall determine, the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:-

Rate of Infiltration

$$Q.I. = 0.65 (L_1d_1h_1 + L_2d_2h_2 + \dots L_nd_nh_n) + H_a$$

Where:

Q.I. = rate of infiltration in litres/hour

L = length of pipe in metres

d = nominal size of pipe in metres

h = average head of groundwater over the invert level of the pipe in the

section under test

H_a = head of groundwater above the invert level of the outlet pipe of the manhole when the manhole is included in the infiltration test.

4. The Contractor shall determine the head of groundwater by a method approved by the Sewer Authority's Representative.

Contractor's Cost

C402.40 TESTING OF RISING MAINS

1. Rising mains shall be pressure tested to detect excessive leakage and defects in the pipeline including joints, thrust and anchor blocks.

2. Pipelines shall be tested in sections approved by the Sewer Authority's Representative as soon as practicable after each section has been laid, jointed and backfilled, provided that:

Timing

(a) if so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Sewer Authority's Representative; and

(b) The pressure testing shall not be commenced earlier than seven

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days after the last concrete thrust or anchor block in the section has been cast.

- | | | |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 3. | For the purpose of this sub-clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, eg by means of main stop valves. | Section
Definition |
| 4. | Pressure testing shall not be carried out during wet weather unless otherwise approved by the Sewer Authority's Representative. | Wet Weather |
| 5. | During pressure testing, all field joints that have not been backfilled shall be clean, dry and accessible for inspection. | Field Joints |
| 6. | During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes. | Stop Valves |
| 7. | Before testing a pipeline section, it shall be cleaned to the satisfaction of the Sewer Authority's Representative and filled slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing. | Filling with
Water |
| 8. | The hydrostatic test pressure which shall be applied to each section of the pipeline shall be such that at each point of the section the test head shall be equal to or greater than the design head specified or shown on the Drawings, but shall not exceed same by more than 20 per cent. | Test Pressure |
| 9. | The specified test pressure shall be maintained as long as required by the Sewer Authority's Representative, while the whole section is examined, and in any case not less than 8 hours. For the purpose of determining the actual leakage losses, the quantity of water added in order to maintain the pressure during the period of testing shall be carefully measured and recorded. | Duration of
Test |
| 10. | The pressure testing of a section shall be considered to be satisfactory if: | Results |
| | (a) there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component; | |
| | (b) there is no visible leakage; and | |
| | (c) the measured leakage rate does not exceed the permissible leakage rate as determined by the following formula: | |
| | $Q_1 = (0.000532 + \frac{C}{L_p}) D.L. (H)^{0.5}$ | |
| | where: | |
| | Q ₁ = permissible leakage rate (litres per hour) | |
| | C = a coefficient as specified hereunder for the particular pipe material and type of joint | |
| | D = nominal diameter of pipe (mm) | |
| | L = length of section tested (km) | |
| | H = average test head (m) | |
| | L _p = average pipe length - $\frac{L}{n}$ (m) | |

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Where "n" is the total number of pipes and fittings in the section tested.

(d) the measured leakage rate does not exceed that rate calculated by the simplified formula for the type of pipe tabulated hereunder, in which event determination of the permissible leakage rate on the basis of the formula specified in (c) above shall not be necessary. The simplified formulae are based on the coefficient "C" and average pipe lengths contained in that tabulation.

Pipe Type	Simplified Formula	Coefficient "C"	Average Pipe Length (m)
D.I.	$Q_1 = 0.0105 \text{ D.L. (H)}^{0.5}$	0.0548	5.5
UPVC	$Q_1 = 0.01 \text{ D.L. (H)}^{0.5}$	0.0568	6.0

11. Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the Developer at his expense, including failure of a thrust block or an anchor block. Where such thrust block or anchor block has been constructed in accordance with the Drawings and the failure is not, the fault of the Contractor, the cost of strengthening or reconstruction of such thrust block or anchor block and the cost of retesting shall still be borne by the Developer.

Rectification

C402.41 BACKFILL AND COMPACTION

1. When laying and jointing of a pipeline has been completed and before backfilling is commenced, the Contractor shall notify the Sewer Authority.

