



Construction Specification for Civil Works

C401 – Water Reticulation

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GENERAL

C401.01 SCOPE

This Specification is for the construction of:

Suitable Works

- (a) Mains up to diameter DN600 nominal size.

This Specification **EXCLUDES** the construction activities for:

Exclusions

- (a) Reservoirs, including repainting of reservoirs.
- (b) Treatment plants.
- (c) Dams.
- (d) Pump Stations.
- (e) Headworks.
- (f) Dosing plants.

The Constructor shall carry out the work and supply materials meeting the requirements of the reference documents except as otherwise specified herein.

Compliance

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements Sub-Annexure B13*.

Quality

C401.02 DEFINITIONS

The Works – Defined as follows:

The Works

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

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

Constructor

TRC Representative – Defined as follows:

TRC Representative

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

Constructor's Representative – Defined as follows:

Constructor's Representative

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

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

Developer's Representative

C401.03 REFERENCE DOCUMENTS

Documents referenced in this Specification are listed below whilst being cited in the text in the abbreviated form or code indicated. The Constructor shall possess, or have access to, the documents required to comply with this Specification.

Documents

Where not otherwise specified in the relevant Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the Specifications at the time of the Works approval.

Currency

(a) Tamworth Regional Council (TRC) Specifications

C201 – Control of Traffic.

C211 – Control of Erosion and Sedimentation.

C271 – Concrete Works.

C242 – Flexible Pavements.

C305 – Trenchless Conduit Installation.

C290 – Road Openings

(b) Australian Standards

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

- AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio.
- AS 1289.5.6.1 - Density Index Method for a Cohesionless Material.
- AS 1432 - Copper tubes for plumbing, gas fitting and drainage applications.
- AS 1449 - Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip.
- AS/NZS 1477 - PVC pipes and fittings for pressure applications.
- AS 1579 - Arc welded steel pipes and fittings for water and waste water.
- AS/NZS 1594 - Hot-rolled steel flat products.
- AS 1646 - Elastomeric seals for waterworks purposes.
- AS 2032 - Code of practice for installation of PVC pipe systems.
- AS 2033 - Installation of polyethylene pipe systems.
- AS 2129 - Flanges for pipes, valves and fittings.
- AS/NZS 2280 - Ductile iron pressure pipes and fittings.
- AS 2419.2 - Fire hydrant installations – fire hydrant valves.
- AS/NZS 2566.1 - Buried flexible pipelines – Structural design.
- AS/NZS 2566.2 - Buried Flexible pipelines – Installation.
- AS 2638 - Sluice valves for waterworks purposes.
- AS 3578 - Cast iron non-return valves for general purposes.
- AS 3681 - Guidelines for the Application of polyethylene sleeving to Ductile Iron pipelines and fittings.
- AS 3862 - External fusion-bonded epoxy coating for steel pipes.
- AS 3952 - Water supply –Spring hydrant valve for waterworks purposes.

- AS 3996 - Metal access covers, road grates and frames.
- AS 4087 - Metallic flanges for waterworks purposes.
- AS/NZS 4129 - Fittings for polyethylene (PE) pipes for pressure applications.
- AS/NZS 4130 - Polyethylene (PE) pipes for pressure applications.
- AS/NZS 4158 - Thermal-bonded polymeric coatings on valves and fittings for water supply purposes.
- AS/NZS 4321 - Fusion bonded medium density polyethylene coating & lining for pipes and fittings.
- AS/NZS 4441 - Orientated PVC (PVC-O) pipes for pressure applications.
- AS/NZS 4680 - Hot-dipped galvanised (zinc) coatings on fabricated ferrous articles.
- AS/NZS 4765 - Modified PVC (PVC-M) pipes for pressure applications.
- AS 4794 - Non-return valves – Swing check and tilting disc.

(c) Water Services Association of Australia (WSAA)

- WSA 03-2002 - Water Supply Code of Australia.

(d) Other

TRC Engineering Design Minimum Standards for Subdivisions and Developments

NSW Workcover - Excavation Work Code of Practice.

(e) TRC Standard Drawings Applicable to this Section

- W1108 – Mains and Connection - Property Services Connection to Main.
- W1150 – Service Details - DN20, DN25 & DN32 Property Service Details.
- W1201 – Trench/Embedment – Embedment and Trench Fill Typical Arrangement.
- W1205 – Trench/Embedment - Concrete Thrust Block Details Sheet 1 of 2
- W1206 – Trench/Embedment - Concrete Thrust Block Details Sheet 2 of 2
- W1207 – Trench/Embedment – Thrust and Anchor Block Details – Gate Valves and Vertical Bends.
- W1209 – Trench/Embedment - Trench Drainage Bulkheads, Trench Stops and Mass Concrete Piers
- W1250 – Trench/Embedment – Standard Trench Details – Reticulation Mains DN100 to DN375.
- W1251 – Trench/Embedment – Standard Trench Details – Reticulation Mains DN450 to DN750.
- W1300 – Fittings – Kerb Marker and Post Details.
- W1301 – Fittings – Typical Valve, Hydrant Installation and Air Relief Valve Installation..
- W1302 – Fittings – Typical Valve Installation Details.
- W1303 – Fittings - Fire Hydrant Installation Details.

TRC Standard Drawings shall take precedence over ALL other drawings related to the Works.

Precedence

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

HOLD POINT

All proposed deviations from the approved design drawings, TRC Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the TRC Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

PROCESS HELD: The lot or element affected by the proposed deviation.

