WATER SERVICES
ASSOCIATION OF AUSTRALIA

DRWSA 137-2019

Industry standard for maintenance shafts, maintenance chambers and maintenance holes for sewerage

Version 3.1

PREFACE

This Standard was prepared by the Water Services Association of Australia (WSAA). It was published on the XXXXXXX.

The objective of this Standard is to provide material and performance requirements for manufacturers and purchasers of plastics maintenance shafts, maintenance chambers and manholes for sewerage and sanitary drainage systems. Typically, a maintenance shaft, maintenance chamber or maintenance hole assembly comprises:

(a) a base;

(b) a vertical riser;

(c) a cone, where required to reduce the opening at the top of a large diameter riser or placed immediately above the base to allow a smaller diameter riser to be used;

(d) a sealed riser cap below, but close to the finished ground surface level.

The diameter range of the base and riser has been extended to DN1000. Maintenance holes complying with this Standard can be supplied with or without steps or fixed ladders. This Standard does not provide detailed requirements for ladders or steps to facilitate man entry but appropriate EN Standards are referenced.

NOTE: Maintenance shafts, maintenance chambers and maintenance holes complying with this Standard may also be suitable for other applications such as stormwater drainage.

In-service performance of a maintenance shaft or chamber or hole is strongly dependent on a supportive embedment. It should be recognised that it is extremely difficult to anticipate soil types, soil loadings and future soil movement in all possible locations and conditions. Specific types of embedment and backfill materials and compaction standards for various depths and soil types should be adopted in order to minimise the risk of long-term failure. Thus, even with compliance with these performance requirements, installation conditions will have a significant influence on the long-term performance of maintenance shafts, maintenance chambers and maintenance holes.

The design criteria of AS/NZS 2566.1, Buried flexible pipelines, Part 1: Structural design, provide guidance. Installation should be in accordance with design drawings and the Gravity Sewerage Code of Australia—WSA 02.

This Standard adopts the same means of determining structural integrity of maintenance shafts, maintenance chambers and maintenance holes and durability of materials as ISO 13272. The elastomeric seal joint requirements are similar to ISO 13272 except that the base-to-pipe and base-to-riser joints are required to additionally comply with interface pressure and contact width as specified in, for example, AS/NZS 1260 and the infiltration / exfiltration test pressures are higher.

The plastics materials covered by this Standard include PVC-U, PE, PP and PP-MD. This document recognises that materials demonstrated to comply with the requirements of some AS/NZS and ISO Standards are suitable for the manufacture of maintenance shaft risers and/or bases, provided the structural integrity and durability requirements are satisfied. Other PVC-U, PE, PP or PP-MD materials need to satisfy additional durability requirements in order to demonstrate suitability. Maintenance shaft, maintenance chamber and maintenance hole bases are typically manufactured by injection moulding, rotational moulding or fabrication.

Provided that installation, embedment support and operating conditions conform to the guidelines in this Standard, maintenance shaft, maintenance chamber and maintenance hole life expectancy are expected to exceed 50 years. A riser stiffness as low as SN4 may be considered, subject to and supported by structural analysis based on AS/NZS 2566.1. The structural analysis shall consider buckling stability of the riser in different soil types with a water table to full installation depth.

This Standard provides for an indicative accessibility test, using proving tools of two standard shapes. Notwithstanding this and for the purposes of product appraisal, the ease of ingress

and egress of maintenance and condition assessment equipment – particularly at higher installation depths and for base configurations that involve smaller diameter vertical shafts and sewer connection diameters, “fit-for-purpose” accessibility should be demonstrated by means of installation trials, using the type of equipment that is routinely used by WSAA member utilities.

It is recognised that low surface energy acrylic structural adhesives may be used to joint dissimilar plastics such as PE and PVC in some shaft and chamber products. Specific test requirements for joint adhesion have not been nominated or included, pending the development of an acceptable product standard for the jointing of dissimilar plastics in typical maintenance shaft, maintenance chamber and maintenance hole applications i.e. buried structures handling sewage, stormwater or combinations of these.

The Appendices are identified as ‘normative’ and, as such, form integral requirements of this Standard.

