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SECTION 7 - WATER

7. WATER

7.1 INTRODUCTION

a) The purpose of Council's water supply engineering standards is to provide design guidance and minimum standards for the design, construction and maintenance of water supply.

b) Design and construction of all water supply works in accordance with these standards will ensure that water is supplied to communities effectively and in a way that is cost-effective in the long-term.

7.1.1 Objectives

a) The Council is seeking to have a water supply system that will distribute water for consumption and fire fighting which meets the appropriate standards and level of service for these uses and delivered in an efficient, safe and sustainable way.

7.1.2 Performance Criteria

7.1.2.1 Hygiene

a) A water supply facility shall:

1) Deliver water to the point of supply that complies with the Drinking-water Standards for New Zealand 2005 (Revised 2008).

2) Minimise the risks of contamination being introduced into the water.

7.1.2.2 Capacity and layout

a) A water supply facility shall:

1) Have sufficient capacity to provide adequate flow and pressure to meet the anticipated demand over its lifetime. allowing for ultimate future development potential[1] within the catchment or adjoining catchments.

2) Meet the fire protection requirements of the NZ Fire Service Fire Fighting Water Supplies Code of Practice 2008.

3) Be located in such a way as to adequately service each lot, and provide reasonable access for maintenance.

4) Minimise adverse effects on, and be compatible with, the existing water reticulation network.

5) Minimise disruption to other parts of the network during maintenance by having adequate interconnections, valves, and separating trunk main supplies from local reticulation.

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[1] Development potential means the likely future development within the Services Overlay taking into account the Council's Strategic City Development Plan and the LTCCP, and the provision of services in a manner that integrates with and does not foreclose this likely future development.

6) Where practical utilise mechanical, electrical, alarm and telemetry equipment which is compatible with existing equipment used by NCC.

7) Where the expected life of any component is less than that of the system of which it is a part, make provision for access and maintenance of that component.

8) Ensure that mechanical and electrical equipment is either designed for submergence, or located above the 100 year design flood level.

9) Minimise whole of life costs.

7.1.2.3 Structural integrity

a) A water supply facility shall:

1) Be constructed of materials compatible with the chemical properties of the water being conveyed, suitable for the intended duty with a minimum design life of 100 years, and having a proven performance record.

2) Minimise leakage, eliminate the ingress of contaminants, and the penetration of roots, using current best practice.

3) Provide electrical and mechanical equipment with a life span and quality of the best currently available technology.

4) Withstand all anticipated superimposed loads and network pressures (including those from transient surges that could reasonably be expected from pump failure, pump starts, and sudden valve closure).

7.1.3 Key References

a) Table 7-1 sets out external standards that are relevant to the management of water.

b) These apply and should be taken into account in the design and construction of any water supply asset in the Nelson City Council area. Where an Act or Standard is referenced this shall be the current version including any associated amendments.

Table 7-1 Standards and Publications Related to the Design and Construction of Water Supply Services

Standard	Comment
	Nelson City Council traffic management guidelines
SNZ PAS 4509	New Zealand Fire Service Firefighting Water Supplies Code of Practice
NZS 4404:2010	Land development and subdivision engineering
NZS/BS 21	Pipe threads for tubes and fittings
NZS/BS 750	Underground fire hydrants and surface box frames and fittings

Standard	Comment
AS/NZS1260	PVC-U Pipes and fittings for drain waste and vent applications
AS/NZS 1254	PVC pipes and fittings for stormwater and surface water applications
AS/NZS 4793	Mechanical tapping bands for waterworks purposes
AS1646	Elastomeric seals for water works purposes
AS/NZS1477	PVC Pipes and fittings for pressure applications
AS/NZS2032	Installation of PVC pipe systems
AS/NZS2033	Installation of polyethylene pipe systems
AS/NZS2280	Ductile iron pipes and fittings
AS/NZS2544	Grey iron pressure fittings
AS/NZS2566	Part 1:1998 Buried flexible pipelines – Structural design Part 1 Supp 1:1998 Buried flexible pipelines – Structural design – Commentary Part 2 – Buried flexible pipelines - Installation
AS/NZS2638	Gate valves for water works purpose – resilient-seated
NZS4058	Specification for pre-cast concrete drainage and pressure and non-pressure pipes
NZS3109	Concrete construction
NZS3121	Specification for water and aggregate for concrete
BS3412	Methods of specifying general purpose PE materials for moulding and extrusion
NZS 3501	Specification for copper tubes for water, gas and sanitation
AS3572	Glass filament reinforced plastics
NZS3604	Timber framed buildings
AS/NZS3725	Loads on buried concrete pipes
AS/NZS4020	Testing of products for use in contact with water
AS/NZS4087	Metallic flanges for water works purposes
AS/NZS4129	Fittings for PE pipes for pressure applications
AS/NZS4130	Polyethylene (PE) pipes for pressure applications
AS/NZS4158	Thermal bonded polymeric coatings on valves and fittings for water industry purposes
AS4181	Stainless steel clamps for water purposes
AS/NZS4331	Metallic flanges – Part 2: Cast iron flanges
AS/NZS 4441	Oriented PVC (PVC-O) pipes for pressure applications.
NZS4442	Welded steel pipes and fittings for water, sewage, and medium pressure gas
NZS4501	Code of practice for the location and marking of fire hydrants
AS/NZS4765	Modified PVC (PVC – M) pipes for pressure applications

Standard	Comment
AS/NZS 4998	Bolted unrestrained mechanical couplings for waterworks purposes
NZS/BS5163	Specification for predominantly key operated cast iron gate valves for water works purposes
AS 3571/AS 3572	Glass reinforced plastics (GRP) pipes joints and fittings
Department of Building and Housing	The Building Act 2004
DWSNZ	Drinking-water Standards for New Zealand

7.2 RETICULATION DESIGN

7.2.1 Level of Service

a) Table 7-2 sets out the minimum levels of service required for urban water supply reticulation. Any proposed water supply system (or extension to an existing water supply system) shall be adequate to meet these levels of service at the time of design and the reasonably foreseeable future.

b) Council may require water mains or water supply facilities to be installed to a higher specification (capacity or strength) in order to provide for future development. In such cases Council may by agreement:

1) Negotiate with the developer and make a financial contribution to the cost of additional capacity over and above that required for the development; or

2) Install the whole water supply reticulation or facility in anticipation of development, on terms requiring the developer to meet an appropriate proportion of the costs incurred by Council.

c) All cost contributions should be agreed in writing with the Engineering Manager prior to construction. Agreement may be reached at a resource consent stage.

Table 7-2 Water Supply Levels of Service

Design Criteria	Level of Service Required
SNZ PAS 4509 - NZ Fire Service Fire Fighting Water Supplies Code of Practice	Full compliance in each and every part of the network
Connection	Each lot shall have an individual metered connection
Minimum flow at each connection	30 litres per minute for design flows as defined in Table 7-3
Minimum normal working residual pressure	300 kPa at ground floor level of each building site
Maximum static water pressure	900k Pa at ground level of each building site

Note:

Lots and buildings in the Rural area provided with private, on-site systems shall meet the requirements of RUr.28 of the NRMP.

7.2.2 Reticulation Design

a) The Nelson water supply reticulation comprises differing pressure zones, supplied from various reservoirs and pressure reducing valves. The extent of a pressure zone is such that the Level of Service (Performance Criteria) can be achieved for each property included. It is dependent on the available head at the reservoir/pressure reducing valve and elevation of the properties.

b) The Council's reticulation and asset plans should be carefully referred to when designing extensions to, or amendments to the existing water supply reticulation.

c) All proposed reticulated water supplies must comply with the minimum levels of service shown in Table 7-2 for both normal demand flows and fire fighting flows.

d) For residential development, network design and pipe sizes will normally be determined by fire fighting flows. As a minimum the Designer must demonstrate compliance with fire fighting requirements. Council, at its discretion, may also require demonstration of compliance for normal demand, or to a nominated higher standard.

e) For commercial or industrial development, network design may be determined by normal demand flows or fire fighting flows and the Designer must demonstrate analysis of both scenarios.

7.2.3 Design Information

a) The Council may provide details of the working pressure or pressures at the point or points of connection to the existing reticulation that may be used for design purposes. When such data is not available or at the Council's request, it will be the responsibility of the designing engineer to obtain the information through independent flow and pressure tests. The Council shall have the right to specify the diameters to be used for the principal water mains within the development with regard to the Council's Strategic and Management Plans.

7.2.4 Permitted Head Losses

a) The new water supply reticulation shall be designed to mitigate large fluctuations in residual pressure as demands vary and minimise the losses of pressure along the watermains. Head losses in the watermains shall not exceed approximately 20kPa/kilometre at peak domestic demand (i.e. 2 metres of head loss per 1000 metres of pipeline). Higher losses may be approved by the Council on a case-by-case basis.

7.2.5 Reservoir Head

a) For design purposes the hydraulic head at a reservoir shall be taken with the reservoir being fifty percent full. The reservoir shall be located at an appropriate height so that properties at the highest location receive a pressure of 30 metres at the point of supply measured from the bottom water level of the reservoir and properties at the lowest location receive a pressure not more than 90 metres from the top water level of the reservoir at the point of supply without the use of a PRV valve.

b) When the source of supply is a pressure-reducing valve the hydraulic head shall be the head the pressure-reducing valve is set to.

7.2.6 Normal Working Demand Flows

a) The minimum flow and normal working residual pressure level of service criteria specified in Table 7-2 shall be satisfied for all reticulation when using the following demand flows.

Table 7-3 Design Demand Flows

Development Type	Design Flows
Residential	33 litres per head per peak hour 400 litres per head per day (peak day) 1,000 litres per dwelling per day (assuming 2.5 persons per dwelling)
Commercial & Industrial	Specifically assessed by the Designer

7.2.7 Firefighting Demand Flows

a) All reticulation (and storage) design must fully comply with the requirements of the NZ Fire Service Fire Fighting Water Supplies Code of Practice (SNZ PAS 4509), hereafter called the Code of Practice.

b) This Code of Practice sets out requirements for firefighting including:

1) firefighting flows,

2) storage,

3) residual pressure and

4) hydrant spacing.

c) Table 7-4 and 7-5 below summarises the more general requirements of the Code of Practice for Normal Reticulation Design. Further specific reference to the requirements Code of Practice may be required for unusual situations.

Table 7-4 SNZ PAS 4509 Fire Fighting Flow, Pressure and Storage Requirements

	Reticulated Water Supply				Non-reticulated water supply	
Fire water class	Hydrant flow required within a distance of 135m (l/s)	Additional Hydrant flow required within a distance of 270m (l/s)	Maximum number of fire hydrants to provide flow	Residual water pressure at hydrants	Minimum water storage within a distance of 90m	
					Time (firefighting) (min)	Volume (m3)
FW1	7.5	-	1	100 kPa	15	7
FW2	12.5	12.5	2	100 kPa	30	45
FW3	25	25	3	100 kPa	60	180
FW4	50	50	4	100 kPa	90	540
FW5	75	75	6	100 kPa	120	1080
Note: See the Code of Practice for additional notes and other specific requirements						

Table 7-5 SNZ PAS 4509 – Water Supply Classes

Class	Description
FW1	Single family homes with a sprinkler system installed.
FW2	Single family homes without a sprinkler system installed and all other structures with a sprinkler system installed.
FW3, FW4, FW5, FW6 and FW7	Various classifications dictated by floor area and hazard category. Refer Table 1 of SNZ PAS 4509.

d) Generally for compliance in residential areas under classification FW2 a flow of 12.5 l/s is required from each fire hydrant, with maximum hydrant spacing of 135.0m. Each hydrant is to be no closer than 6.0m and no further than 135.0m from the potential fire source.

7.2.8 Alteration of Existing Infrastructure

a) Any alteration of the existing water supply reticulation (upgrading, relocation and lowering of watermains and other water supply element(s), required for compliance of the new development to the Council's standards shall be at the developer's cost. The connections to the existing reticulation shall be undertaken by a contractor approved by the Council at the developer's cost.

7.2.9 Depth of Water Mains

a) The following standards apply to the installation of water mains:

1) Compliance with SD 702.

2) Both principal mains and rider mains shall have the following cover, except in circumstances requiring special protection. Greater depth shall be provided if required by Council.

3) Under grass berms, the top of pipe is 600mm below finished surface (minimum) and 900mm (maximum) for water mains in residential areas. Top of pipe is 750mm (minimum) and 1000mm (maximum) below finished surface for water mains in commercial and industrial areas and for rural pipelines.

4) Under carriageways, the top of pipe is 750mm (minimum) and 1000mm (maximum) below finished surface level, measured at the lowest point of the carriageway.

5) The sections of watermain adjacent to a driveway/vehicle crossing shall be gradually deepened, to allow the specified cover under the driveway/vehicle crossing without the provision of vertical bends. Similar provision shall be made to give the specified cover over valve and hydrant spindles.

6) In berms, service connection pipes shall have a minimum cover of 350mm and maximum cover of 500mm. In the carriageway, right-of-way or accessway, service connection pipes shall have a minimum cover of 450m and maximum cover of 750mm. At the meter box or rider main valve, the pipe is permitted to have lesser cover where it is raised to suit the fitting height.