Hold Point

MATERIALS

C401.04 GENERAL

The Constructor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this Specification. *Due Diligence*

The Constructor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits. *Rejection*

All materials shall be tested in accordance with AS/NZS 4020 to determine their suitability to be in contact with drinking water. *Standard*

C401.05 UNPLASTICISED, MODIFIED and Orientated PVC (uPVC, PVC-M, PVC-O)

Unplasticised PVC (uPVC), modified PVC (PVC-M) and orientated PVC (PVC-O) pipes and fittings for mains and suction pipes shall comply with AS/NZS 1477, AS/NZS 4765 and AS/NZS 4441, shall be suitable for use with rubber ring (elastomeric) seal, complying with AS 1646, joints and shall be of the class and size as shown on the approved design drawings. *Standard*

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS 2032 and AS/NZS 2566.1. *Installation*

Pipes and fittings are to be handled and stored protected from sunlight as per the manufacturer's recommendations. The Constructor shall provide protection for the pipes and fittings from ultra violet light and damage. The Constructor shall take account of the time for storage and type of shelter. *Protection*

C401.06 DUCTILE IRON PIPE AND FITTINGS

Ductile Iron pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the approved design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric), complying with AS 1646, to the class and type as shown on the approved design drawings. *Standard*

Flanges shall be to AS 2129 and AS 4087 with a minimum allowable operating pressure class of PN16 or to the class and size shown on the approved design drawings. Bolts and nuts for flanged joints below ground shall be Grade 316 stainless steel, unless shown otherwise on the approved design drawings. Grade 316 stainless steel bolts and nuts shall have a liberal application of Nickel Anti seize prior to assembly. *Flanges*

Where corrosive environments have been identified, all pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS 4321, or wrapped. The Constructor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the TRC Representative. *Corrosion Protection*

C401.07 STEEL PIPES AND FITTINGS

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the approved design drawings. **Standard**

The Constructor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the TRC Representative. **Corrosion Protection**

The jointing system shall be rubber ring (elastomeric), complying with AS 1646, unless shown otherwise on the approved design drawings. **Joints**

The Constructor shall not lay continuously welded steel pipelines parallel to, when in close proximity, high voltage power lines. **High Voltage Powerlines**

C401.08 COPPER PIPE AND FITTINGS

Copper tube and fittings shall comply with AS 1432 and shall be of the size and type as shown on the approved design drawings. The installation and commissioning shall comply with AS 4809. **Standard**

Copper services shall have a minimum size of DN25 with a 1.4mm wall thickness. The Constructor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the approved design drawings. Where DN20 water meters are to be fitted the service shall be reduced to DN20 prior to the meter.

C401.09 POLYETHYLENE (PE)

Polyethylene (PE) pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size as shown on the approved design drawings and installed in accordance with AS 2033. **Standard**

Jointing shall be by butt thermal fusion or by electrofusion couplings. The use of compression fittings is not permitted. **Jointing**

Fittings up to 110mm shall comply with AS/NZS 4129. Fittings from 110mm to 600mm shall be ductile iron in accordance with AS/NZS 2280 and coated internally and externally in polyethylene in accordance with AS/NZS 4129. **Fittings**

The Constructor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the approved design drawings. **Internal Diameter**

VALVES AND HYDRANTS

C401.10 GENERAL

The Constructor shall ensure that the valves and hydrants supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

***Compatibility
with Pipework***

The Constructor shall ensure that the valves and hydrants are installed so as to facilitate maintenance and repair. The Constructor shall take into account the manufacturer's recommendations, the requirements shown on the approved design drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material.

Installation

The type of external protection of buried valves and hydrants shall be fusion-bonded medium density polyethylene coating to AS 3862 and AS/NZS 4321 or thermal-bonded polymeric coating to AS/NZS 4158.

***Corrosion
Protection***

Flanges shall comply with AS 2129 and AS 4087 and shall be of the class and size shown on the approved design drawings.

Flanges

C401.11 STOP VALVES

Stop valves shall comply with the following:

- a. Stop valves shall be resilient seated valves manufactured in accordance with AS 2638. The valves shall be flanged, where permitted by TRC, unless shown otherwise on the approved design drawings.
- b. Ball valves shall be flanged, where permitted by TRC, unless shown otherwise on the approved design drawings.
- c. Butterfly valves shall comply with AS 4795. The valve shall be double flanged unless shown otherwise on the approved design drawings.
- d. Knife Gate valves shall comply with AS 6401. The valve shall be flanged where permitted by TRC unless shown otherwise on the approved design drawings.
- e. Scour valve assemblies shall be as shown on the approved design drawings.
- f. The direction of closing for all stop valves and scour valves shall be in an anti-clockwise closing (ACC) direction. Excluding ball valves and butterfly valves (unless fitted with a gear box).
- g. All valves shall have a minimum pressure rating of PN16.

Stop Valves

Ball Valves

Butterfly Valves

***Knife Gate
Valves***

Scour Valves

***Valve Closing
Direction***

Pressure Rating

Valves shall be operated by a removable key. The Constructor shall size "Tee Key" valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel. Valves greater than DN375 shall be fitted with an appropriate gearbox.

Operation

Hand wheels, where specified, shall display an embossed or engraved arrow, together with "open" and/or "close" corresponding to the valve operation.

***Hand Wheel
Arrow***

The top of valve key shall be between 100mm and 300mm below finished surface level and installed as shown in TRC Standard Drawing W1302. If necessary, this shall be achieved by the use of an extension spindle of height to suite. **Access**

C401.12 AIR VALVES

Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80, and shall be installed as shown in TRC Standard Drawing W1301. **Standard**

Air valves shall be installed such that they can be maintained without affecting supply. **Isolation**

The direction of closing for air valve isolators shall be in a clockwise direction. **Valve Closing Direction**

C401.13 NON-RETURN VALVES

Non-return valves shall resilient seated swing check type to AS 3578 or AS 4794 of cast iron or steel body, cover and an EPDM coated disc. The leaf shall swing clear and provide an unobstructed waterway. Lifting lugs shall be provided for >DN250. Wafer style non-return valves shall not be used. **Standard**

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body. **Maintenance**

C401.14 SPRING HYDRANTS

Spring hydrant bodies shall be manufactured in accordance with AS 3952 and installed in accordance with AS 2419.2 except as varied below. **Standard**

The top of spring hydrants shall be between 100mm and 200mm below finished surface level as shown in TRC Standard Drawing W1303. If necessary, this shall be achieved by the use of hydrant risers of a height to suite. **Access**

Spring hydrants shall be protected internally and externally with fusion-bonded coating in accordance with AS/NZS 4158.