Notification

2. Backfill shall not be placed until the Sewer Authority has given approval.

Approval

3. Material for the side support and overlay of the pipe shall comply with Clause C402.17. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289.5.7.1.

Side Support and Overlay

4. The remainder of the excavation shall be backfilled with excavated material. The backfill shall be compacted in layers of not more than 150mm thick to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289.5.7.1. Flooding of cohesive material shall not be permitted as a means of compacting backfill.

Remainder of Trench

5. Backfilling and compaction shall be carried out without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

Care

C402.42 RESTORATION OF SURFACES

1. Pavements, lawns and other improved areas shall be cleaned and left in the same order as they were at the commencement of the works. Lawns shall be restored with turf cut and set aside from the original surface and with turf imported from a source approved by the Sewer Authority.

Original Condition

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2. All restored surfaces shall be maintained in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period. Pavements shall be maintained with crushed metal, gravel or other suitable material allowing for consolidation and shall then be restored to a condition equivalent to that of the original pavement. **Maintenance**

3. Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement shall be temporarily restored. Where the trench crosses bitumen or concrete pavement, a pre-mixed asphaltic material shall be used for such temporary restoration. Temporary restoration shall be maintained by the Developer until final restoration is carried out. Final restoration of the pavement shall be carried out to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Sewer Authority, the removal of temporary restoration. **Temporary Pavement Restoration**

4. Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform with the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Developer **Backfill**

5. In locations where, in the opinion of the Sewer Authority, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Sewer Authority's Representative in such a way as to minimise future erosion of the backfill and adjacent ground surfaces. The Developer shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period. **Disposal of Surplus Material**

6. Where, within public or private property, the reasonable convenience of persons will require such, the Sewer Authority may order trenches to be levelled off at the time of backfilling. Any subsequent settlement shall be made good by the Developer, as required by placing additional fill. **Settlement**

7. Should the Developer elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Developer shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period. **Tunnelling**

PUMPING STATIONS

C402.43 PUMPS

1. Pumps shall be submersible sewage pumps complying with the Australian Water Supply & Sewerage Authorities (AWSSA) Specification of Technical Requirements **Type**

2. Pump construction materials shall be:- **Materials**

DESCRIPTION	MATERIAL
PUMP	
Casing and suction bend	Cast iron AS 1830 Gr T200
Casing wear rings	Cast iron AS 1830 Gr T200/Mild steel
Impeller	416 Stainless steel/AS 1444

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Impeller nut	Gunmetal AS 1565-905C
Impeller wear rings	Mild steel
Shaft	416 Stainless steel/AS 1444
Shaft sleeve	Phosphor bronze AS 1565-906D 416
Neck bush, lantern ring	Stainless steel/AS 1444
Gland follower	Phosphor bronze AS 1565-906D
Gland studs	416 Stainless steel
Gland nuts	416 Stainless steel/AS 1444
Fixing nuts and bolts handhole	416 Stainless steel/AS 1444
Covers	416 Stainless steel/AS 1444
Fitted bolts and nuts, casing and dowels	416 Stainless steel/AS 1444
Forcing screws	416 Stainless steel/AS 1444
Water thrower and drip tray	416 Stainless steel/AS 1444
Pump set base plate	Cast iron AS 1830 Gr T2000/Fabricated steel
MOTOR	
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Cast iron/Mild steel
Motor fan cover	Mild steel
Motor fan	Metal
HOLDING DOWN BOLTS	416 Stainless steel/AS 1444
MECHANICAL SEALS	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

C402.44 ELECTRICAL COMPLIANCE

1. The works shall be in accordance with the Department of Public Works General Requirements for Building Services (Electrical Installations) dated June, 1984, including amendment 1 August 1987 (known as EDS E101) and General Requirements for Water Supply - Section B except where this Specification or the Drawings indicate otherwise. **Standards**

2. PWD-EDS E101 covers the Department's general requirements for materials, workmanship, and methods of installation as follows: **EDS 101**

Part 0	Generally
Part 1	Reticulation and Wiring
Part 2	Switchboards and Equipment
Part 3	Accessories
Part 4	Luminaries - Supply and Installation
Part 5	Electric Motors
Part 6	Painting, Colour Coding and Labelling