7) Council will not accept public water supply pipes located through private property, other than rural pipeline supplies.

7.2.10 Building Over or Alongside a Public Watermain

a) Building over or alongside any Public water main is only a Permitted Activity if it complies with the rules in the appropriate zone section of the Nelson Resource Management Plan.

b) The engineering requirements for building over or alongside watermains are as follows:

1) Structures

- Must be located no closer than 1.0 metre measured horizontally from the centre line of any public watermain where the pipe is less than or equal to 300mm in diameter.
- Must be located no closer than 1.5 metres measured horizontally from the near side of any public watermain where the pipe is greater than 300mm diameter.

- Which are balconies, may overhang the line of the pipe provided the balcony is cantilevered and its height above ground level is not less than 1.8m.
- Which are located within 3 metres measured horizontally from the near side of the pipe must have the base of the foundations deeper than a line drawn at 30 degrees from the horizontal from the invert (bottom) of the pipe (or between 30 degrees and 45 degrees if the design has been certified by a suitably qualified engineer).

2) Pipe Specifications

- Table 7-6 sets out the general pipe size, material, and pressure specifications for principal and rider mains.

Table 7-6 General Pipe Specifications

	Principal Mains	**Rider Mains**
Pipe Size	Generally not less than 150mm ID Standard pipe sizes (see Section 7.3.1): DN 100 (with specific approval), DN 150, 200, 250, 300, 375, 450, 525 and 575mm ID.	Generally not less than DN 63 (50mm ID) With specific approval: DN 25, 32, 50 PE (20, 25, 40mm ID) provided that the minimum required supply per household can be met.
Acceptable Materials and Specification	PVC-U (Series 1 or Series 2 dimensions) PVC-M/PVC-O Series 1 or Series 2 (with specific approval) PE 80 Type B (MDPE) PE100 (HDPE) Concrete lined steel (arc butt welded) Concrete Lined Ductile iron Hobas GR (with specific approval)	PE 80 Type B (MDPE) PVC-U (DN 50mm internal diameter only Series 1 dimensions, not less than PN15) Copper (must be used for valve upstands, see SD 707)
Pressure class	No less than PN12 A higher class will be required in higher pressure zones	

7.3 PIPE SPECIFICATIONS

7.3.1 Pipe Size

a) PVC and PE pressure pipes in New Zealand and Australia are usually referred to by their nominal diameter or “DN”.

By Convention, PVC pipes are referred to by their nominal INTERNAL diameter (i.e. DN50, 100, 150 etc) and either Series 1 (metric sizes) or Series 2 (Imperial or CIOD sizes).

PE pipes are usually referred to and specified by their nominal OUTSIDE diameter (i.e. DN 63, 125, 180mm OD etc).

b) These standards generally refer to pipe dimensions by internal diameter (ID).

c) In any instance where an external diameter is shown on a drawing or specified it shall be annotated "OD". Dimensions in absence of either "ID" or "OD" shall be assumed by Council to refer to an internal diameter.

d) Minimum and standard pipe sizes for principal and rider mains are shown in Table 7-6. PVC pipes should generally be specified in metric (Series 1) sizes, but imperial (series 2) sizes may be required in some instances for specific pipelines to achieve compatibility with Council's existing pipe system. Series 1 (metric) sizes or Series 2 (CIOD) sizes are listed in the relevant PVC pipe manufacturing standards.

e) Principal mains shall be generally no less than 150mm ID. Table 7-7 sets out instances where smaller principal mains may be permitted, but subject to the levels of service specified in Table 7-2.

Table 7-7 Reduced Dimension Principal Mains

Size of Principal Main (generally uPVC Class D)	**Maximum Length**	
	Connected to larger main at one end	Connected to larger main at both ends
100mm ID	135m	400m

Rider mains shall be generally no less than 50mm ID.Table 7-8 sets out instances where smaller rider mains may be permitted, but subject to the levels of service specified in Table 7-2.

Table 7-8 Reduced Dimension Rider Mains

Size of Rider Main (minimum PE80 MDPE Class D)	**Maximum Number of Domestic Service Connections (Home Units not Lots)**	
	Connected to larger main at one end	Connected to larger main at both ends
20mm ID (25mm OD)	1	N/A
25mm ID (32mm OD)	5	10
40mm ID (50mm OD)	10	20
50mm ID (63mm OD)	15	32

7.3.2 Pipe Materials

a) PVC-U pipes are acceptable in all normal circumstances for principal mains.

b) PVC-M and PVC-O pipes may be approved on application. The installation shall be to AS/NZS2032 and AS/NZS2566 Part 2, with particular attention to the anchoring of valves and hydrants against displacement in operation. Refer SD 704 and 706.

c) PE pipes shall be normally used in all rider mains.

d) PE pipes may be appropriate for principal mains in special cases and shall require specific approval by the Engineering Manager. For PE pipes generally PE80B material is the standard used; however PE100 may be used where higher pipe strength is required or increased capacity is an important criterion. Pipes of differing compositions shall not be mixed within a common pipe length, (i.e. valve-to-valve). Installation of PE pipes shall be to AS/NZS2033 and AS/NZS2566 Part 2.

e) Concrete lined steel pipes may be required in potentially unstable ground, for lengths of exposed pipe, or in other special cases, and shall be the subject of specific design. Suitable corrosion protection shall be provided. Steel pipes laid underground shall have an extruded blue or black HDPE external coating. Pipe laid above ground shall have a black HDPE coating or shall have an approved epoxy coating applied by a specialist applicator.

f) Ductile iron pipes may be appropriate in special cases and shall require specific approval of Council. Ductile iron pipes shall be sleeved with a polyethylene sleeve, conforming to AS 3681.

7.4 PIPE JOINTS

7.4.1 Connection of Rider Mains to Principal Main

a) Where a rider main is to be extended at right angles to a principal main, it shall normally be connected with a tapping band without ferrule (SD 707), where the size of the principal main and rider main allow this, otherwise a cast or ductile iron tee with a tapped blank plate shall be used (see SD 708).

b) Where a rider main is to be extended along the same alignment beyond the end of the principal main, it shall normally be connected in a similar manner with an anchored blank end plate, and with a vertical socket and right angle (De-zincification resistant) bronze bend.

7.4.2 Unrestrained Mechanical Couplings

a) Old style ‘Gibault’ joints have been superseded by new “universal” design bolted unrestrained mechanical couplings, conforming to AS/NZS 4998, for all pipes except PE where only end load restraint compression fittings, or heat fusion fittings, conforming to AS/NZS 4129, shall be used. Unrestrained mechanical couplings shall only be used with specific approval. This will generally be for connection to existing principal mains where no feasible alternative is available or repair to principal mains.

b) Unrestrained Mechanical Couplings shall be category 2 (50 year life) to AS/NZS 4998:2009.

7.4.3 PVC Pipe Joints

a) Joints for PVC pipes shall normally be integral thermoformed socket/spigot rubber ring type (Z joints or locked-in-place Bleuseal/Forsheda/Reiber style), with a biocidal lubricant. Elastomeric seal rings shall conform to NZS/BS2494 or AS1646. Solvent cement joints may be permitted where the necessary Z ring fitting is not manufactured. Unrestrained Mechanical Couplings (repair couplings) shall only be used to close a section of pipe where no other fittings are possible, or to adapt PVC pipe to existing *insitu* pipes, such as cast iron, asbestos cement, steel or ductile iron, or to connect PVC pipe to a purpose made ductile iron spigoted fitting.

7.4.4 PE Pipe Joints

a) All PE pipe less than or equal to 100mm ID (125mm OD) shall be jointed by end load restraint mechanical seal ring compression joints to AS/NZS4129, appropriate for the type of pipe (e.g. “Plasson, “Philmac”) and rated to PN16 maximum working pressure.

b) Pipes greater than 100mm ID (125mm OD) may be jointed by the use of a butt welding or electrofusion technique. Electrofusion fittings shall conform to AS/NZS4129.

c) The pipes shall be installed in accordance with AS2033 and AS/NZS2566.

d) Certified tradespersons approved by Council, shall be employed with equipment specifically designed for the task. The contractor shall provide their own power source and earth leakage protection for the safety of their personnel.

e) For electrofusion jointing only personnel trained and holding a current certificate of competency in the system to be used, will be permitted by Council to carry out the work.

7.4.5 Welded Steel Pipe Joints

a) Welded joints in steel pipes shall be either butt joints, with an external welding band, spigot and socket joints, or as otherwise approved by Council. All welds shall be fillet welds of 7mm or larger, applied in the field.

b) Flange joints shall be to AS/NZS40

c) Where butt jointed pipes are used the ends shall be neatly butted where possible with a seal weld applied from the outside before the welding band is affixed. Steel pipes shall be cut to a neat and true line with an abrasive saw.

d) After welding and testing (if required) all unprotected metal inside and outside shall be thoroughly cleaned by appropriate methods. The exposed steel shall be protected promptly and damaged protective coating repaired in an approved manner by the application of one of the treatments listed below:

1) Emer-tan rust converter; Emer-guard primer; Emer-clad membrane, or

2) Polyken Synergy™ which includes an appropriate primer coat, or

3) Carbomastic 15 primer; Servi-Wrap R15A membrane; Servi-Wrap Outerwrap.

e) Joints shall be internally protected with a mortar lining to give a smooth internal bore. Materials for the mortar shall comply with the requirements of NZS3121. It is important to get a satisfactory mortar consistency to prevent the mortar from sagging or dropping out.

f) The pipe joint shall be plugged with a suitable plunger prior to applying the mortar and then withdrawn evenly to smooth out the mortar joint.

g) Epoxy mortar (suitable with potable water) shall be used for making good the mortar lining where pipes have been cut for mitred joints, or the fitting of flanges etc.

7.5 FITTINGS

7.5.1 Pipe Fittings

a) The following standards apply to pipe fittings:

1) Ductile iron fittings such as tees, hydrant tees, crosses, tapers, hydrant risers, blank caps, plugs and bends shall conform to AS/NZS 2280, with thermo-bonded polymeric coating conforming to AS/NZS 4145. Ductile iron sockets for Elastomeric seal joints, used with PVC pipes shall be "deep socket" type.

2) Tapping bands used on PVC pipes shall be "full encirclement style" conforming to AS/NZS 4793.

3) Thermoformed PVC, elastomeric socket, long radius bends may be used with PVC pipes. Solvent cement bends and short radius (elbow) bends shall not be used.

4) On PE pipes DN 125 and larger, fittings shall be end load resistant electrofusion or butt fusion style, to AS/NZS 4129.

5) Flanges shall be to Table 9 of AS/NZS4331.2 and BS10. Fittings laid adjacent to other fittings shall have flanges.

b) All bolts, nuts and washers shall be 316 stainless steel with molybond anti galling coating.

c) Graphite greases, packing and compounds shall not be used in contact with stainless steel.

d) Where dissimilar metals are used, purpose-made delrin thermoplastic inserts shall be installed in the flanges to prevent electrolytic action.

e) Fittings which do not have bolts, nuts and washers which are 316 stainless steel and/or fittings which are not thermo bonded polymeric coated in accordance with AS/NZS 4158, shall only be used at the Engineering Manager's discretion where no alternative product is available. In this case these fittings shall be wrapped as detailed in SD 710 and 711.

7.5.2 Corrosion Protection

a) These standards apply to the protection of flange and unrestrained mechanical couplings:

1) Protection shall normally be provided by the use of 316 stainless steel bolts, nuts and washers and fittings coated to AS/NZS 4158: 1996. Fittings which do not have bolts, nuts, and washers that are 316 stainless steel and/or fittings which are not thermobonded polymeric shall only be used with approval of the Engineering Manager.

2) Where metallic pipes and fittings are not coated delrin thermoplastic inserts shall be installed in the flange to prevent electrolytic action. Steel, grey cast iron and ductile iron flanges shall be further protected by a wrapping system.

3) Corrosion protection will be required (as follows) for all new flange and unrestrained mechanical couplings, where materials other than 316 stainless steel and coatings to AS/NZS 4158: 1996 are used.

4) For flanges see SD 710. For Unrestrained Mechanical Couplings see SD 711.

7.5.3 Hydrants

a) The following standards must be met in respect of supply hydrants:

1) Fire hydrants shall be installed on all principal mains in accordance with the requirements of the New Zealand Fire Service Code of Practice.

2) Hydrants must be readily accessible for fire appliances and should generally be positioned near road/street intersections in conjunction with valves.

3) A fire hydrant shall be located at each road/street intersection and not be positioned closer than 6.0m from any dwelling.

4) In a cul-de-sac or other terminal streets, the last hydrant shall be at the head of the cul-de-sac.

5) The distance between the hydrants and from the hydrants to the furthest building platform shall not exceed 135.0m.

6) A principal main shall be constructed and hydrant(s) placed within the private access way in order to ensure each building is within a distance of a fire hydrant as specified above. The width of the private access way shall be no less than 3.0m and sufficient to enable a fire appliance access to the hydrant. The main will be private from the road boundary to, and including, the fire hydrant

7) Should a fire hydrant be approved by Council within a private way, then Council will require an Easement In Gross in favour of Council over that line from the principal main to the hydrant.