C401.15 PRESSURE REDUCING VALVES

Pressure reducing valves shall be of the type as shown on the approved design drawings. **Type**

Pressure reducing valves shall be installed with restrained isolating valves, bypass arrangement and dismantling joints to facilitate maintenance. **Installation**

PIPELINE CONSTRUCTION

C401.16 GENERAL

The Constructor shall implement traffic control measures in accordance with C201 - *Control of Traffic* when working within or adjacent to a public road reserve.

Traffic Management

The Constructor shall not change the pipeline alignment without prior approval from the TRC Representative. The Constructor shall provide full details, of any proposed changes to the pipeline alignment. This action constitutes a **HOLD POINT**.

Alignment Changes

HOLD POINT

Submission to the TRC Representative of evidence supporting the proposal to deviate from the pipeline alignment by more than the tolerances shown in C401.17. The alternative pipeline alignment shall be adequately described with the hold point for approval.

Process Held: Placement of section or lot of affected pipeline.

Hold Point

C401.17 LOCATION

The location of the mains, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the approved design drawings. The pipelines shall be laid to grades and locations shown on the approved design drawings and to tolerances shown in Table C401.1. The Constructor shall confirm the locations immediately prior to construction.

Pipe Laying Method

Description	Horizontal	Vertical
Water Main	± 100mm lateral displacement from alignment	± 50mm [^]
Appurtenances & Structures	± 200mm lateral displacement from design position or alignment	± 50mm [*]
Property Services	± 100mm lateral displacement from alignment	± 50mm [*]
Water Meters	± 100mm lateral displacement from design position or alignment	As required depending on ground surface level
Structures and Fixtures at or above Ground Level		+ 5mm in trafficable areas [#]
Trench Dimensions	+ 150mm wider than the design trench width.	+ 0mm and - 50mm from the design level of the floor of the excavation.
[*] Provided minimum clearance and cover requirements are achieved. [#] Trafficable areas including sealed pavements, footpaths, cycle ways, driveways or other critical areas within public places. [^] Pipelines to be constructed with continuously rising grade between design low and design high points.		

Tolerances

Table C401.1 – Tolerances

C401.18 COVER OVER PIPELINES

The minimum depth of cover to be provided for mains shall be in accordance with TRC Standard Drawing W1250 and W1251

Minimum Cover

Lesser cover may be provided where special protection of the pipelines has been shown on the approved design drawings or directed by the TRC Representative.

Special Protection

Greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

Special Needs

The maximum desired cover shall be 1000mm.

Maximum Cover

C401.19 CROSSINGS

Where a pipeline crosses any road, creek or involves features shown on the approved design drawings, under the control of any Authority, the Constructor shall carry out the work in accordance with the requirements of that Authority. The Constructor shall provide written notification to the relevant Authority of the intention to carry out the work, pay the appropriate fees and provide written approval from the Authority to the TRC Representative and/or Developer's Representative (for Developer Infrastructure Works) prior to commencement of the work.

Constructor's Responsibility

For local and regional roads, the Constructor is to obtain a Road Occupancy Licence (ROL) from TRC and undertake all work in accordance with C290 - Road Openings.

Where the road is a classified road, (i.e.: State or National Highway), the Constructor shall obtain a ROL from the Roads and Maritime Services (RMS), pay the appropriate fees and provide a copy of the ROL to the TRC Representative prior to commencement of the work.

HOLD POINT

Written approval from the relevant Authorities of the intention to carry out the work shall be provided to the TRC Representative and/or Developer's Representative (for Developer Infrastructure Works).

Hold Point

Process Held: Commencement of pipeline crossing work.

Where shown on the approved design drawings, the Constructor shall use trenchless methods for the installation of the pipelines in accordance with C305 – *Trenchless Conduit Installation*. The installation of the pipelines by open trenching shall not be permitted over the lengths designated for trenchless installation.

Existing Road Crossings

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing. Where the carrier pipe is proposed to be PVC or similar, precautions need to be taken to prevent damage from excessive heat during curing of the grout.

Carrier Pipe Type

C401.20 EARTHWORKS

The Constructor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the approved design drawings within the specified tolerances. The Constructor shall comply with all requirements of TRC including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners.

Constructor Responsibility

All excavations shall be undertaken in accordance with the NSW WorkCover Excavation Work Code of Practice. The Constructor shall leave a clear space of 1000mm minimum between the edge of the zone of influence of any excavation. No excavated materials shall be stockpiled against the walls of any building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

***Excavated
Material***

At the completion of work each day, the Constructor shall install appropriate safety fencing along the edges of open excavations and any other measures to ensure the public are isolated and protected from open excavations. The Constructor shall provide fenced walkways and vehicular crossways across trenches to maintain access from the carriageway to individual properties or within individual properties and advise all affected residents beforehand. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

***Public Safety
Access to
Property***

The Constructor shall locate, protect and repair, as necessary, all services affected by the Works at the Constructor's expense.

***Existing
Services***

The Constructor shall carry out erosion and sedimentation control at all construction work sites in accordance with C211 - *Control of Erosion and Sedimentation*.