3. Except where PWD-EDS E101 and PWD-B requires a higher standard, works shall be carried out in accordance with AS 3000, the Service Rules of the Supply Authority and all relevant Statutory Authorities. **Compliance**

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4. Proof of compliance with a standard or specified test may be required. Where requested, such proof shall comprise a test certificate from an approved independent testing authority. **Proof of Compliance**

5. The Developer shall submit all designs and material to each Authority having jurisdiction for approval, as required. The Developer shall arrange for each Authority having jurisdiction to inspect the works. **Approval**

C402.45 SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA)

1. The switchboard shall be designed and assembled by a manufacturer approved by the Sewer Authority. **Manufacturer**

2. The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 1939. **Type**

3. All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A steel galvanised channel base shall be provided. **Construction**

4. Starter contactors shall have a minimum rating sixty (60) Amps to AC3. **Starter Contactors**

5. All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the Drawings. **Terminals**

6. The Sewer Authority's Representative will supply padlocks for use on the SCA. **Padlocks**

7. The electrical characteristics of the SCA shall be:- **Characteristics**

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.

Motor Control Circuit: 240 V, 50 Hz.

Common Control Circuit: 240 & 24 V, A.C.

Prospective short-circuit current:
14kA for 1 second.

Peak Factor: 2.2

Earthing (M.E.N. system)

8. All cables shall enter the SCA from below. **Cable Entry**

9. Data from the switchgear supplier confirming Type "2" co-ordination between contactors, motor protection relays and corresponding circuit breakers shall be submitted to the Sewer Authority. **Switchgear Data**

10. Install telemetry equipment for automatic control signals. **Telemetry**

11. The "AUTO" mode shall be capable of being overridden by turning the starter selector switch to the "ON" position. Manual operation would normally be used in the event of failure of the telemetry system or for function testing. A warning label (R/W/R) advising selector switches to be left in the "AUTO" mode shall be fitted to common control cover. **Operation**

12. Factory tests shall be carried out in accordance with Schedule EDS-E101 and shall comprise all routine Tests specified in AS 3439. The Sewer Authority shall be given seven (7) days notice of the proposed date of such tests and may elect to be present during Factory testing. **Factory Tests**

13. Functional tests referred to in Schedule EDS-E101 shall include electrical function tests as defined in AS 3439. **Functional**

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	Tests
14. After satisfactory final factory inspection and tests, the equipment shall be packed for transport. Any relays and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.	Packing
15. The Developer shall be responsible for any damage that may occur during transit and unloading at site.	Damage
16. Spare parts, tools etc, shall be packed separately from the main plant and shall be marked "Spare Parts," "Tools" etc, as applicable.	Tools
17. Supply three spare globes for every ten indicating lamps (together with removal tool); one (1) spare coil and one (1) three phase set of contacts (or complete contactor) within the SCA together with two (2) off each of the following 240V and a.c. relay; 240V a.c. timer; 24V a.c. relay; 24V a.c. timer and thermistor relay.	Spare Parts
C402.46 ELECTRICAL INSTALLATION	
1. The Developer shall liaise with the Supply Authority for the electricity supply to the pumping station site.	Liaison
2. All facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges shall be the responsibility of the Developer.	Contractor's Responsibility
3. All cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits shall be supplied and installed by the Developer.	Cabling
4. All wiring shall be installed in HD-UPVC underground conduits laid a minimum 500mm below the finished ground level in non-trafficable areas and 600mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.	Conduits
5. Electrical marker tape shall be run 150mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150mm wide and stamped with the words "DANGER - ELECTRIC CABLES BELOW" or similar.	Marker Tape
6. The route of all underground cabling shall be approved by the Sewer Authority's Representative prior to commencement of trenching.	Route
7. The Points of Attachment shall be determined on site by the Developer and any consumer's connection poles for the consumer mains required by the Supply Authority shall be supplied and installed by the Developer.	Point of Attachment
8. The consumer mains shall be generally run underground and commence at the Point of Attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.	Consumer Mains
9. The minimum size of the consumers mains shall be sized to satisfy the following requirements:	Size
(a) Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.	
(b) Be sized for a voltage drop less than 1.5% to the maximum demand as calculated.	
(c) Be single core PVC/PVC cables. XLPE insulated cable may also	

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be used.