8) Hydrants shall be screw-down type to NZS/BS750. Normally the short pattern shall be used, except where Council may approve or require the medium or tall pattern for extra flow capacity. Hydrants shall not be self-draining. Hydrants shall be blue nylon coated inside and out (location dependent) and be clockwise closing.

9) In some high risk areas hydrants shall be installed in pairs to provide better water flows.

10) Hydrant tees shall be flanged if laid next to other fittings. Otherwise flexible Z ring joints are permitted. Refer SD 706.

11) Hydrant risers shall be used or the water main laid deeper where necessary, in order to ensure that the top of the spindle is between 100mm and 200mm below finished surface level.

12) Hydrants shall be installed so the spindle cap and riser connection are in line with the water main below.

13) The manufacture and installation of hydrant boxes shall be to BS 750. Hydrant boxes shall be aligned in the direction of the water main. Heavy pattern hydrant boxes shall be used. All hydrant boxes (cover and frame) shall meet Class D strength to AS 3996. Covers must be 'anti-rocking'.

14) Hydrants shall be marked in accordance with SNZ PAS 4509 Appendix G. Hydrants shall be marked in accordance with NZS4501 with raised blue reflectorised markers together with painted triangle and painted fire hydrant box and circle as shown on SD 712 and 713.

15) Hydrant boxes shall be set on approved pre-cast concrete sections.

16) The top of the surface box shall be 5mm above the finished surface level in sealed carriageway and grassed surfaces. For areas to be planted, the top of the surface box shall be between 40mm and 60mm above the finished surface level and no closer than 1.5m to trees or shrubs.

7.5.4 Positioning of Valves

a) Valves shall generally be placed on all the three legs of a tee intersection to optimise control of the water supply system and minimise the number of customers without water in case of a shut-down. Where practical, valves shall be located in berms.

b) Sluice valves shall be flanged and bolted to each leg of the "tee" to form a single assembly. A hydrant will be included between the valves.

c) Line valves shall be installed where the distance between other control valves exceeds 250m. For water mains over 200mm diameter, line valves shall be required every 450m and shall be positioned as agreed by Council. Rider mains shall have valves at both ends, located as close to the principal main as practical, but within the berm or footpath.

7.5.5 Depth of Valves

a) The top of sluice valve spindles shall be 200-300mm below ground level, refer SD 704 and 705.

b) The top of the hand wheel on a "Saunders" valve shall be 150 to 225mm below ground level.

7.5.6 Sluice Valves

a) The valves on all principal water mains shall comply with NZS/AS 2638.2, Class PN16 (a class higher than 16 may be required in certain circumstances). Valves shall be resilient seated and anti clockwise closing with a stem sealed by "o" rings capable of being replaced under pressure. They shall have external and internal polymeric coating to AS/NZS4158.

b) Specific design, subject to the approval of Council, shall be required for valves over 250mm NB.

c) The valve shall be capable of bi-directional flow of water. Valves shall be set so that the spindle is truly vertical. Bolted joints shall be wrapped with a wrapping system, see SD 710 and 711.

d) Sluice valves shall be installed in accordance with SD 704 and shall be marked as per SD 712 and 713.

e) Approval of any particular sluice or gate valve shall be entirely at the discretion of the Engineering Manager.

7.5.7 Rider Main Valves

a) Valves on rider mains shall be genuine "Saunders" A-type and "Valam" weir-type diaphragm valves with cast iron body, rubber diaphragm, and 316 stainless steel bolts.

7.5.8 Air Release Valves

a) Water mains shall be laid to grade such that, for the purpose of the release of the air, a fire hydrant, an automatic air valve or a 20mm diameter ferrule and gate valve in a permanent surface box shall be installed at high points or in locations required by Council. They shall be installed so that ground water cannot enter the main at negative main pressure.

b) Automatic air valves shall be testable 'Gillies' manufacture, single or double, large or small orifice, and of appropriate nominal bore. Automatic air valves shall be flanged and be mounted on flanged risers with an integral isolating valve accessible from ground level. Automatic air valves shall be installed within a standard manhole (marked 'AV) with positive drainage to an outlet such that ground water cannot enter the main at negative mains pressure.

7.5.9 Scour Valves

a) Scour valves shall be either a fire hydrant or Saunders valve as for air release above and shall be installed at low points or to facilitate draining of a water main where required by Council.

b) All dead end mains or rider mains shall be fitted with permanent scour valves complete with valve box.

c) In areas where the scouring of mains is needed as a frequent operation, a connection to the stormwater kerb outlets, open channels or sumps shall be provided. The connection of a scour valve to stormwater pipes or manholes is not permitted.

d) Where Saunders valves are used for a bleed or scour valve, a copper pipe ('Hockey Stick' shaped) fitted with a crox nipple shall be provided in each box.

e) The box shall be similar to a fire hydrant box but shall be marked "AV" rather than "FH".

7.5.10 Butterfly Valves

a) Butterfly valves shall only be used with the specific approval of the Engineering Manager. Butterfly valves shall be located in concrete valve chambers.

7.5.11 Non-Return Valves

a) Non-return valves shall be installed at reservoir and tank outlets and at reservoir inlets and at the lower extremity of the tank reticulation zone.

b) 50mm diameter swing check valves shall be 'Cambrian' bronze valve. Valves larger than 50mm diameter shall be 'Gillies' swing check valves, with external arm. Non-return valves shall be capable of being serviced without removal from the main. Cast iron swing check valves shall be fusion bonded thermoplastic coated or epoxy coated. All coatings shall be compatible with potable water and shall be coloured blue.

c) Below ground swing check valves shall be within a standard manhole.

d) "Wafer" check valves may be approved for specific applications.

7.5.12 Valve Boxes

a) All valves shall be fitted with an approved square pattern cast iron surface box with the lid marked "SV" or "V" and a 150mm lid on a PVC riser pipe. Heavy duty lids shall be used.

b) The riser pipe shall extend from the valve bonnet to 80mm below the finished surface and be placed vertically over the valve. The valve box shall be supported on a firm foundation so that no direct loading is transmitted from the box to the main or riser. See SD 704.

c) The top of the surface box shall be 5mm above the finished surface level in sealed carriageway and grassed surfaces. For areas to be planted, the top of the surface box shall be between 40mm and 60mm above the finished surface level and no closer than 1.5m to trees or shrubs.

d) If the distance between the finished surface level and the top of the valve is greater than 900mm, a valve key extension shall be fitted.

e) Valve boxes shall be painted white with a 300mm wide kerb flash adjacent to the valve. See SD 712 and 713.

7.6 ANCHORAGE AND THRUST BLOCKS

a) Cast in-situ concrete anchor blocks shall be provided on mains 50mm ID or greater, at all points where an unbalanced thrust occurs. This shall include all bends, tapers, valves, pressure reducing valves, tees and blank ends.

b) For butt welded and electrofused PE pipework up to 150mm ID, anchor blocks are not required. Where PE pipes connect to other pipework or fittings with flexible joints, anchor blocks are required.

c) The design of anchor blocks shall be based on "good ground" soil bearing capacity (as defined in NZS3604) or the ultimate bearing capacity of the site soils, whichever is lesser. A safety factor of between 1.5 and 2 shall be used in the design. Anchor block bearing area calculations shall be submitted with the engineering plans for checking and approval.

d) The inner face of the block shall not be of a lesser thickness than the diameter of the fittings, and shall be so constructed as not to impair access to the bolts on the fittings. Concrete shall have a minimum compressive strength of 17.5mPa at 28 days.

e) All concrete blocks shall be cast in-situ. Pre-cast concrete blocks are not permitted.

f) A protective membrane of not less than three layers of 250 micron polythene sheet or similar shall be provided between the pipe (irrespective of the pipe material) and the concrete anchor and thrust blocks to prevent abrasive damage to the water main.

g) Valves and hydrants on uPVC pipe lines require anchorage to resist torque when the valve is operated.

h) Valves shall be anchored as shown on SD 704. A fish-tailed galvanised flat steel bar shall be attached to the bottom bolt on each flange of the valve and incorporated into a cast in-situ concrete pad 200mm deep, of the same width as the trench and extending 150mm beyond each anchor bar. Care shall be taken to ensure that all bolts can be removed for future maintenance and are not obstructed by concrete.

i) Hydrant tees, when flanged, shall be anchored as valves. Refer SD 704. Hydrant tees with rubber ring joints shall be anchored by bedding the tee in a concrete pad 200mm deep, of the same width as the trench and not extending beyond the length of the tee. Care shall be taken to ensure that the flexible joints are not encased. Refer SD 706.

7.6.1 Thrust Block Design

a) In designing water main thrust blocks, the following formula shall be used:

Thrust Force	R = 15.7 Hd^2 sin (θ/2) R = thrust in kN
Where	H = head of water in metres, i.e. 180m max d = diameter of pipe in metres θ = angle of deflection

Pipe dia - d	θ -11.25º bend	θ -22.5º bend	θ -45º bend	θ -90º bend
100	2.77	5.51	10.81	19.98
150	6.23	12.40	24.33	44.96
200	11.08	22.05	43.26	79.93

R – thrust in kN for each diameter and bend

b) When the thrust force is known as above, the following formula can be used to ascertain the face dimensions – m^2 or weight of concrete – m^3 to be used for the thrust block in the following table:

Case 1: Vertical Downward Thrust

A (m^2) = FOS x R (kN) / q_u (kPa) (but not less than 0.09m)

q_u = Ultimate bearing capacity
R = Thrust force
FOS = Factor of safety = 2

Case 2: Vertical Upward Thrust

V (m^3) = FOS x R (kN) / γc (kN/m^3)

y_c = Unit weight of concrete (24 kN/m^3)
FOS = 1.5

Case 3: Horizontal Thrust

A (m^2) = FOS x R (kN) / [K_p x y(kN/m^3) x (h(mm) - 100)/1000]

K_p = Coefficient of passive pressure (=(1+sinΦ)/(1-sinΦ) = (1+sin35)/(1-sin35) = 3.6)
y = Unit weight of soil (19 kN/m^3)
h = depth of cover, 100mm subtracted for extra FOS
FOS = 2.0

Table 7-9 is a guide only for design.

Table 7-9 Pipe Thrust Design

	Pipe diameter	Face area m^2 or m^3	11.25º Angle of deflection	22.5º Angle of deflection	45º Angle of deflection	90º Angle of deflection
Vertical downward thrust	100 150 200	m2 m2 m2	0.09* 0.09* 0.09*	0.09* 0.09* 0.15	0.09* 0.16 0.29	0.13 0.30 0.53
Vertical upward thrust	100 150 200	m3 m3 m3	0.17 0.39 0.69	0.34 0.74 1.34	0.68 1.52 2.70	1.25 2.81 5.00
Horizontal sideways thrust	100 150 200	m2 m2 m2	0.12 0.26 0.46	0.23 0.52 0.92	0.45 1.02 1.81	0.83 1.88 3.34

Notes:

1. * Minimum thrust block size 300 x 300 x 300.
2. Table is a guide only.
3. Soil parameters are classed as "good ground" in accordance with NZS3604.
4. Test head 150m and factor of safety of 2 for all applications.

7.7 WATER SUPPLY CONNECTIONS

7.7.1 Point of Supply to Consumer

a) The point of supply to each customer shall be determined in accordance with the NCC Water Supply Bylaw. Each individual dwelling or unit shall have a single point of water supply and a meter. Premises of multiple ownership including body corporate, strata title and leasehold/tenancy in common scheme shall be supplied and metered in accordance with the NCC Water Supply Bylaw.

7.7.2 Point of Metering

a) The point of metering will generally be at the point of supply, other than for rear lots where the point of metering may be on private property in accordance with the NCC Water Supply Bylaw. Also see SD 701.

7.7.3 Diameter of Service Connections

a) The standard connection sizes are 20mm NB, 25mm NB, 40mm NB, 50mm NB, 100mm NB and 150mm NB.

b) The minimum size shall be 20mm internal diameter.

7.7.4 Service Connection Materials

a) ISO dimension PE80 Type B pipes to NZS4130 are normally technically adequate.

b) Council may require use of copper for specific operational reasons. Copper shall be to NZS3501. Joints shall be as for ridermains.

7.7.5 Individual Connections

a) Water supply to cross leases and subdivisions will be treated on a common basis as follows:

b) An individual connection shall be required for each dwelling via its own legal street frontage with the meter assembly located at the street boundary.

c) For back sections an acceptable alternative will be a common pipe in the Right of Way (ROW)/Common Access serving only those dwellings with legal access onto the ROW/Common Access. Each dwelling shall have an individual connection from the common pipe with a meter assembly located at the edge of the ROW/Common Access. A meter assembly shall be located on the common pipe at the street boundary, where the pipe is 20mm or 25mm internal diameter. A genuine Saunders valve with stainless steel bolts shall be used where the pipe is 40mm to 50mm internal diameter.

d) The supply pipe for one lot shall not pass through another lot unless there is physically no alternative (e.g. no water main in the street, insufficient water pressure in the main at the street boundary). In such a case an easement shall be required to protect the line of the supply pipe. Refer SD 701.

e) In commercial and industrial subdivisions tapping bands and service connections may be omitted until the specific requirements of the consumer are known. In this case a condition will be placed on the lot outlining that the lot owner is responsible for the cost of installing the service connection at the time of Building Consent (or earlier if required by the lot owner).

f) Where the Council requires the subdividing owner to lay the service connections, this shall be as far as and including the manifold and the meter box.

g) These connections shall be temporarily supported on waratah or similar standards until after the electric power or any other reticulation between the water main and the boundary has been laid.

h) Service connections shall be laid at right angles to the frontage. The service line between the ferrule and the meter box is to be laid as a single length of pipe with no joins or fittings or tight bends along its length. However, where the horizontal distance between the ferrule and the meter manifold is less than 1.0m, the ferrule shall be offset from the water meter by 0.5m and 2 x 90 degree fittings shall be used in the service connection to avoid pipe stresses.