Erosion Control

The Constructor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open.

***Limiting
Excavations***

C401.21 MINIMUM TRENCH WIDTH FOR PIPELINES

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 in accordance with the dimensions shown on TRC Standard Drawing W1201, W1250 and W1251.

Where the approved design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum and the restoration undertaken in accordance with C290 - *Road Openings*. The wearing course on road surfaces shall be saw cut to avoid damage to the adjacent roadway.

***Minimum
Disturbances***

The Constructor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

***Widen for
Fittings***

C401.22 EXCAVATION DEPTH

The Constructor shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for mains, or as otherwise shown on the approved design drawings. An additional 50mm shall be added to the depth of bedding material in rock (i.e.: total depth of bedding = 125mm).

75mm Below

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping.

Pipe Support

C401.23 SUPPORT OF EXCAVATION

The Constructor shall adequately support all excavations to Statutory requirements including the NSW WorkCover Excavation Work Code of Practice. Records documenting compliance with this Code, and other Statutory requirements shall be kept on the Works site.

***Precautions
Against Slips or
Falls***

C401.24 TRENCH FLOOR PREPARATION AND BEDDING

The trench floor shall be prepared in a manner which prevents differential settlement. The floor shall be inspected for rock outcrops, soft spots or loose areas. Where issues are identified the areas shall be either reworked or over excavated and replaced with a cohesive material uniform with the remainder of the trench. Reworked and excavated section of the trench floor shall be compacted to at least the equivalent of the surrounding natural ground.

Approval

When the preparation of the trench floor has been completed, the Constructor shall obtain the TRC Representative's approval prior to commencing the placement of bedding, pipe laying and jointing. Reworked areas shall be identified along with the treatment undertaken. This action constitutes a **HOLD POINT**.

HOLD POINT
The floor of the trench shall be inspected by the TRC Representative. Where applicable, supporting documentation verifying conformance shall be made available from the Constructor to the TRC Representative either prior to or during the inspection.
Process Held: Placement of bedding material.

Hold Point

Bedding material shall be Processed Aggregate that meets the following material specification requirements:

- Grading shall fall within the specified limits shown in Table C401.2.
- Wet strength shall be greater than 80kN.
- Wet strength / dry strength variation shall not exceed 35%.

Sieve Size (mm)	% of Mass Passing
9.5	100
6.7	85-100
2.36	0-20
0.075	0-2

Table C401.2 - Grading of Bedding Material for Pipes

Alternative sources, complying with AS/NZS 2566.1, may be nominated for approval by the TRC Representative. Use of an alternative source of material shall constitute a **HOLD POINT**.

HOLD POINT
Alternative sources of bedding material can be nominated by the Constructor for the TRC Representative's approval, with conformance records demonstrating compliance with AS/NZS 2566.1, at least five (5) working days prior to placement.
Process Held: Placement of bedding material.

Hold Point

C401.25 LAYING AND JOINTING OF PIPES

Unless detailed otherwise in this Specification, the Constructor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.2 or as appropriate

Installation

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Constructor and, if required by the TRC Representative, the Constructor shall suspend each one in a sling to enable the TRC Representative to inspect it.

Examination

The Constructor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter (including run-off) entering sections of pipeline which are left uncompleted overnight or unattended during rainfall.

Cleaning

The Constructor 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

Joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll-on or skid type or, where shown on the approved design plans, mechanical joints, either fixed flange or bolted gland type.

Joint Type

For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Constructor shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.

Rubber Ring

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

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine-toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Constructor shall ensure that fire-fighting equipment, in working order, is on the Works site prior to the field cuts being made. If the Constructor proposes to use a petrol-engine pipe cutter in an excavation, the Constructor shall ensure that a safe atmosphere is maintained in the excavation at all times. Cuts in the trench shall be checked for plumb, cuts above ground are to be conducted to ensure plumb and checked afterwards.

Pipe Cutting

The Constructor shall chamfer the ends of any pipes cut in the field to the manufacturer's written instructions.

End Preparation

Where pipes are cut in the field, the Constructor shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Constructor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Constructor shall refer to the socket manufacturer for the correct marking depth.

Witness Mark

Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.

Different Joints

If the Constructor encounters asbestos associated with the installation of the pipeline, work shall cease and the TRC Representative and Developer's Representative (for Developer Infrastructure Works) shall be notified immediately. Constructor's and/or their nominated sub-contractors are not permitted to deliberately expose or remove asbestos material.

**Existing
Asbestos Pipe**

Only appropriately trained personnel shall be permitted to work with asbestos materials and where cutting and disposal of asbestos cement pipes is required, the Constructor shall conform with all relevant WHS requirements.

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Constructor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

Joint Deflection

The Constructor shall lay pipes on continuously rising grades from design low point (e.g. scour valve) to design high point (e.g. air release valve or hydrant), notwithstanding any minor irregularities in the ground surface.

Grade

Green detectable marking tape shall be laid along the line of mains constructed from material other than Ductile Iron Cement Lined pipe. The tape is to be positioned at either the interface between the bedding material and the backfill material, or 150mm above the top of the service when the backfill material is the same as the bedding material. It shall be laid in a manner to create a continuous connection between valves and/or hydrants. Strip the end of the tape to expose its conducting wires and connect bare wires to a nut or bolt of a valve or hydrant to form an electrical connection of the wire to the valve or hydrant.

Detectable Tape

C401.26 TRENCH STOPS

Where a pipe is laid on bedding at a grade of 5% to 14%, the Constructor shall construct, as below, trench stops consisting of bags filled with cement stabilised sand and sealed, or concrete bulk heads. Refer TRC Standard Drawing W1209. Trench stops shall be installed and spaced as prescribed by TRC Standard Drawing W1209 or as shown in the approved design drawings.