- (d) Comply with the requirements of the Supply Authority.
- (e) Pole termination method shall be as shown on the Drawings.

10. In addition to the requirements of the Supply Authority and EDS E101 the main earthing conductor shall be run in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50mm² cable and a Type 4 pit for larger cable. **Earthing Conductor**

11. A separate earthing conductor and electrode shall be provided for the surge diverters. Each electrode shall be bonded and suitably labelled with an engraved brass label. **Surge Diverters**

12. The pumping station pipework shall be bonded to the main earth. **Pipework**

13. Metering facilities shall be installed within the SCA. The metering facilities and panel shall be Energy Authority approved and suitable for the installation of the metering equipment required by the Supply Authority. **Meters**

14. The following metering equipment shall be supplied and installed:- **Metering Equipment**

- (a) Plug-in meter bases.
- (b) Service potential fuses.
- (c) Current transformers metering equipment (if required).
- (d) All necessary wiring and other accessories as required by the Supply Authority.
- (e) Key locking facilities for Supply Authority access.

15. Cables entering the outdoor SCA compartment shall be glanded using non-ferrous metallic or plastic glands with neoprene compression seals. Connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed. **Cable Entry**

16. At the completion of commissioning tests all conduits into the outdoor SCA shall be sealed with a non-setting sealing compound to prevent the ingress of vermin. **Sealing**

C402.47 TESTING AND COMMISSIONING OF PUMPING STATION

1. All materials, equipment, installation and workmanship shall be tested and/or inspected to prove compliance with the Specification requirements. **Compliance**

2. Tests and inspections shall comply with relevant Australian Standards. **Standards**

3. Testing shall include water-tightness testing, pre-commissioning, field-testing and performance testing of each part of the whole installation. **Testing**

4. Hydrostatic testing of wet wells and emergency storage chambers shall be undertaken by the Contractor to test for leakage and infiltration. The proposed procedure for testing is to be prepared by the Developer and approved by the Sewer Authority. **Water Tightness Testing**

5. Hydrostatic Testing **Hydrostatic Testing**

Test the pumping station wet well for leakage as soon as practicable after construction.

Make the test by plugging all pipe openings in the walls, with plugs placed as near as practicable to the internal face of the well, and by filling the well with water to the level of the underside of the access covers.

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Provide all necessary temporary blank flanges, plugs, anchors and approved test equipment for testing.

After allowing an interval for absorption of a minimum of two minutes, the well shall be refilled and the loss of water measured during a period of thirty minutes.

The test on 1800 and 2100mm diameter sewage pumping station wet wells will be considered satisfactory provided the water loss is less than 1.4 and 1.2mm depth respectively for each 1000mm depth of well. The loss allowed for other diameter wells shall be considered on a case-by-case basis.

The depth of the wet well is to be taken from the underside of the roof slab to the floor of the well.

6. Acceptance Testing Measurement of Infiltration by Visual Inspection

**Visual
Inspection**

Where, in the case of acceptance testing, the pumping station wet well is subjected to a significant head of groundwater, the Water and Sewerage Authority may order that the hydrostatic test on the wet well be dispensed with in favour of visual inspection and measurement of infiltration. If a visual inspection and infiltration test is required, the Water and Sewerage Authority shall determine the duration over which infiltration is to be measured and at the amount of infiltration allowable for a satisfactory test.

7. Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

**Pre-
Commissioning**

8. Pre-commissioning shall be conducted in a logical sequence in accordance with the programme prepared by the Developer and approved by the Sewer Authority.

Sequence

9. The Developer shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Record Sheets

10. Specific requirements for pre-commissioning shall include, but are not limited to:-

- (a) Initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in".
- (b) Physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc, depending on the type of equipment.
- (c) Electrical and instrument installation tests, including motor insulation tests, checking instruments against certified instruments and correcting as necessary.
- (d) Tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms.
- (e) Equipment and system operating tests. The Developer shall certify compliance of each item and submit a signed copy to the Sewer Authority prior to commissioning.