7.7.6 Tapping Bands and Ferrules

a) Where possible lateral connections and ferrules shall be located clear of driveway entrances.

b) Each service connection to a principal main or a rider main shall be by means of a tapping band and a "Talbot" Bronze pushfit swivel ferrule with the flow of water controlled by a screwed brass plug.

c) Tapping bands on PVC pipes shall be of an approved cast bronze complying with AS/NZS 4793, fully encircling the pipe to prevent over tightening and distortion of the pipe.

d) Refer SD 709.

e) Tappings on ISO dimension PE80 Type B pipes shall be by means of a vertical compression tee (with BSP female branch) and ferrule. Tapping saddles shall not be used on PE pipe.

f) If the required service is larger than is possible to connect with a tapping band the main connection shall be by a tee or a tapped elongated joint having a vertically connected ferrule. For connections larger than 50mm NB the connection shall be by means of a tee and sluice valve.

g) Tapping bands and ferrules on the water mains shall be fitted when the mains are first laid.

7.7.7 Meter Assembly for 20mm and 25mm ID Connection

a) The service connection shall terminate adjacent to the street boundary with a Nelson City Council approved 20mm nominal bore water meter assembly and box.

b) This shall consist of an “Acuflo” water meter manifold, isolating valve and double check valve housed in an “Everhard” or “Draper” DRA 20/1 underground meter box. Metal meter boxes are to be used for commercial and industrial accessways and in residential areas that will be traffic loaded.

c) An approved water meter shall be fitted to the manifold. The meter shall be either a Sensus 620M or Elster (Kent) V210.

d) The meter box shall be within 150mm of the street boundary on the street side of the boundary, clear of regular vehicle traffic movement.

e) Where there is a service pipe in a Right of Way serving more than one property, the meter assembly shall be located in the Right of Way clear of regular vehicle traffic movements as if it was in the street.

f) The pipework at the meter box shall have an earth cover of 260mm to 300mm depth over it. Refer SD 709.

g) The meter box shall be placed on a firm base so that it will not be depressed below the finished surface by settlement or occasional vehicular traffic.

7.7.8 Meter Assembly for 32 - 40mm ID Connection

a) For 32 – 40mm ID services a meter assembly consisting of genuine Saunders diaphragm valve with stainless steel bolts shall be used. The meter shall be either an Elster V100, Helix 4000, or Sensus 620. An approved backflow preventer shall be used with the meter, and housed in an approved meter box.

7.7.9 Meter assembly for larger than 50mm ID Connection

a) Connections 50mm ID and larger shall consist of a tee and sluice valve on the main. The sluice valve shall be bolted to the tee.

b) All service connections other than dedicated fire sprinkler or fire-fighting mains will be required to be metered.

c) The meter shall be either a Meitwin 50 – 100 compound or Meistream and shall be installed at the boundary to the manufacturer's specification, and housed along with approved isolating valve and backflow preventer in a meter box of size and construction approved by the Council. If a reduced pressure zone backflow preventer is used, this shall be mounted above ground level.

7.7.10 Water Meters

a) At the completion of works and prior to issue of the 224 certificate for developments the developer must supply a completed water meter location form (see Appendix A) to the Engineering Manager for approval. Water meters shall be fitted to all connections as follows:

Table 7-10 Approved Water Meters

Connection Size, DN (mm)	Meter Size (mm)	Meter Designation	Average Flow m^3/hr	Maximum flow m^3/hr	Meter Class	Meter Type	Meter Model
20	20	Qn 1.5	1.5	3.0	C	Manifold	Sensus 620 M or Elster (Kent) V210
25	20	Qn 1.5	1.5	3.0	C	Manifold	
25	25	Qn 3.5	3.5	7.0	C	In line	Elster V100 / Sensus 620
40/50	40	Qn 15	15/30	45/50	C	In line	Elster Helix 4000 (H4000) / Sensus MeiStream Plus
50	50	Qn 15	35	50	C	In line	Elster Helix 4000 (H4000) / Sensus MeiStream Plus

100	80 100	Qn 40 Qn 60	40 60	80 120	B/C* B/C*	Compound	Elster C 4000 / Sensus Meitwin
150	100	Qn 60	60	120	B/C*	In Line	Elster C 4000 / Sensus Meitwin
	150	Qn 150	150	300	B/C*		Elster Helix 4000 (H4000) / Sensus MeiStream Plus

*Note: For Compound meters; high flow meters Class B, low flow meters Class C.

b) Meter connections larger than 25 mm diameter shall be subject to the approval of the Council. The applicant may be required to present hydraulic calculations supporting the choice of meter size to the Council for approval.

7.7.11 Backflow Preventers

a) All new industrial and commercial properties shall have a backflow preventer installed on the owner's side at or as close as practical to the point of supply. The type and location of backflow preventers shall comply with the Building Act 1991, the Health Act 1956 as amended by the Health (Drinking Water) Amendment Act 2007, AS/NZS 2845.1 and the NCC Water Bylaw 217.

7.7.12 Reuse of Existing Service Connections

a) A proposal to reuse an existing service will only be approved if the service is of adequate size and one of the following conditions applies:

b) It can be established that the service is less than 40 years old or;

c) The service is to continue supplying the same building that it was originally intended for, and no others.

d) This policy applies only to the Council portion of the water service i.e. from the main up to and including the meter assembly.

7.7.13 Disconnections

a) Redundant services shall be disconnected from the supply line. The service fitting shall be removed or plugged to the satisfaction of the Council.

b) Meter box, manifold assembly and meter shall be removed. These remain the property of Nelson City Council and they shall be delivered to the Council representative.

7.7.14 Fire Sprinkler Supply

a) A fire sprinkler supply, if installed, shall come off the Individual water supply after the NCC water meter assembly. This may require specific design. All above ground valves shall be suitably protected from vandalism or accidental damage.

b) Fire sprinkler supply connections may require combination metering.

c) Designs for fire sprinkler and reticulation shall allow for pressure reductions due to backflow prevention devices.

d) Residential buildings that use a sprinkler system as a means of compliance with the New Zealand Fire Service Fire Fighting Water Supplies Code of Practice will require a Consent Notice to be registered on the land title setting out the requirements of the landowner for ongoing maintenance of the system and a condition entered in the NCC register accordingly.

7.8 PUMPING AND STORAGE

7.8.1 Pump Station Design

a) Pump stations shall comply with NCC requirements and these specific designs are updated on a regular basis. Design will be dependent on a number of factors and should be discussed with the Council at an early stage.

b) New pumping stations will only be accepted by Council when all other practical options have been ruled out

c) Design of the pumping station shall enable operation of the station in compliance with industry health and safety requirements having particular regard to safety from falling aspects on site and confined space entry.

d) In all pumping stations the following design specifications apply:

   1) Sufficient duty pumping capacity shall be available to handle the design peak flow within a pumping period of 12 – 15 hours.

   2) A minimum of two pumps shall be installed, with one acting as duty pump and the other on automatic standby. The duty sequence is to be alternate start on variable speed drives in accordance with Nelson City Council control system standards. The standby pump shall be equal in capacity to the duty pump.

   3) Ground floor levels shall be at least 200mm above finished ground levels in order to exclude surface water entry.

   4) All pump station site structures shall be designed for a minimum 50-year life complying with the building code.

7.8.2 Access and Services

a) Pumping stations and control buildings shall be sited on a separate lot or a utility reserve. The lot is to be vested in Council and shall have a sealed access road for maintenance vehicles. The site as a minimum should have screen planting on all common boundaries that will not exceed 2m in height on the South boundary.

b) A means of lifting pumps and other heavy equipment, or alternatively access to enable mobile plant to perform this task is to be provided on site.

c) An approved flow meter shall be installed on the outlet line from the pump station and connected to the telemetry system.

7.8.3 Electrical Equipment

a) An electrical pump control, alarm, and telemetry system is required on site. It shall be assembled and installed in accordance with Council's standard specification, as follows:

1) A stainless steel control cabinet is required to house electrical equipment. Cabinets are to be fitted with a lock keyed to Council's security system.

2) All electrical switch gear is to be located a minimum of 300mm above ground level. All electrical equipment is to be assembled and installed in accordance with these standards or the manufacturer's specifications.

3) All equipment including metering must comply with the requirements of the Network Utility operator and supplier (power).

4) Suitable alarm and system control interrogation and transmitting facilities shall be provided to enable the pumping stations to be connected to Council's telemetry system.

5) Cable ducting from the pump station to the control cabinet must be sealed to protect against corrosive gasses travelling to the electrical switchboard.

6) All electrical and pump station control gear including telemetry shall be housed within a weather proof, lockable, walk-in building to Council approval.

7) Phase failure protection relays shall be provided for all pump motors unless that protection is incorporated into the electronic control for Soft Start or Variable Speed Drive units.

8) Automatic control of the pump operation, together with a manual override facility is to be provided.

9) A standard three-phase industrial power connection shall be supplied such that a portable generator can be connected when power failure occurs.

10) Suitable lighting shall be provided for the pump station, cabinets and valve chambers with protective materials suited to the corrosive environment.

11) Details on pump/motor components and electrical control equipment shall be incorporated into an Operation and Maintenance Instruction Manual enclosed in a hard copy A4 bound folder. Four copies shall be provided.

12) The Manual shall include as-built plans of the pump station including electrical wiring and operational schematic diagrams. Four copies of the Manual shall be supplied to Council on handover of the completed pump station and associated works.

7.8.4 Private Pumping Stations

a) Individual, private pump systems are permitted provided the design and construction meets the requirements of the NZ Building Code (a Building Consent will be required) and the connection to the Council system is via a water meter and backflow protection.

7.8.5 Commissioning

a) On completion of any pump station, and prior to handover to Council, a full commissioning test shall be carried out on all components of the pump station. This commissioning shall be in the presence of a representative of Council and of Council's operations and maintenance contractor.

7.8.6 Reservoirs

7.8.6.1 General

a) The size of the reservoir shall be able to supply all newly created lots, future growth (available developable land) and fire fighting requirement. Subdividers/Developers are advised to consult the District Plan.

b) The design shall show details of wall fittings, pipe penetration details through the wall and floor and details of pipe support and restrain. It shall be the responsibility of the designer to ensure that the proposed reservoir location is capable of receiving and transmitting uninterrupted telemetry signals from the Council's telemetry network.

c) It is recommended that the design and construction plans be discussed with Council before these are formally submitted.

d) All newly created sections are to be fed from publicly owned reservoirs in dedicated water supply zones, for minimum and maximum pressures to be achieved at the point of supply. This is to ensure all sections can be serviced on a sustainable basis with at least the minimum level of pressure and flow set by Council, as well as minimising the risk of contamination of the supply by maintaining minimum pressures in the supply network.

e) Council aims to avoid small individual reservoirs, associated with new developments, in favour of larger reservoirs providing greater community benefit, especially for contingency storage.

f) Publicly owned community service reservoirs must provide water to meet daily supply demands to ensure consistency and continuity of supply to customers.

g) Publicly owned community service reservoirs must provide fire fighting storage reserves, in accordance with the requirements of the New Zealand Fire Service Fire Fighting Water Supplies Code of Practice, which requires minimum quantities of water to be held for fire fighting purposes.

h) The capacity of the reservoir is such that it should hold 24 hours storage to enable an ongoing availability of water in the event of an emergency or burst pipes required taking into consideration future growth potential.

i) The dimensions and shape of the reservoirs shall provide structural efficiencies, resist earthquake movements and economical to maintain.

7.8.6.2 Storage

a) The minimum storage required is 600 litres per head, in addition to the fire storage provision required by the Fire Code.

b) The proposed storage volume shall be approved by Council.

7.8.6.3 Technical requirements

a) The design and construction shall be to the latest codes and standards.

b) The reservoir shall be located at an appropriate height so that properties at the highest location receive a pressure of 30 metres at the point of supply measured from the bottom water level of the reservoir and properties at the lowest location receive a pressure not more than 90 metres from the top water level of the reservoir at the point of supply without the use of a PRV valve.

c) Reservoirs shall have appropriately sized valve chamber to house inlet and outlet control valves, cross connection valve between inlet and outlet, auto shut off valves, flow meters, control and monitoring equipments etc.

d) The outlet main from the reservoir shall be appropriately sized to supply the proposed zone during peak demand plus fire fighting supply without the need to supplement from another zone.

e) The reservoir shall have all weather access road and parking space for a large truck and a small vehicle.

f) Reservoir depth monitoring equipment shall be fitted.