Trench Stops

Grade 5-14%

- (a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 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 and extend to within 300mm below finished surface level, or up to a maximum 1 metre above the pipe obvert (whichever is the lesser).
- (b) The bags shall be placed around and above the pipe, as in (a) above, 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.

C401.27 CONCRETE BULKHEADS

Where a pipe is installed at a grade of 15% and to 29%, the Constructor shall construct concrete bulkheads. Where a pipe is installed at a grade of 30% to 50%, the Constructor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is installed at a grade of 50% and over, the Constructor shall install the pipe in accordance with the approved design drawings. Bulkheads shall be of 20MPa concrete in accordance with TRC Standard Drawing W1209, C271 – *Concrete Works*, and 150mm minimum thickness as follows.

**Concrete
Bulkheads**

**15% to 29% and
30% to 50% and
over 50%**

- (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. The bulkhead shall extend to within 300mm below finished surface level, or up to a minimum 1 metre above the pipe invert (whichever is the lesser).
- (b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm 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.

Concrete bulkheads shall be installed and spaced as prescribed by TRC Standard Drawing W1209 or as shown in the approved design drawings.

Spacing

WITNESS POINT
<p>The Constructor shall notify the TRC Representative at least two (2) days prior to the placement of concrete for concrete bulkheads for inspection and approval by the TRC Representative.</p> <p>Process Held: Placement of Concrete.</p>

Witness Point

C401.28 VALVE AND HYDRANT CHAMBERS

The Constructor shall construct around each valve and hydrant a chamber of the type and to the details shown on the approved design drawings. Where no details are provided, TRC Standard Drawing W1302 shall be complied with for valves and TRC Standard Drawing W1303 shall be complied with for hydrant chambers. Plastic chambers shall not be used in roadways.

Type

The concrete shall comply with *C271 - Concrete Works*.

Concrete

Valve and hydrant chamber covers shall be manufactured from coloured materials (where required), and not painted after installation. Colours to be in accordance with Table C401.3.

Colour Designation

Colour	Designation
Yellow	Potable Water
Red	Closed Valve, Zone Boundary
White	Dedicated Rising Mains
Lilac	Reuse Water
Black/Grey	Wastewater

Table C401.3 – Valve and Hydrant Chamber Cover Colours

Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Constructor shall either wrap the valve using Denso or approved equivalent applied in accordance with the manufacturer's guidelines.

Corrosion Protection

C401.29 CHAMBER COVERS AND FRAMES

Covers and frames 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 to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius.

Finish

Tolerances for the dimensions on the COVER shall be - 5mm + NIL.
Tolerances for the dimensions on the FRAME shall be - 5mm + 5mm.

Tolerances

Covers shall be seated as shown on the approved design drawings.

Cover Seating

Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces. Elsewhere, covers shall be finished 50mm above the surface of the ground, in a manner designed to avoid as far as possible, the entry of surface water.

Cover Levels

Cast iron covers and frames shall be manufactured in accordance with AS 3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

Installation

The Constructor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

Plastic Covers

Covers to be type "Class D" where located within trafficable areas (including asphalt, bitumen seal, concrete, nature strip) and "Class B" for non-trafficable areas.

Cover Type

C401.30 SERVICE CONNECTIONS

The Constructor shall provide service connections in accordance with the approved design drawings. Where no detail is provided, service connections to be in accordance with TRC Standard Drawings W1108 and W1150.

Provision

The Constructor shall leave the water main exposed for a distance of half a metre either side of the service connection to enable the necessary inspections by the TRC Representative prior to backfilling by the Constructor.

Main Exposed

Water services should be single service drawn copper pipe or polyethylene in accordance with C401.08.

Single Service

Services are to be a minimum of DN25 with 1.4mm thickness copper or DN32 PE100 PN16. Fittings at joints, branches and bends are to be brass or copper capillary fittings or of a type approved by TRC. Ball valves and elbows are to be of brass and a type approved by TRC. Flared fittings will not be acceptable.

Service Type

In industrial and commercial areas, services under the carriageway are to be laid in approved conduit. The minimum conduit pipe shall be 100mm, PN9 UPVC. In residential areas, services under the carriageway are to be laid in approved conduit. The minimum conduit pipe shall be 100mm, PN9 UPVC.

Conduits

Conduits may be laid for future proposed services however, the service is not to be connected to the water main.

Service connections shall have a minimum cover of 500mm under carriageways and 300mm in footways.

Service Cover

TRC will supply and install water meters once applicable fees have been paid and upon registration of the subdivision for Developer Infrastructure Works.

Meter Installation

Tapping bands approved by the manufacturer for use on the specific type of pipe are to be used for all service connections (readytap connectors or equivalent are acceptable). The minimum distance between two adjacent tapping bands should be 600mm. Thin brass type tapping bands without rubber backing will not be permitted.

Tapping Bands

C401.31 THRUST AND ANCHOR BLOCKS

Thrust and anchor blocks shall be installed at the locations shown in the approved design drawings in accordance with TRC Standard Drawings W1205, W1206 and W1207. 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

The Constructor shall provide permanent thrust blocks in accordance with TRC Standard Drawings W1205, W1206 and W1207 such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area.

Thrust Blocks

The Constructor shall provide permanent anchor blocks (e.g. at end caps) in accordance with the approved design drawings or TRC Standard Drawing W1207. Where no detail is provided, the proposed position and dimensions of the anchor block shall be referred to the TRC Representative.

Anchor Blocks

WITNESS POINT

The Constructor shall notify the TRC Representative at least two (2) days prior to the placement of concrete of any thrust blocks and/or anchor blocks for inspection and approval by the TRC Representative.