Requirements

11. Pre-commissioning tests shall be carried out to the satisfaction of the Sewer Authority and shall be recorded on the appropriate Pre-commissioning Record Sheet.

Recording

12. The Developer shall furnish the Sewer Authority with one signed copy of each

Submission

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completed Pre-commissioning Record Sheet countersigned by the Sewer Authority's Representative who witnessed the test.

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| 13. Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions. | Commissioning |
| 14. The Sewer Authority shall be given five (5) working days notice of the Developer's intention to undertake commissioning. | Notification |
| 15. Commissioning shall be conducted in a logical sequence in accordance with a programme prepared by the Developer and approved by the Sewer Authority. | Sequence |
| 16. Throughout commissioning the Developer shall be responsible for the test programme. | Responsibility |
| 17. The Developer shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests. | Supervision |
| 18. The Developer shall prepare schedules, test record sheets and programmes for approval by the Sewer Authority prior to each stage of the overall commissioning. | Documentation |
| 19. Final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment shall be carried out in accordance with EDS E101. | Final Testing |
| 20. The Developer shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel. | Qualified Personnel |

C402.48 COMPLETION OF PUMPING STATION

1. The following requirements shall be fulfilled before the Subdivision Certificate is issued:-
- Certificate of approval from the relevant statutory authorities have been received by the Sewer Authority.
 - Pumping station is in working order as demonstrated by the testing and commissioning.
 - Operating and maintenance manuals have been approved by the Sewer Authority.
 - As-built drawings of the pumping station have been submitted to the Sewer Authority.

C402.49 TELEMETRY

- | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1. Equipment to link the pumping station to the existing telemetry network is to be provided by the appropriate supplier used by Council at the Developer's expense. | Contractor's Cost |
| 2. The pumping station shall operate automatically by control signals from the telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system. | Operation |

C402.50 OPERATION AND MAINTENANCE MANUALS

1. Manuals shall contain the following information:
- (a) Developer and Contractor's name, address and telephone

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number.

- (b) Developer's Contract number, job name.
- (c) Pumping station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

2. Manuals for pumps shall contain the following information:

Pumps

- (a) Manufacture.
- (b) Type and model number.
- (c) Serial number.
- (d) Dimensioned general arrangement drawing of pump and motor.
- (e) Sectional arrangement drawing with parts and list.
- (f) Dimensioned sectional arrangements detailing:
 - (i) Maximum and minimum shaft/bearing clearance (radial)
 - (ii) Maximum and minimum impeller/bowl clearance (axial)
 - (iii) Maximum and minimum impeller/bowl clearance (axial)
 - (iv) Impeller/bowl wear rings.
 - (v) Motor/pump coupling - type, make and model number.
 - (vi) Mechanical seals where applicable.

3. Manual for motors shall contain the following information:

Motors

- (a) Manufacture.
- (b) Type and model number.
- (c) Serial number.
- (d) Dimensioned general arrangement drawing.
- (e) Sectional arrangement drawing for submersible motor power cabling where applicable.
- (f) Gland sealing arrangement drawing for submersible motor power cabling where applicable.
- (g) Cables where applicable.
- (h) Terminal block arrangement drawing where applicable.

4. Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

Valves

5. Manuals shall contain the following test curves:-

Test Curves

- (a) Pump witnessed test curves.
- (b) Motor test curves.
- (c) Motor torque/speed/efficiency characteristic curves.

6. The operating and maintenance manual shall include:-

Operation and Maintenance

- Safe working procedures: For switching and isolating the supply and distribution system;
- Description of Operation;

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- Maintenance procedures: Recommended maintenance periods and procedures;
- Tools: Particulars of maintenance equipment and tools provided, with instructions for their use.
- Equipment: A technical description of the equipment supplied, with diagrams and illustrations where appropriate;
- Dismantling: Where necessary, procedures for dismantling and reassembling equipment;
- Spare parts: A list of the spare parts provided.

7. Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

***Trouble
Shooting***

8. Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

***Replacement
Procedures***