7.8.6.4 Reservoir design

a) Precast 25m³ reservoirs may be used up to a storage volume of 150m³. For storage volume greater than this a single reservoir should be constructed.

b) Circular reservoirs are preferred although site requirements may dictate alternative shapes.

c) Generally, only concrete reservoirs will be permitted. Alternative materials will require specific approval.

d) The subdivider/developer shall carry out appropriate geotechnical investigation to design the foundation for the reservoir. A summary report of the geotechnical investigation shall be attached to the construction drawings. Where the ground condition is incongruous, foundation shall be designed to overcome the situation.

e) Reservoir walls shall be cast in-situ reinforced or pre-stressed concrete or precast concrete.

f) Where post tensioning the walls is employed, it shall be carried out by a specialist contractor. Upon tensioning the pre-stressing cable ducts shall be pressure-grout filled.

g) Construction of the reservoir floor shall be with reinforced concrete.

h) Non-shrink concrete additives may be used to control cracking and to minimise the need for construction joist.

i) Sumps shall be positioned opposite to the inlet, with the floor graded to the low point. The sumps shall connect to the scour pipes and associated valves.

j) For single reservoirs greater than $150m^3$, under floor drain system shall be placed below the reservoir floor. The trench for under reservoir drains shall be excavated to a true line and grade. The under reservoir drains are to be wrapped with durable geotextile and stone wrapped with clean durable stone. Perforated high density polyethylene pipe with 6.5mm diameter perforations, at 76mm centres shall be used for under reservoir drains. The upstream ends of all under reservoir drains are to be capped to prevent ingress foreign material. The under reservoir drain system shall discharge into a collector manhole draining to the stormwater system. The under reservoir drain system discharge points shall be clearly marked by means of permanent engraved signs to allow the source of any leakage through the floor to be identified.

k) The joints at the base of the walls must allow positive restraint. Sliding or sideways movement of the wall at its base relative to the floor is not permitted.

l) The structure shall be designed for a minimum service life of 100 years to all relevant standards and Codes.

m) Suitable concrete mix and reinforcement covers shall be employed to provide the design life.

n) The reservoir structure shall be a Category 1 structure as defined in Table 2.3.1 of NZS 4203 and designed for all Code loading requirement to withstand a water level of at least 450mm higher than the crest level, independent of surcharge due to earthquake.

o) All materials used for water-stopping/water proofing (water bars, sealants, additives etc) shall be materials that are certified to be used in contact with drinking water. The materials used shall carry certification as per AS/NS 4020. All materials used for water stopping shall be approved by the Council.

p) Pipe penetration in the floor and wall shall be waterproofed.

q) The roof shall be designed to withstand surcharge because of water level within the reservoir.

r) Reservoir roofs shall be watertight and have sufficient fall to prevent ponding of rain water by draining rain water satisfactorily over the whole roof area.

s) Precast column, beam and roof units are acceptable.

t) The roof and access hatches must be watertight and vermin/insect proof.

u) One hinged, sealed, raised airtight access hatch cover shall be provided above the roof level.

v) Hatch covers are to be fabricated in bright finished aluminium chequer plate, with grade 304 stainless steel hinges and bolts and neoprene washers as insulator in between different types of metals.

w) Bolts and nuts are to be locked with steel plates to prevent removal.

x) Hand access lock box type locks shall be provided for hatch covers.

y) The hatch shall be provided with an inclined ladder access to the interior of the reservoir.

z) The hatch shall be designed in such a way that it can be operated safely and easily by one person, allow adequate headroom while descending the ladder and permit equipment to be lowered into the reservoir for general maintenance in the future.

aa) For single reservoirs greater than $150m^3$ access ladders and safety rails shall be designed, constructed and installed in accordance with the relevant standards and codes. The internal access ladder shall be installed at a slope between 65^0 and 70^0 from the horizontal. The material to be used for internal metal work shall be corrosion free material and approved to be used in drinking water.

bb) The design is to provide extending the safety rail above the roof when the hatches are opened for safe entry into the reservoir.

cc) Fixings for safety harnesses shall be provided.

dd) Provision shall be made at the hatch covers for installation of limit switches and associated cabling to indicate when the hatches are open.

7.8.6.5 Pipework

a) The reservoir shall be constructed with inlet, outlet, scour and overflow pipework.

b) The scour pipe shall be connected to the stormwater system through a manhole. The entry of scour pipe into the manhole shall be at a higher elevation than the stormwater pipe from the manhole to prevent surcharging. It is the responsibility of the subdivider/developer to ensure the stormwater system could handle an overflow event at any time. Where this is not possible the responsibility of upgrading the stormwater system lies with the subdivider/developer.

c) Pipework within the reservoir shall be appropriately supported and restrained.

d) All metallic pipe support and restrain shall be 316 stainless steel.

e) All pipes within the valve chamber and reservoir shall be disinfected and pressure tested to withstand a water pressure of 100m at the highest point of the pipework.

7.8.6.6 Valve chamber

a) For reservoirs greater than $500m^3$ a valve chamber shall be attached to the reservoir at a suitable location to house all electrical and mechanical components required for the function of the reservoir.

b) Entry into the valve chamber may be through a side door with external steps.

c) The hatch or door shall have hand access lock box type lockable facility.

d) The inlet, outlet, overflow and scour pipes within the valve chamber are to be fitted with stainless steel flanged EPDM rubber bellows joint connections.

e) The valve chamber shall accommodate the following:

1) Isolating valves for all pipes (inlet, outlet etc)

2) Auto shutoff valve

3) Magflow meters

4) Reflux valves

5) Air valves

6) Cross connection between pumping main and outlet main with closed valve

7) Sampling point

8) Check valves

9) Pressure tapping for reservoir level monitoring

10) Electrical and controls

11) Pump control equipment where necessary

12) Continuous monitoring and telemetry

f) The subdivider/developer shall arrange power supply to the reservoir as directed by the Council.

7.8.7 Security of Water Supply Facilities

a) The following additional requirements will ensure the security of facilities:

1) Locks shall be provided on all doors, lids, chamber covers and gates that require limited access for operational or security purposes. All newly constructed facilities shall be keyed (master keyed) to Council security systems.

2) Appropriate locks shall be ordered through Council's Utilities Asset Engineer and fitted to facilities prior to application for 224 certification. The developer shall be responsible for all costs associated with the supply and fitting of locks.

3) Once Council locks are fitted to water supply facilities only Council or their maintenance and engineering consultancy staff shall have access to the equipment.

4) Council's maintenance contractor will assume responsibility for routine maintenance of the asset but any work arising from failure of equipment or materials, or faulty workmanship will be on-charged to the Developer during the prescribed maintenance or guarantee period.

7.9 RETICULATION CONSTRUCTION AND INSTALLATION

7.9.1 Excavation Works

The following standards and conditions apply to the excavation in preparation for pipework laying:

7.9.1.1 Trench width

a) The Minimum trench width shall be 200mm wider than the external diameter of the collar of the pipe being laid.

b) The trench shall be of sufficient width to permit with freedom the installation of all trench support and to allow the laying and jointing of pipes and placing of bedding and pipe surround materials.

7.9.1.2 Base of excavation

a) No construction or work upon the excavation bottom shall commence until the natural bottom of the excavation has been inspected and accepted by the DPA.

b) The foundation of the trench is to be checked for stability of the soil by the DPA. Generally a plate compactor is to be run over the trench floor to bind the surface and identify any obvious weak spots. Where the bottom of an excavation is unable to provide a firm foundation with minimum bearing capacity of 50kPa (e.g., clay soils that can easily be penetrated 40mm with a thumb or in sand or gravel that makes a footprint more than 10mm deep) at the required level without abrupt irregularities, engineering advice should be sought on how to provide a satisfactory foundation (see AS/NZS 2032:2006, clause 5.3.6). The DPA shall order the use of additional granular bedding material as specified in AS/NZS 3725:2007 for concrete pipes, or AS/NZS 2566.2:2002 for PVC and other flexible pipe systems.

7.9.1.3 Trench support

a) The Contractor shall provide trench support to comply with the requirements of the Occupational Safety and Health service of the Department or Labour. The Contractor shall ensure that the sides of the trench are sufficiently supported so that cracking of the surrounding ground does not occur.

b) Where trench support extends below the invert of the pipeline or structure special precautions may be required, including leaving part of the support in place, to ensure the foundation of the pipe or structure is not weakened.

7.9.1.4 Dewatering

a) Excavations shall be kept free of water during construction.

b) In no circumstances shall stormwater or ground water be allowed to drain into any existing wastewater drain.

c) Discharge of stormwater or groundwater to existing stormwater drains will be permitted providing adequate silt traps prevent debris and suspended matter from entering drains. Should deposits in existing stormwater drains or the pipes already laid occur as a result of the operations of the Developer or the Contractor such deposits shall be cleared forthwith at the Developer's or the Contractor's cost as the case may be.

d) Ground water lowering may be permitted except where this practice may present a risk of subsidence.

e) The Contractor or Developer shall cause as little damage or interference to property or persons as possible in disposing of water from the works, and shall be responsible for any damage or interference, which may be caused. This shall include any damage to the structure of any road.

7.9.2 Bedding of Pipes and Pipe Protection

7.9.2.1 Metal bedding

(Note: Includes bedding, haunch support and side support material as defined by NZS 2566.2:2002 and AS/NZS 3725: 2007.)

a) Metal Bedding shall be in accordance with SD 617.

b) The bedding material shall be:

1) In a sand environment - Sand

2) For PVC and flexible pipes - AP20 as per SD 401, or as per AS/NZS 2566.2:2002, Appendix G

c) Bedding shall be placed and raked-in so as to provide support for the pipe uniformly along the whole length of the barrel with chases provided for sockets, couplings and other appurtenances. For PVC and flexible pipes the bedding shall not be compacted and the centre of the bedding shall not be walked on either during or after placement.

d) The pipes shall be laid and brought to true alignment and level before installing the metal haunching, side support and covering the pipes.

7.9.2.2 Pipe embedment

a) The metal haunching and side support shall be placed uniformly along and around the whole length of the pipe barrel, couplings and other appurtenances in a manner to ensure uniform density of side support (including haunch support) and overlay with no distortion, dislodgement or damage to the pipeline.

b) Following placement, the embedment material shall be compacted in layers to uniformly support the pipe. When choosing compaction equipment, the number of passes and the thickness of layer to be compacted, account shall be taken of the material to be compacted and the pipe to be installed.

c) Compaction equipment or methods that produce horizontal or vertical earth pressures that may cause damage to, or excessive distortion of, the pipe shall not be employed.

d) Metal haunching and side support shall be compacted to the manufacturer's requirements and as a guide, a minimum Clegg Impact Value of 35 under vehicle loaded areas or 25 under non traffic loaded areas shall be achieved at any point on any haunching constructed of AP20.

7.9.2.3 Installation of geotextiles

a) Where there is a possibility of migration of fines between the native soil and the pipe surround soil, the DPA shall require the metals to be protected by an approved geotextile filter fabric that overlaps by at least 300mm.

7.9.2.4 Concrete protection slab for PVC pipes

a) Where cover over PVC pipes is less than the minimum stated in section 7.2.9, including temporarily under construction traffic, a concrete protection slab shall be constructed in accordance with SD 618.

7.9.2.5 Water-stops and trench groundwater

a) Where permeable bedding such as 'bedding chip' 'drainage metal' or 'sand' is used, water-stops and trench drainage shall be constructed to prevent unwanted movement of groundwater along the trench and pipe bedding. Also see section 7.9.2.3.

b) Water-stops shall be constructed to the requirements of SD 615. Trench Drainage shall be constructed to the requirements of SD 614.

c) Where water stops are required, they should be provided at the following intervals:

Grade	Spacing
1 in 15 or steeper	12m
1 in 15	15m
1 in 25	30m
1 in 100	60m

Note: Intermediate grades (and spacing) are determined by interpolation

7.9.3 Pipe Installation

a) Pipes shall not be laid on bricks, blocks and wedges or other temporary or permanent supports.

b) Pipes shall be kept clear of dirt or debris, and any pipes that contain such matter shall be required to be cleaned out. Internal pipe walls shall be kept clean and free of all dirt, rubbish and water. Spigots, sockets, rubber rings, fittings etc, shall be thoroughly cleaned before jointing.

7.9.4 Installation by Trenchless Technology

7.9.4.1 General

a) Directional Drilling shall only be used in specific circumstances where approved by the Engineering Manager, but shall be limited to the crossing of busy roads (where disruption to traffic is an issue) and / or where it is essential that existing driveways / entrances remain open or undisturbed and in the vicinity of tree roots.

b) Trenchless technology, including directional drilling for the installation of new water reticulation shall be limited to watermains with a diameter equal to or less than OD 63mm (ID 51mm). In specific circumstances it may also be used to install larger diameter watermains for example (but shall not be limited to) the crossing of busy roads (where disruption to traffic is an issue) and / or where it is essential that existing driveways / entrances remain open or undisturbed. These instances will be identified on the tender drawings.

c) Pipe material used for trenchless applications shall be limited to PE to NZS 4130 and have a pressure rating of PN15 or greater.

d) Depth of thrusts or drilling shall be the same as for general pipe-laying. The pipes shall be installed in a straight line or in a smooth curve. The alignment deviation – both vertical and horizontal – shall not exceed 150mm. Minimum NCC standard cover depths shall be achieved at all times.

e) Where the new pipe crosses other services, a clearance of 200mm to those services shall be maintained.

f) All precautions shall be taken to ensure that the end of the pipe to be passed through the bore is sealed to prevent the ingress of earth or other foreign matter into the pipe.

g) The Contractor shall be liable for damages to any underground services.