Witness Point

Process Held: Placement of Concrete.

The Constructor shall provide temporary anchorages adequate to restrain the pipe when under test.

Temporary Anchorage

The Constructor shall obtain the approval of TRC for the type and use of restrained joints as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

Restrained Joints

C401.32 CONCRETE ENCASEMENT

Where pipes have less than 450mm of cover above the top of the pipe barrel, or where directed by the TRC Representative, they shall be encased in concrete. Concrete shall be 20MPa complying with C271 - 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:** 75mm minimum under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.

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 (1) face of each coupling.

Contraction Joint

Reinforcement in concrete encasement shall be as shown on the approved design drawings.

Reinforcement

C401.33 WRAPPING OF PIPELINES

Sleeving / wrapping is only required where it is envisaged that a corrosive environment may exist (i.e. isolation for electrical installations, sullage lines etc). Application of polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the TRC Representative. The Constructor shall take due care not to damage the sleeving / wrapping during its application or during the backfilling of the trench.

Application

C401.34 CORROSION PROTECTION OF STEEL BOLTS AND NUTS

All bolts and nuts used in below ground applications shall be Grade 316 stainless steel bolts and nuts, with a liberal application of Nickel Anti-seize applied prior to assembly. For above ground applications, hot-dipped galvanised bolts and nuts may be used.

Bolts and Nuts

PIPELINE TESTING AND RESTORATION

C401.35 PRESSURE TESTING

The Constructor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. This action constitutes a **HOLD POINT**. Testing shall be undertaken and recorded in accordance with **Annexure C401A** and shall be submitted as evidence of lot or section conformance.

Pressure Testing

HOLD POINT

Inspection of pressure testing including the Constructor's requirement to nominate test method(s) to the TRC Representative for approval at least two (2) working days prior to undertaking the test.

Hold Point

Process Held: Undertaking pressure test of lot or section.

Pipelines shall be tested in sections approved by the TRC Representative as soon as practicable after each section has been laid, jointed and backfilled, provided that:

- (a) 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 TRC Representative; and
- (b) The pressure testing shall not be commenced earlier than five (5) working days after the last concrete thrust or anchor block in the section has been cast.

Timing

For the purpose of this Clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g.: by means of main stop valves.

Section Definition

Pressure testing shall not be carried out during wet weather unless otherwise approved by the TRC Representative.

Wet Weather

During pressure testing, all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

Field Joints

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one (1) side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Stop Valves

Before testing a pipeline section, the Constructor shall clean it to the satisfaction of the TRC Representative and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves / hydrants / services. 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

The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be a minimum 1200kPa or 1.5 times the standard operating pressure, whichever is the greater. The test pressure however, shall not exceed the pipe or fitting design pressure.

Test Pressure

The Constructor shall maintain the specified test pressure as long as required by the TRC Representative while the Constructor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 2 hours. For the purpose of determining the actual leakage losses, the Constructor shall use the Constant Pressure Test (Water Loss Method) in accordance with AS 2566.2 by carefully measuring and recording the quantity of water added in order to maintain the pressure during the period of testing.

Duration of Test

Note: This test method is applicable only to ductile iron, PVC and steel pipelines. For PE pipelines, the test method outlined in AS 2566.2 - Appendix M5 shall be adopted.

The pressure testing of a section shall be considered to be satisfactory if:

Satisfactory Pressure Test

- (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:

$$Q_1 = (0.14 \times D \times L \times H) / 1,000,000$$

where:

Q_1 = permissible leakage rate (litres per hour)

D = internal diameter of pipe (mm)

L = length of main tested (m)

H = average test head (m)

- (d) Unless otherwise specified by the TRC Representative adopt a maximum test length of 1 kilometre.

Any failure, defect, visible leakage or excessive leakage rate which is detected during the pressure testing of the pipeline or during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, shall be made good by the Constructor at the Constructor's expense.

Rectification

Final water inspections are to be carried out immediately prior to final practical inspection, to ensure all water infrastructure is compliant.

Timing of Final Inspection

C401.36 CONNECTION TO EXISTING PIPES

Connections to existing pipes shall be undertaken by TRC. A request for a connection to TRC mains shall be directed to the TRC Representative. The timing of the connection shall be determined by TRC in consultation with the Constructor.

Time of Least Interference

C401.37 FLUSHING OF PIPELINES

In association with TRC's operational staff and after connection by TRC to its existing water supply system, all water mains shall be thoroughly flushed to the satisfaction of the TRC Representative.

Flushing

C401.38 BACKFILL AND COMPACTION

After laying and jointing of a pipeline has been completed, the Constructor shall present the laid and jointed pipes for inspection by the TRC Representative prior to the commencement of trench backfilling. This action constitutes a **HOLD POINT**. The TRC Representative's approval of the laid and jointed pipes is required prior to the release of the hold point.

Notification

HOLD POINT

Inspection by the TRC Representative of the laid and jointed pipes at least two (2) working days prior to backfilling.

Hold Point

Process Held: Backfilling of lot or section of laid and jointed pipes.

Material for the side support and overlay of the pipe shall comply with the requirements for pipe bedding specified in Clause C401.27. The material shall be compacted in layers of not more than 150mm to 95% of the standard maximum dry density as determined by AS 1289.5.4.1 for cohesive materials. The extent of the bedding material within the trench shall be determined in accordance with TRC Standard Drawing W1201, W1250 and W1251.

Side Support and Overlay

The Constructor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows:

Remainder of Trench

(a) Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be:

Roadway Area

(i) Backfilled with Select Material to the underside of the pavement. Alternative materials, including excavated materials, or stabilised sand may be nominated to the TRC Representative.

Backfill to Subgrade Level

(ii) Backfilled with road base and sub-base material in accordance with C242 – Flexible Pavements.

Backfill in Pavement Zone

(iii) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a Density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

Backfill of Pavement Layers

The Constructor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe. Vibratory compaction should be avoided in close proximity to the pipe and associated connections and infrastructure.

Care

The Constructor shall carry out compaction tests 75mm to 100mm below the level being tested.

Compaction Tests

C401.39 VALVE AND HYDRANT MARKING

The Constructor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with TRC Standard Drawing W1300 and/or as approved by the TRC Representative. The markings shall be abbreviated as follows:

Valve and Hydrant

- **SV** – Stop Valve
- **SCV** - Scour Valve
- **H** – Hydrant
- **W** – Water Main or Water Service
- **AV** – Air Valve

The Constructor shall provide formed kerb impressions for each valve and hydrant, with lettering to be 75mm high and 15mm wide and placed on top of the kerb with reflective white paint with glass beads. Alternatively, in areas where kerb is existing, a stainless steel kerb marker disc with a central hole for a mushroom head nail or peg to secure the disc to the top of the kerb may be used. The face of the disc shall be stamped or engraved with letters to identify the adjacent service/fitting.

Kerb Impressions & Marker Discs

Where there is no kerb, or as otherwise directed by the TRC Representative, the Constructor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting in accordance with TRC Standard Drawing W1300. The distance to the valve or hydrant in metres, to an accuracy of 0.1m and the size of the main, shall be permanently marked or stamped on the plate with legible numbers a minimum 12mm high and Red or Black in colour. The top number gives the distance (in metres) from the plate to the hydrant and the bottom number gives the size (in mm) of the water main.

Plates on Posts

The post shall conform to the following requirements:

Post Details

- (a) The post shall be of sufficient length to be set firmly in place under saturated ground conditions.
- (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) The post shall be metal, with blue powder coating for reticulation mains or white powder coating for rising mains and trunk mains.

For hydrants, the Constructor shall affix blue two-way reflective raised pavement markers to the centreline of road pavement.

Raised Pavement Markers

C401.40 RESTORATION OF SURFACES

The Constructor shall make good at their cost all fencing, roads, footpaths and surfaces generally, which may be disturbed by operations of the Constructor. The Constructor shall restore all work sites and areas adjacent thereto to a condition, standard and finish equivalent to that which existed prior to the works commencing.

Original Condition

Where restoration to an equivalent condition, standard and finish is not reasonably practical, the Constructor is required to consult with the relevant property owner, statutory agency or land custodian to agree on a suitable alternate that is in general terms functionally equivalent and to the satisfaction of the relevant parties. (E.g.: a uniquely patterned concrete driveway could be replaced by a 'plain' finish concrete driveway if agreed by the property owner).

Alternate Condition

The Constructor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, 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 or Maintenance Bond Period for Developer Infrastructure Works. The Constructor shall maintain pavements in accordance with *C290 - Road Openings*.

Maintenance

In other than roadways, the Constructor shall place the backfill 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 or Maintenance Bond Period for Developer Infrastructure Works in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the

Backfill

Constructor. Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, the Constructor shall take all necessary steps to consolidate the trench before removing surplus materials from the Works site.

In locations where, in the opinion of the TRC Representative, 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 TRC Representative in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Constructor shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works.

Disposal of Surplus Material

Excess excavated material shall be disposed of to a Licenced waste facility authorised to accept the waste, unless:

- a) The excavated material meets the definition of "Virgin Excavated Natural Material" (VENM) as defined in the NSW Protection of Environment Operations Act 1997 (POEO Act); or
- b) The excavated material meets the requirements of "The Excavated Natural Material Order 2014" (ENM) issued under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014;

and,

- a) The excess excavated material is tested and disposed of in accordance with the requirements of the relevant classification (VENM or ENM);
- b) The Constructor (or Principal) obtains all necessary approvals for disposal to a destination other than a Licenced waste facility. This is to include written authority from the owner of the land where the material is to be placed that they approve acceptance.

Where, within public or private property, the Constructor shall level trenches at the time of backfilling or otherwise as directed by the TRC Representative. The Constructor shall make good any subsequent settlement, as required by placing additional fill.

Settlement

The Constructor shall immediately restore any damaged or disturbed private property and services.

Restoration

Should the Constructor 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. The Constructor 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 or Maintenance Bond Period for Developer Infrastructure Works.

Tunnelling

The Constructor shall provide notice to affected property owners of any pending work. Written notification shall be delivered to all affected property owners as per the minimum time frames for notification shown in Table C401.4.

Property Owner Advice

Properties Affected	Minimum Timeframe for Notification
1	24 hours
Up to 25	5 working days
Greater than 25	10 working says

Table C401.4 – Notification Timeframes

ANNEXURE C401A – PRESSURE TESTING

MSF-180 – Water and Wastewater Test Sheet – Pressure Main Hydrostatic Test Result

PRESSURE MAIN HYDROSTATIC TEST RESULT SHEET - FOR PVC, DICL, GRP & STEEL PIPE SYSTEMS (Not Suitable for PE)

Testing Method to be in accordance with Australian Standards - Compressed Air Testing SHALL NOT be permitted for pressure pipe.