7.9.4.2 Pipe Line Tracer Tape

a) For water work a tracer tape system must be incorporated into the trenchless work. The tracer tape must comply with section 7.9.5.3.

7.9.5 Pumping/Pressure Main Tracer Tape or Wire

a) The location of all pumping mains and gravity pressure mains shall be marked with a foil tape buried in the trench.

7.9.5.1 Tape

a) The tape shall be blue, 50mm wide, and printed with "CAUTION WATER MAIN BURIED BELOW" or similar message. All printing shall be encased to avoid in rub-off.

b) The tape shall be either a woven reinforced acid and alkali resistant polythene plastic with a solid aluminium foil core which shall be visible from both sides. "Thor TecTM" tape is an accepted product. Alternatively the tape shall be a sinusoidal stainless steel wire encased in a polythene strip. "Waterwave" and "Wavelay" are acceptable products.

7.9.5.2 Installation

a) The tape shall be buried above the centre line of the pipe within 300mm to 400mm from the finished surface. Refer SD 702.

b) All joints in the tape (e.g. roll ends, accidental breaks and at tees) shall be made electrically conductive with purpose made splice clips installed to the specific manufacturer's instructions. Tying together of the tape ends is not acceptable as the polythene coating will prevent electrical conductivity.

c) The tape shall be brought up inside the surface box risers at all valves and hydrants with a 300mm long tail so that pipe location equipment can be readily connected.

7.9.5.3 Tracer wire

a) When a pipe is installed by a directional drilling technique or bored through the ground for a distance exceeding 20 metres, the pipe shall have a 'Tracer Wire' attached. This wire shall take the form of a continuous 2.5mm 2 multi strand (polythene sleeved) cable, strapped to the pipe wall by means of a minimum of two complete wraps of heavy duty adhesive tape, at a maximum of 3.0m intervals.

7.9.5.4 Tape or wire testing

a) The tracer tape may be tested and checked at Practical Completion by NCC for continuity using an electric pulse induction system. The new watermain/ridermain will be tested between any new valves, hydrants etc where the tape is brought up inside the surface box risers. Nelson City Council will carry out this test only when all work associated with laying the watermain/ ridermain is complete.

7.9.6 Connection to Council Network

a) Connection to existing water main shall not be made until all new work (excluding the connection) has been completed and inspected and approved by Council. Specifically, this shall include testing, chlorinating and flushing of all new pipework, and fittings by the contractor.

Appendix A Water Meter Location Form

NELSON CITY COUNCIL

Nelson City Council
P O Box 645
Nelson 7040

To: Water Meter Officer
Subdivision/Meter Location

Resource Consent No. _________________ (If applicable)

The following table defines information required by the Nelson City Council for all new water meters.

In the Meter Type Column please indicate whether the meter is a Sensus 620M or Elster (Kent) V120 water meter. Indicate either S or E.

In the Meter Reading Column show the reading to the nearest whole cubic meter only (BLACK NUMBERS on the meter).

In the Location Column, indicate whether the measurement is from the right or left boundary when facing the lot from the road (R or L) Show one measurement to the meter from either the right or left boundary (measured along the front boundary) and one measurement to the meter from the front boundary (measured perpendicular to the front boundary).

Lot No	D.P No.	Street No.	Street Name	Meter Type S or E	Meter No.	Meter Reading (m3)	Reading Date	Location (Distance from)		
								R/L	Side Bdy (m)	Front Bdy (m)

(Use additional page if required)

Name: ______________________________

Signature: ______________________________ Date: _______________

Address: ______________________________

Appendix B Field Acceptance Pressure Testing for Water Supply Pipelines

FIELD ACCEPTANCE PRESSURE TESTING FOR

WATER SUPPLY PIPELINES

1.0 Introduction and General Comments

The acceptance pressure test requirements used for water supply pipelines have generally been too insensitive to date. It is believed that many pipelines have been allowed to pass with unacceptable leaks, generally through ineffective testing procedures and/or low acceptance requirements. The procedures detailed in this document represent the latest acceptance requirements and procedures from Australia and Europe.

Section 3 gives general pressure test requirements for all pressure testing and Sections 4, 5 and 6 give material-specific test methods in detail. Section 7.0 has a pressure test record and Section 8.0 has some general comments on the measurement of make-up water volume and pressure measuring equipment.

2.0 Terminology and Definitions

CLS: Concrete lined steel pipes, generally welded spiral wound steel with a cement mortar lining in accordance with NZS 4441.

Design Pressure (DP): The pressure that the designer expects to act on the pipeline in service. In a gravity supply system, this is usually the elevation difference between the reservoir top water level and the lowest elevation of the pipeline in metres head.

DI: Ductile iron pipes - generally socket jointed with Tyton elastomeric seal rings.

DN: Nominal pipe bore diameter in millimetres. For PE pipes, this relates to the pipes outside diameter.

GRP: Glass reinforced plastics pipes, e.g. Hobas. This type of pipe is generally only used for major transfer or transmission mains since pipe diameters of less than DN 300 mm are rare.

Maximum Design Pressure (MDP): The DP plus a pressure surge allowance (preferably calculated), or a fixed allowance of 200-500 kPa or such other allowance as the pipeline designer may decide is appropriate.

Operating Pressure: The internal pressure which occurs at a particular time and at a particular point in the water reticulation system. For a gravity system, the operating pressure will depend on the water level of the reservoir, the ground level at the point on the pipeline under consideration, and the head loss due to demand in the system.

PE: Polyethylene pipes, generally PE 80B or PE 100 for water supply networks. PE 80C is not recommend for long term water reticulation networks.

Nominal Pressure Rating (PN): The pressure marked on the pipe or component and the maximum pressure that it can operate at throughout its design life.

System Test Pressure (STP): The hydrostatic pressure to be applied to a newly laid pipeline (measured at the lowest point) to ensure its integrity and water tightness.

3.0 Acceptance Pressure Tests for all Pipeline Materials

3.1 General

Every pressure pipeline is required to pass a water pressure test to verify the integrity of the pipes, joints, fittings and other components such as thrust blocks.

For drinking-water pipelines, the test medium shall be potable water that may contain sufficient additional disinfectant to minimise the risk of the commissioned pipeline containing potentially harmful organisms. For safety reasons, compressed air shall not be used for pressure testing

3.2 Health and Safety Issues

Appropriate safety equipment shall be available on site prior to commencement of any pressure testing operations. Only suitably qualified personnel shall carry out and oversee the testing and shall have appropriate protective clothing.

All excavations shall be adequately barricaded. Work in pipe trenches that is not related to the pressure test shall not be permitted during the pressure test.

All test equipment shall be correctly calibrated, in good working order, suitable for the test procedure and be correctly fitted to the pipeline.

The section to be tested shall be completed in accordance with the specification and the pipes and fittings etc adequately restrained. Any permanent or temporary concrete thrust blocks shall be designed for and have attained sufficient compressive strength to resist the test thrusts. No temporary thrust blocks or supports shall be removed until the pipeline is depressurised.

Where water for testing purposes is derived from a potable water supply, appropriate backflow prevention equipment shall be incorporated in the connection to the potable water supply to minimise the risk of accidental backflow and possible contamination of the potable water supply occurring.

The contractor shall have contingency plans and sufficient equipment on site to deal with any bursts or other foreseeable emergency that may arise during testing.

3.3 Personnel Qualifications

The testing of all pipelines shall only be carried out and supervised by acceptably qualified or accredited personnel.

Qualified or accredited personnel shall:

- hold appropriate qualifications issued by a registered training organisation; or

- have attended a relevant training course, and received accreditation relating to the work being undertaken, and

- show competence and knowledge of the relevant testing methods and procedures.

3.4 Filling the Pipeline

New pipelines should preferably be filled from the low end of the line. The rate of flow and time of day for filling may be controlled by the availability of water. Where the pipeline is to be charged with water from the existing reticulation network, the filling rate of flow should not cause a pressure drop that will be noticeable or cause inconvenience to consumers. Water from an alternative source shall not be used to fill pipelines for testing purposes unless the quality of the water complies in all respects with grade B (or better) for water Source and Treatment of the Public Health Grading of Drinking-Water Supplies.

It may be necessary to carry out the filling, flushing or swabbing operations at times that do not coincide with peak demands on the reticulation network. The pipeline designer should specify the filling times and rates of flow, especially where large diameter pipelines are involved.

Suitable means of introducing flushing water, including temporary facilities for launching and release of swabs (as appropriate) shall be installed as part of the testing procedure and a means provided for the safe disposal of any water that is flushed from the pipeline.

A suitable backflow preventer shall be used on any connection made to fill, flush out or to drive a swab or swabs through a new pipeline. A dual check valve (without test facilities) will be suitable provided its effectiveness is confirmed prior to use.

3.5 Pressure and Volume Measurement

The accuracy and readability of pressure monitoring and make-up volume measurement equipment used for pressure testing can have a significant bearing on the interpretation of pressure tests. This is particularly so when a pipeline contains a significant amount of air.

Appendix B gives detailed requirements for volume and pressure measurement equipment.

3.6 Test Section Length

The pipeline length tested may be either the whole or a section of the pipeline, depending on the length and diameter, the availability of water and the spacing between sectioning valves or blank ends. When installing long pipelines, it is advisable to begin testing early in the installation to confirm the adequacy of the laying procedures, and to increase the length tested progressively as experience is gained. The Contract documents may contain specific requirements that effectively control the length/s to be tested.

Note: Long sections may incorporate large numbers of mechanical joints that may need to be checked for leakage if there is a test failure. Leaks become harder and more costly to pinpoint in longer test sections.

Pipeline test sections longer than 1,000 m may need to be tested in shorter sections. If long lengths are to be tested, the use of radios or cell phones may be necessary to facilitate the testing procedure.

Pipelines should be tested in suitable lengths so that:

- The overall pressure at the lowest point of the line does not exceed the STP.
- The pressure at the highest point in the section is at least equal to the MDP.

- Sufficient suitable water is available for the test and there are appropriate plans in place for the disposal of the test water (including disinfection residual if applicable).
- Site considerations such as; mixed pipe materials, locations of blank ends to ensure safe and convenient accessibility, etc are taken into account.

3.7 Test Duration

The test duration will vary depending on the testing method used. The main test phase for any method will be at least an hour and may take more than one working day. The test duration given in the specification or in the approved methodology shall be used.

3.8 Pipe Temperature

The temperature of the pipe may need to be taken into account when testing plastics pipes. If the average temperature of the pipe wall is greater than 23°C the test pressure may have to be reduced to allow for pipe material de-rating requirements. This situation can occur where pipelines are not buried, but are exposed to the sun.

Refer also to Appendix B for additional comments on temperature effects.

3.9 Test Methodology

The Contractor shall provide a test methodology for the Engineers approval prior to commencing testing. The methodology shall include at least the following:

- names and experience/qualifications of the personnel to be used
- details of the test length (including any changes in diameter or pipe material) marked on a longitudinal profile of the pipeline
- details of temporary anchors or thrust blocks and sectioning valves
- timing of, method proposed for and rate of filling the pipeline (including details of backflow prevention equipment proposed
- details of method for removal of air from the line
- details of the pressurising pump, its capacity and the method proposed for controlling pulsation's and ensuring that the STP is not exceeded
- pressure rating of the lowest rated pipeline component
- system test pressure
- test duration
- details of the test rig (pressure gauges and/or transducer and data logger to be used)
- details of the method (and equipment) proposed for determining make-up water volume or volume discharged in confirming the remaining air for the rebound test
- method for ensuring that line valves seal satisfactorily
- acceptance criteria for the method proposed

- maximum allowable concentration of total available chlorine that can be discharged to a stormwater system or natural channel (if applicable)
- proposals for disposal of water drained on completion of the test, including the method of de-chlorination and the means of measuring the chlorine residual to ensure it does not exceed the allowable value (if applicable)
- test record sheet proposed

3.10 Acceptance Test Requirements

3.10.1 General Requirements

The length to be tested shall be as scheduled in the contract documents or as planned by the Contractor in the approved methodology. If any test proves to be unsatisfactory, detect and rectify the fault/s, and re-test. Even if testing procedures produce a satisfactory result, any visible leaks that are discovered shall be rectified and the pipeline re-tested.

Acceptance testing may be done progressively, but shall not be commenced before:

- at least 2 working days notice of the intention to start testing has been given to the Engineer
- the Contractors written testing methodology and all equipment (including backflow prevention device/s, pressure test rig, makeup volume measurement, etc) have been approved
- suitable means for filling and flushing, including temporary facilities for launching and release of swabs (as appropriate) are in place
- the Engineer has approved the source of water and the rate of flow for filling the line
- the section to be tested has been completed and backfilled (joints, fittings and connections visible) and is in conformity with the specification
- any permanent or temporary concrete thrust blocks have been poured and have attained sufficient compressive strength to resist test thrusts
- end caps (that allow for filling and bleeding of air) and any temporary anchors are in place and are adequately braced to resist test thrusts
- air valves (if applicable) are installed and their isolating valves are open
- arrangements have been made for the safe disposal of water flushed from the pipeline
- contingency plans are in place for dealing with a possible pipeline burst
- suitably qualified personnel are on site to carry out, oversee and approve the acceptance test
- appropriate and approved record sheets are available for recording all aspects of the test

3.10.2 Filling the Pipeline

Nelson City Council will make water available from its reticulation for the first filling and flushing operations at no cost to the Contractor. Water used for any subsequent fill/s and flushing will be charged at Council's current supply rate. The quantity of water to be charged shall be as measured by meter or as assessed by the Engineer if suitable metering equipment is not used.