Works Title / Street Name / Locality: _____

Line No / Pipeline Description: _____ Diameter: _____ Pipe Material: _____

Date of Test: _____ Test pressure Required (k Pa) (at top of pipe – allow for elevation at bottom of pipe)# : _____

Downstream Chainage and Fitting (e.g. SV at Ch 0)	Upstream Chainage and Fitting (e.g. EC at Ch 600)	L Length of Main Under Test (m)	D Pipe Diameter (mm)	H Test Pressure (m)	Q Allowable Make-up Water (l/hr)	Test Duration (hrs)	Difference in vertical elevation of test section (m)	Testing Result – Did the pipeline meet the specification requirements?	Comments (e.g. re-test required) Complete another test result sheet if re-test required.
								<input type="checkbox"/> YES <input type="checkbox"/> NO Record quantity of make-up water added	

Name of Witness: _____ Signed by Witness: _____

Reference : AS/NZS 2566.2:2002, Buried flexible pipelines – Part 2:Installation, The hydrostatic test pressure at any point in the pipeline shall be (a) not less than the design pressure; and (b) not more than 1.25 times the PN of the lowest rated component in the system) shall be applied to the section under test.

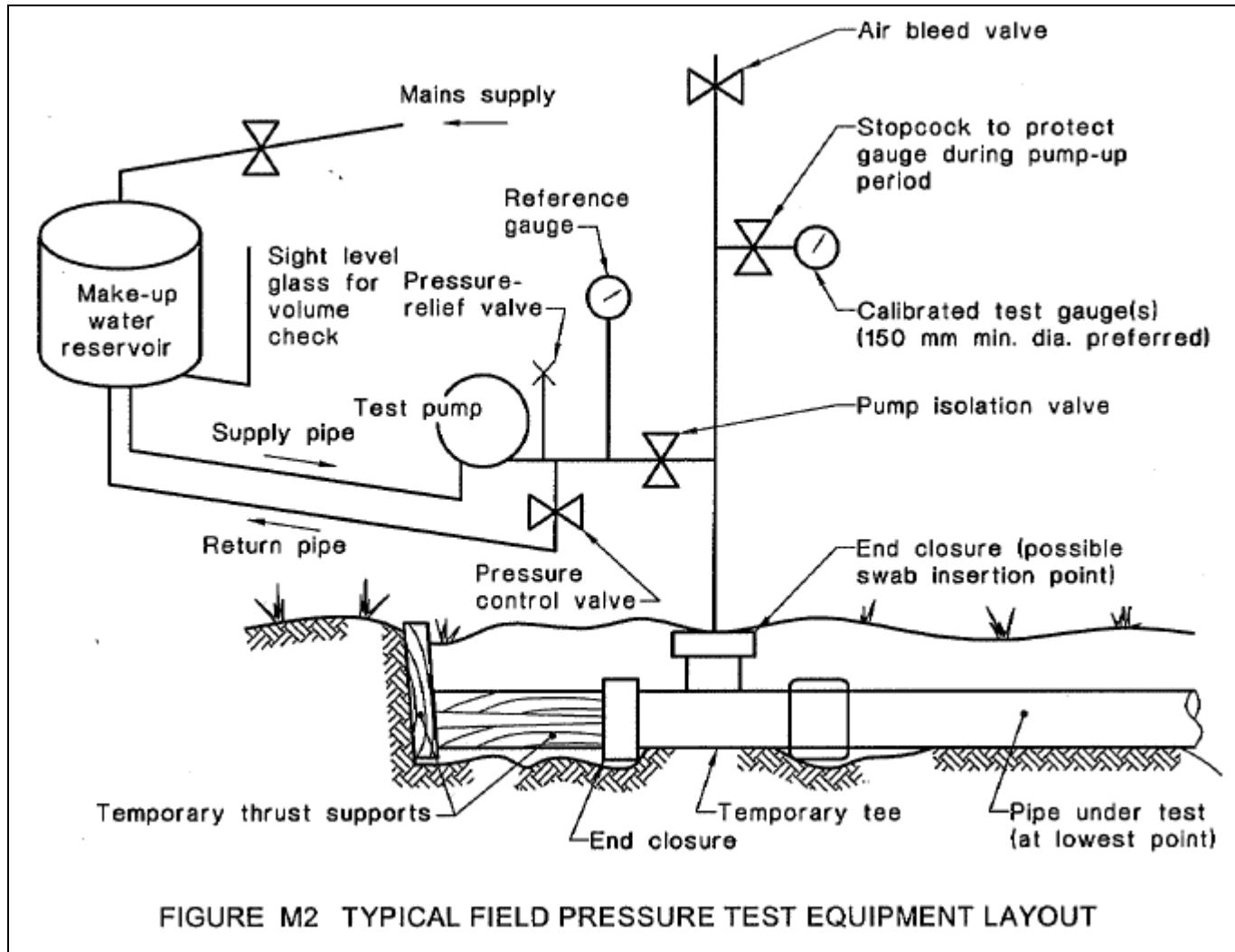
The test length shall be acceptable where (a) there is no failure of any thrust block, pipe, fitting, joint or any other pipeline component; (b) there is no visible leakage; and (c) the quantity of make-up water necessary to maintain the test pressure shall comply with the following equation:

$$Q = \frac{0.14 \times D \times L \times H}{1,000,000}$$

Where, Q = Allowable Make-up Water, (L/h)
 D = nominal pipe diameter, (mm)
 L = length of the test length, (m)
 H = average test pressure, (m). (note: 1m ≈ 10kPa) or (120m ≈ 1,200kPa)

Note: The make-up water is not a leakage allowance, but it is an allowance to cover the effects of the test head forcing small quantities of entrapped air into solution. Normally the test should last for a minimum of 2hrs and be concluded within 5hrs to 8hrs. The make-up water requirement should reduce with time as air goes into solution.

AS/NZS 2032:2006, Installation of PVC Pipe Systems - two pressure measuring instruments to be used. Where the joints are accessible for inspection and there is no evidence of leaks of the test water after at least 15 minutes, the section is deemed to have passed. Where the joints are not accessible for inspection and the loss of water is less than that calculated as the maximum allowable loss (Q), the section is deemed to have passed the test. # Subtract 10kPa from the pressure input for each 1m that the test rig is above the bottom of the pipe.



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