The pipeline shall be filled at the approved rate, in accordance with the following conditions:

- fill from the low end and ensure that air valves and venting points are open and operating

- run a polyurethane foam swab along with the filling water to assist with air removal if specified or approved

- where swabbing is not carried out, flush (if possible and approved) the pipeline at a rate that will transport construction debris to scour point/s and air to vented connections and air valves

- make sure that the filling or flushing operations do not cause an unacceptable pressure drop in the reticulation

- make adequate provision for the safe disposal of any flushed water

- raise the pressure in the pipeline to the pipeline DP as specified or to 75 ± 5% of the STP if the DP is not specified

- repair any leaks or make good any defects that are revealed

- allow the pipeline to "soak" for a period of 2 to 24 hours (or more) to allow the temperature to stabilise and any time dependent movement to take place (the longer period may be necessary for saturation of cement mortar linings on pipes or fittings)

- a disinfection solution may be introduced with the fill water or final flushing water if approved by the Engineer

3.10.3 System Test Pressure (STP)

The STP shall be as set by the system designer. If the STP has not been specified, the pipeline shall be subjected to a pressure that is the lower of:

- 1.25 x PN of the lowest rated pipe or component installed in the section to be tested, or

Where surge pressures have been included:

- DP + 100kPa, or

Where surge pressures have not been included:

- DP + 500 kPa, or 1.5 x DP (whichever is the greater),

Where short lengths of pipeline are tested separately, e.g. for service pipes of DN ≤ 63 and of ≤ 100 metres the STP may be taken as the DP unless otherwise specified.

3.10.4 Pressure Monitoring Point

The pressure shall be monitored at the lowest part of the pipeline or if that is not possible, at some other convenient point and the STP adjusted to take account of the elevation difference between the pipelines lowest point and the test rig. The adjustment shall be made by subtracting 10 kPa for every metre elevation that the rig is above the lowest part of the line.

3.11 Pressurising the Pipeline

3.11.1 Test Pump Capacity

The pump capacity is an important consideration. If its capacity is too small, it may take too long to reach the test pressure, conversely, if its capacity is too great, it may not be controllable and could cause over-pressurisation.

If a motorised test pump is used, it shall be fitted with an adjustable pressure relief valve that is set to discharge the full flow of the pump at a pressure equal to the PN of the pipe. To pressurise the pipeline, the relief valve setting should be gradually adjusted to raise the pressure in a controlled manner until the STP is reached. Continual discharge from the relief valve is preferable to the possibility of overloading the pipeline. The test pump should not create excessive pulsation's that may affect the ability to achieve the STP accurately. A surge-damping device may be needed to control pressure pulsations.

3.11.2 General Comments

Pressurising the pipeline above the DP (or 75% of the STP) shall not begin until the Engineer and Designer (if appropriate) is on site to witness the test, unless the Engineer has given prior approval.

The pressure shall be raised steadily and smoothly to the STP and must not be raised to more than 1.5 x the PN of the lowest rated component in the line.

If over pressurisation is considered by the Engineer to have compromised the pipeline materials integrity, the Contractor may be liable for all costs involved in replacing and relaying the over-stressed section of pipeline. The degree and duration of the over pressurisation will have a bearing on the outcome and the Engineer may wish to consult with a recognised expert in pipeline materials before making a ruling. The Contractor shall be responsible for any costs incurred and for any delays that may be associated.

3.12 Testing Against a Closed Valve

Pressure testing against a closed valve is not acceptable. The test line shall be blanked off and suitably anchored.

3.13 Final Pressure Test

When a pipeline has been divided into two or more test sections for pressure testing and all sections have tested satisfactorily, the total pipeline shall be pressurised to the DP. After one hour at the DP, all joints on closer pipes between sections or any additional components that have been installed after the pressure test of the adjacent sections shall be inspected visually for leaks and changes of line or level. This inspection shall only be carried out in dry weather or if a suitable shelter is erected over the joints and the area dried sufficiently to show dripping or weeping.

If, for any reason, it is not possible to observe leakage at joints on closer sections, the final test shall be carried out using a full test procedure as per the appropriate test method for the pipeline material. The STP for this final test shall be selected so that:

- the pressure at the lowest part of the pipeline does not exceed 1.5 x PN of the lowest rated component in the system
- the pressure at the highest part of the line is at least equal to the MDP

The Engineer shall be advised so that the final test can be witnessed before backfilling. Any leakage or other fault shall be rectified and the test repeated until there is no fault.

3.14 Connections to Existing Pipelines

No connection to an existing pipeline shall be made until the new pipeline and any connecting pipes and fittings have been disinfected. The joints between the new pipeline and existing pipelines shall be subjected to the operating pressure for at least one hour and then inspected for leakage. This inspection shall only be carried out in dry weather or if a suitable shelter is erected over the joints and the area dried sufficiently to show dripping or weeping.

The Engineer shall be advised so that the final connecting joints can be witnessed before backfilling. Any leakage or other fault shall be rectified and the test repeated until there is no fault.

3.15 Additional or Failed Pressure Tests

The cost for the Engineer to attend pressure tests that fail shall be a cost to the contractor for Council contracts and a cost to the Developer when the work is for a subdivision.

3.16 Reporting

A complete record of all details of the test shall be made. This record shall include the following:

- full details of the pipeline tested (including details of pipe material, diameter and pressure class, pressure rating, manufacturers identification, jointing system, pipeline profile showing changes in pipe material as well as the location of valves and fittings, and the location of test sections)
- failure of any thrust block, pipe, fitting or other component
- any visible leakage detected and repaired
- a detailed record of the pressure in the pipeline at appropriate time intervals. This may be from a pressure data logger or by manually recording times and pressure readings at appropriate intervals
- details of the addition of make-up water (either by volume drawn off or volume pumped in)
- the allowable quantity of make up water for the test conditions
- confirmation that valves sealed when subjected to DP on one side
- whether the pipeline passed or failed the test
- the signatures of the representatives of the Contractor, Engineer and/or Designer who witnessed the test

A suitable record form is attached as Appendix A.

3.17 Completion of the Test

After testing, release the test pressure slowly and if necessary, open air valves and drain points to drain the line. If the pipeline has been disinfected, do not drain it until just prior to final commissioning so that the risk of contamination is minimised.

If it is necessary to drain a line that contains a disinfection residual of chlorine, this residual shall be reduced to an acceptable level before being discharged to a storm water system. Alternatively, (and with the Engineers approval) the chlorinated water may be discharged to the sewage system provided a positive air gap separation is maintained at all times and the rate of discharge does not overload the sewer.

4.0 Method for Pressure Testing DI, CLS, PVC-U, PVC-O, PVC-M & GRP Pipelines

4.1 Pressurising the Pipeline

Pressurising of the pipeline above the DP (or 75% of the STP) shall not begin until the Engineer and Designer (if appropriate) are on site to witness the test, unless the Engineer has given prior approval.

The pressure shall be raised steadily and smoothly to the STP and shall not be raised to more than 1.5 x PN of the lowest rated component in the line.

Maintain the STP, by pumping at 15-30 minute intervals (if necessary) for the specified test duration (usually at least one hour). Measure and record the quantity of make-up water added at each occasion, either by the volume pumped in or the volume drawn off method as detailed in the Contractors approved test methodology or Appendix B. Restore the STP whenever the pressure drops by more than 5%.

4.2 Acceptance Criteria

The pressure test shall be satisfactory if:

- There is no failure of any thrust block, pipe, fitting or other pipeline component
- There is no visible leakage – if a leak is suspected but not visible, use aural or ultrasonic assistance to locate
- The total make-up water volume does not exceed the maximum allowable quantity as calculated from the equation:

$$Q(\text{litres/hr}) \leq (0.14 \times L \times D \times H)$$

Where:

L = Length of pipeline under test (km)

D = Internal diameter of pipe (m)

H = Average value of head in the pipeline over the full test length (m)

4.3 Failure of Test

Should the test fail, the cause shall be located and rectified and the section re-tested until satisfactory results are obtained.

Failure to allow adequate "soak" time for a cement mortar lined pipe or if there is a significant amount of entrapped air in the pipeline may result in an inconclusive test or a marginal failure. In such a case, the test period may be extended for a further one to two hours, as may be agreed between the Contractor and the Engineer.

Provided the quantity of make-up water meets the acceptance criteria during the last hour of this extended period, the pipeline will pass the test.

When PE service connections or sub-mains are tested along with a main pipeline, the visco elastic creep of these pipes may cause a test failure. It may be necessary to isolate the PE sections and test these separately or to apply the methods given in sections 5 or 6.

4.4 Reporting

On satisfactory completion of the test, the test report shall be prepared by the Contractor and signed off by the Contractor, Engineer and Designer witnessing the test.

5.0 Method for Pressure Testing Visco-Elastic Pipes (PE) – Rebound Method

5.1 General

Pressurising of the pipeline above the DP (or 75% of the STP) shall not begin until the Engineer and Designer are on site to witness the test, unless the Engineer has given prior approval.

A Pressure transducer and data logger is required for monitoring the pressure during this test method. However, results are to be supplied in an Excel spreadsheet or 'CSV' file.

5.2 Preliminary Phase

This preliminary phase is necessary before proceeding to the subsequent phases. It is intended to set up the prerequisites for volume alterations that are dependent on pressure, time and temperature.

- After flushing/swabbing and thoroughly venting the pipeline, depressurise to just above atmospheric at the highest point of the line and allow a relaxation period of at least 60 minutes to release pressure related stress. Ensure that no air enters the line.

- After the relaxation period, raise the pressure steadily and smoothly to the STP (it must not be raised to more than 1.5 x PN of the pipe or fittings). Maintain the STP for a period of 30 minutes by pumping continuously or at short intervals. Take care not to exceed the STP. During this time, carry out an inspection to identify any obvious leaks.

- Stop pumping and allow the pressure to decay by visco-elastic creep for 1 hour.

- Measure the remaining pressure at the end of the hour.

- If the pressure has dropped to 70% (or less) of the STP, the pipeline will not pass the test and the cause should be located and rectified. This could be due to leakage or temperature change. If the pressure at the end of the hour >70% of the STP, continue with phase two, the pressure drop test to prove the volume of air in the pipeline is sufficiently low to allow the main test phase to be carried out.

5.3 Pressure Drop Test

The main test phase requires that the pipeline has been adequately vented and the volume of remaining air is less than the calculated maximum allowable. The procedure to confirm the air volume is described below. This test (pressure drop test) is carried out immediately after the completion of a successful preliminary phase.

- Reduce the pressure remaining in the pipeline rapidly at the end of the preliminary phase by opening a metered "bleed" connection to produce a pressure drop (Δp) of 10 – 15% of the STP. The bleed time should be kept as short as possible, (preferably less than 2 minutes). A large diameter/volume test section will require a large connection and meter in order to achieve the bleed time requirement – this should be confirmed by calculation.

- Measure accurately and record the volume of water "bled" from the line (ΔV).

- Measure and record the temperature of the water within the pipe at the end of the pressure drop phase and at the finish of the test.

- Calculate the maximum allowable water loss ($\Delta Vmax$) using the following formula. The volume of water removed should not exceed $\Delta Vmax$.

- If ΔV is more than $\Delta Vmax$, stop the test and remove excess air.

$$\Delta Vmax = 1.2V\Delta p\,[1/E_w + D/eE_R]$$

Where:

$\Delta Vmax$ = allowable water loss in litres

V = total volume of the tested pipeline in litres

Δp = measured pressure drop in kPa

Ew = bulk modulus of water (kPa) @ test temperature (see Table 1)

D = internal pipe diameter in metres

e = wall thickness of the pipe in metres

ER = modulus of elasticity of the pipe wall in kPa (see Table2)

1.2 = an allowance for remaining air

Table 1 – Bulk Modulus of Water at Various Temperatures

TEMPERATURE °C	BULK MODULUS (kPa)
5	2080000
10	2110000
15	2140000
20	2170000
25	2210000
30	2230000

Table 2 – E Modulus of PE 80B and PE100 at Various Temperatures

TEMP. °C	PE 80B - E Modulus (kPa) @ hrs			PE 100 – E Modulus (kPa) @ hrs		
	1 hour	2 hours	3 hours	1 hour	2 hours	3 hours
5	740000	700000	680000	990000	930000	900000
10	670000	630000	610000	900000	850000	820000
15	600000	570000	550000	820000	780000	750000
20	550000	520000	510000	750000	710000	680000
25	510000	490000	470000	690000	650000	630000
30	470000	450000	430000	640000	610000	600000

Notes:

The value of ER should be representative of the temperature and duration of the test (see Table 2 above).

Δp and ΔV should be measured as accurately as possible, especially where the test section volume is small. =

5.4 Main Test Phase

The visco-elastic creep due to the STP is interrupted by the rapid pressure drop described above. The rapid drop in pressure leads to the contraction of the pipeline. Observe and record the increase in pressure that results from the contraction of the pipeline for a period of 30 or 90 minutes.

5.5 Acceptance Criteria

The pressure test shall be satisfactory if:

- There is no failure of any thrust block, pipe, fitting or other pipeline component.
- There is no visible leakage.
- The pressure shows a rising tendency throughout the 30 minute period.
- If doubt exists about the pressure recovery, the monitoring period may be increased to 90-minutes and any pressure drop that does occur shall not exceed 20kPa over the full 90-minute period.
- If the pressure drops by more than 20kPa during the 90 minute extended period, the test fails.
- Repetition of the main test phase may only be done by carrying out the whole test procedure including the relaxation period of 60 minutes described in the preliminary phase.

5.6 Failure of Test

Should the test fail, the cause shall be located, rectified and the section re-tested until satisfactory results are obtained.

5.7 Reporting

On satisfactory completion of the test, the test report shall be prepared by the Contractor and signed off by the Contractor, Engineer and Designer witnessing the test.

6.0 Method for Pressure Testing Visco-Elastic Pipes (PE,) – Volumetric Method

6.1 Purpose

This method is included as a reference method that can quantify the amount of leakage in a visco-elastic pipeline. It will generally require a greater length of time to achieve a result.

6.2 Pressurising the Pipeline

The pressure shall be raised steadily and smoothly to STP. (It must not be raised to more than 1.5 x PN of the pipe or fittings).

When the STP has been reached, isolate the pipeline and allow the pressure to decay naturally for 12 hours. (The pressure will drop significantly during this pre-stressing period).

After 12 hours, re-apply and maintain the STP for 5 hours as detailed below:

- Restore the STP at the end of the 12 hour pre-stressing period

- Restore the STP at the end of hour 1
- Restore the STP at the end of hour 2
- Measure and record the water volume (V1 Litres) needed to restore the STP at the end of hour 3
- Restore the STP at the end of hour 4
- Measure and record the water volume (V2 Litres) required to restore the STP at the end of hour 5

Calculate

$V2 \leq 0.55 \times V_1 + Q$

Where:

Q is the allowable make-up volume obtained from the equation:

$Q\ (\text{litres/hr}) \leq (0.14 \times L \times D \times H)$

Where:

L = Length of pipeline under test (km)

D = Internal diameter of pipe (m)

H = Average value of head in the pipeline (m)

6.3 Acceptance Criteria

The pressure test shall be satisfactory if:

- There is no failure of any thrust block, pipe, fitting or other pipeline component.
- There is no visible leakage – if a leak is suspected but not visible, use aural or ultrasonic assistance.
- The make-up water volume (Q) does not exceed the maximum allowable volume as calculated.

6.4 Failure of Test

Should the test fail, the cause shall be located, rectified and the section re-tested until satisfactory results are obtained. Note that the STP and the quantity of water required to restore the STP must be measured as accurately as possible.

6.5 Reporting

On satisfactory completion of the test, a test report prepared by the Contractor shall be signed off by the Contractor, Engineer and Consultant witnessing the test.

7.0 Pressure Test Record

Nelson City Council

PRESSURE PIPELINE - TEST RECORD

PIPE PURPOSE: DATE:

LOCATION: DESIGNER:

CONTRACTOR: FOREMAN:

CONSULTANT OBSERVER: COUNCIL OBSERVER:

OPERATING & TEST DETAILS

MAX. OPERATING PRES:

SYSTEM TEST PRESSURE:

PASS CRITERIA:

PASSED THE TEST?

SIGNATURES:

MAIN PIPELINE DETAILS

PIPE MAKE/DESCRIPTION:

NOMINAL DIAMETER: PIPE OD (mm):

PIPE MATERIAL: PRESSURE CLASS:

JOINTING SYSTEM: LENGTH OF PIPE:

PIPE SERIAL NUMBER/S:

RIDER MAIN DETAILS

PIPE MAKE/DESCRIPTION:

NOMINAL DIAMETER: PIPE OD (mm):

PIPE MATERIAL: PRESSURE CLASS:

JOINTING SYSTEM: LENGTH OF PIPE:

PIPE SERIAL NUMBER/S:

HOUSE CONNECTION DETAILS

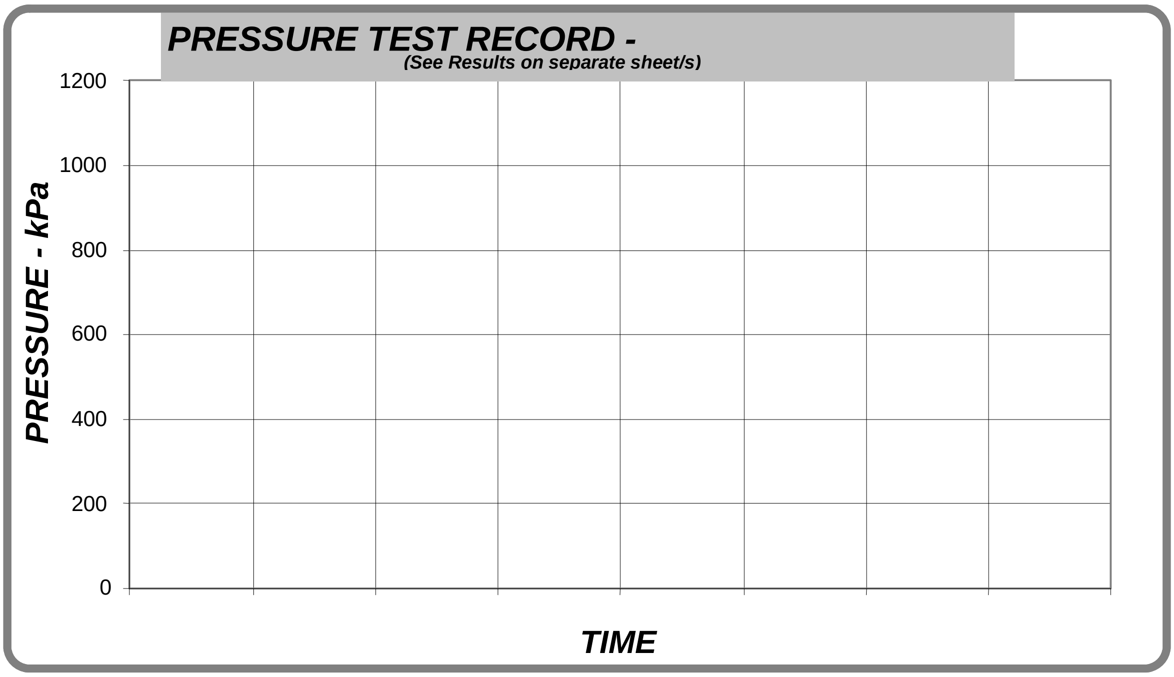
PIPE MAKE/DESCRIPTION:

NOMINAL DIAMETER: PIPE OD (mm):

PIPE MATERIAL: PRESSURE CLASS:

JOINTING SYSTEM: LENGTH OF PIPE:

PIPE SERIAL NUMBER/S:



RECORD OF PRESSURE TEST RESULTS (Including pipeline filling etc)

TIME	PRESSURE	REMARKS

8.0 Measurement of Make-up Water Volume

There are two equivalent methods for measuring the volume of make-up water; i.e. measurement of the volume drawn off or the volume pumped in.

8.1 Measurement of the Volume Pumped in

At the end of the test period (or at intervals during the test) measure and record the reduced pressure in the main. Then restore the STP by pumping and measure the volume that is pumped in.

The quantities of water pumped in should be summed if it's necessary to raise the pressure in the line more than once during the test.

The volume of water pumped into the pipeline may be measured by any suitable device. A 15 or 20-mm class C or D water meter may be appropriate, provided the inflow rate is within the meters' Q_{min} and Q_{max}.

The quantity of water may be quite small (especially for a small diameter and short length of main). If a motorised test pump is used, it may be difficult to control the rate of pressure rise and pump pulsations may affect the water meter's accuracy. If this is the case, the use of a hand pump should be considered or the "volume drawn off" method used.

8.2 Measurement of the Volume Drawn off

At the end of the test period (or at intervals during the test) measure and record the reduced pressure in the main. Restore the STP by pumping and measure the volume that has to be drawn off to reach the reduced pressure previously recorded, then restore the STP. This whole operation should be carried out as quickly as possible, consistent with ensuring the accuracy of the pressure and volume measurement.

The quantities of water drawn off should be summed if it's necessary to restore the pressure in the line more than once during the test.

The volume of water drawn off may be measured by any suitable device. A 15 or 20-mm class C or D water meter may be appropriate, provided the outflow rate is within the meters' Q_{min} and Q_{max}.

8.3 Accuracy of Pressure and Volume Measurement

The equipment used to determine the make-up volume shall be capable of measuring the quantity of water to an accuracy of ±2% or better.

The precision of the pressure measurement will have an effect on the accuracy of the volume measurements, especially if a significant amount of air remains in the pipeline. The precision with which the STP is set and restored will also have an effect on the test results. Measurement of the volume drawn off may be more precise and controllable than the volume pumped in. The equipment (pressure gauges and volume measuring devices) shall be to the accuracy specified and every care shall be taken to ensure that the results are as accurate as the equipment will allow.

8.4 Acceptable Pressure Measurement Devices

The accuracy and readability of pressure monitoring equipment used for pressure testing can have a significant bearing on the interpretation of pressure tests. This is particularly so when a pipeline contains a significant amount of air.

The pressure range of the gauges used shall be such that the STP falls within the range 50 - 90% of the full-scale range of the gauge. The main gauge shall have been calibrated within 6 months of use and have a minimum dial diameter of 100-mm (preferably 150 mm). A check gauge of a similar pressure range shall also be used to confirm the calibration of the main gauge. (A "test" pressure gauge with an accuracy of ±0.5% of full scale is preferred for the main gauge).

Alternatively, a data logger may be used to log the pressure signal from an accurately calibrated pressure transducer. A suitable "check" pressure gauge shall be used in conjunction with the pressure transducer to confirm the calibration of the transducer. The test gauge shall be read at frequent intervals and the readings recorded for later comparison with the data logger results. The data logger shall be set to log the pressure at suitable intervals that are not more than 2 minutes apart for PE pipeline tests and 5 minutes for testing pipelines of other materials.

Note that pressure pulsations from a motorised test pump may destroy a pressure gauge unless some form of pressure damping is incorporated to protect the gauge.

8.5 Preferred Pressure Test Rig

The preferred rig shall have a recently calibrated pressure transducer and check pressure gauge.

The transducer shall have:

- non-linearity and hysteresis within ±0.2%
- a resolution of 0.02 bar or better
- a pressure range so that the output at STP is 50 - 90% of full scale
- been checked for calibration within the last 6 months
- a data logger capable of storing the pressures at 2-minute intervals over a period of up to 24 hours

The check pressure gauge shall have:

- a dial of ≥100-mm
- readability to within 10 kPa
- a pressure range so that the STP falls within 50 - 90% of the range
- been checked for calibration within the last 6 months

The transducer and the check gauge shall read within 3% of each other. If they do not agree within this limitation, the cause shall be determined and the faulty unit/s replaced or recalibrated at the Contractor's cost.

8.6 Alternative Pressure Test Rig

The pressure test may be conducted using two pressure gauges.

The main "test" gauge shall have:

- an accuracy of ±0.5% of full scale
- ≥100-mm dial
- readability of 5 kPa
- a pressure range so that the STP falls within 50 - 90% of the range

The check gauge shall have:

- an accuracy of ±1% of full scale
- ≥100-mm dial
- readability of 10 kPa
- a pressure range so that STP falls within 50 - 90% of the range
- been checked for calibration within the last 6 months

The gauges shall read within 3% of each other. If they do not agree within this limitation, the cause shall be determined and the faulty unit/s replaced or recalibrated at the Contractor's cost.

The test rig shall incorporate provision for manually bleeding air as well as an isolated 15-mm BSP socket to allow for the installation of an independent check gauge.

In the case of a dispute over a pressure test result, a pressure transducer and data logger and check gauge shall be used for any re-testing that may be necessary.

8.7 Effects of Entrapped Air

Air trapped in a pipeline during the test will affect the test results. As much air as possible should be expelled from the pipeline during filling and before the pressure test is commenced. Air removal may necessitate swabbing.

8.8 Pipe Temperature and Temperature Changes During the Test

The temperature of the pipe may need to be taken into account when testing plastics pipes. If the average temperature of the pipe wall is greater than 23°C the test pressure may have to be reduced to allow for pipe material de-rating requirements. This situation can occur where pipelines are not buried, but are exposed to the sun.

Changes in temperature during the test can have a significant effect on the internal pressure as a temperature change can cause the pipe to expand or contract. Under normal circumstances, the temperature of a buried pipeline will remain relatively constant after initial filling and stabilising.

Note that the temperature of any water added to a pipeline (e.g. to restore the STP) should be within ± 3°C of the temperature of the water already in the pipeline.