CONTENTS

1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies the material, performance and design requirements for plastics maintenance shafts, maintenance chambers and maintenance holes comprising an injection moulded, rotationally moulded or fabricated base and riser made of unplasticised polyvinylchloride (PVC-U), polyethylene (PE), polypropylene (PP) or polypropylene with mineral modifiers (PP-MD).

A maintenance shaft, maintenance chamber or maintenance hole may be a one-piece construction or an assembly of different components manufactured from compatible materials.

The jointing of individual components may be achieved using:

(a) elastomeric ring seal joints;

(b) solvent cement joints for PVC-U;

(c) welded joints for PVC-U, PP, PP-MD and PE;

(d) extrusion welding;

(e) mechanical jointing.

Maintenance shafts, maintenance chambers and maintenance holes comprises a base and riser. They may also include:

(i) a cone between the base and riser, or between the riser and cap, or on top of the riser;

(ii) a telescopic part;

(iii) other near-surface components.

(iv) an inlet connector that is inserted into or fixed to the riser or forms part of the riser to provide for one or more pipe connections to the riser itself.

All maintenance shafts, maintenance chambers and maintenance holes complying with this specification are:

(A) intended to operate at atmospheric pressure and sewage temperature not greater than 40°C;

(B) intended to be suitable for an installation depth of 4 m but not exceeding 6 m (or $\geq$ 4m and $\leq$ 6 m).

(C) not intended to bear vertical traffic loads directly,

(D) intended for installation where vehicular traffic loads are transfer to the surrounding embedment, but not to the riser/ cone assembly beneath.

1.2 COMPLIANCE REQUIREMENTS

Methods for demonstrating compliance with this Standard shall be in accordance with Appendix A.

1.3 LIMITATIONS

This Standard does not cover the use of maintenance shafts, maintenance chambers and and maintenance holes intended at pressures other than atmospheric pressure nor the imposition of superimposed loads e.g. due to seismic events nor exposure to a average service temperature in excess of 35°C. Such special conditions shall be provided for by maintenance shaft, maintenance chamber and maintenance hole designers and the design performance shall be subjected to compliance testing.

1.4 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

681.1	Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Vulcanized rubber
681.2	Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Thermoplastic elastomers
1199	Sampling procedures for inspection by attributes
1199.1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
1646	Elastomeric seals for waterworks purposes

AS/NZS

1260	PVC-U pipes and fittings for drain, waste and vent application
1462.1	Methods of test for plastics pipes and fittings Method 1: Method for determining the dimensions of pipes and fittings
1462.8	Methods of test for plastics pipes and fittings Method 8. Method for testing the leak tightness of assemblies
1462.11	Methods of test for plastics pipes and fittings Method 11. Method for high temperature stress relief testing of fittings
1462.13	Methods of test for plastics pipes and fittings Method 13. Method for the determination of elastomeric seal joint contact width and pressure
1462.22	Methods of test for plastics pipes and fittings Method 22. Method for the determination of pipe stiffness
1462.28	Methods of test for plastics pipes and fittings Method 28. Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds
1477	PVC pipes and fittings for pressure applications
2032	Installation of PVC pipe systems
2566.1	Buried flexible pipelines Part 1: Structural
2566.2	Buried flexible pipelines Part 2: Installation
3879	Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS and ASA pipes and fittings
4131	Polyethylene (PE) compounds for pressure pipes and fittings
4441	Oriented PVC (PVC-O) pipes for pressure applications
4765	Modified PVC (PVC-M) pipes for pressure applications
5065	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

EN

13101	Steps for underground man entry chambers. Requirements marking, testing and evaluation of conformity.
14396	Fixed ladders for manholes.
14758-1	Plastics piping systems for non-pressure underground drainage and sewerage – Polypropylene with mineral modifiers (PP – MD) – Part 1: Specifications for pipes, fittings and the system

ISO

1133	Plastics – Determination of The Melt Mass-Flow Rate (MFR) and the Melt Volume-Flow Rate (MVR) of Thermoplastics
3127	Thermoplastics pipes – Determination of resistance to external blows – Round-the-clock method

3951.1	Sampling procedures for inspection by variables – Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL
3951.2	Sampling procedures for inspection by variables – Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics
3951.3	Sampling procedures for inspection by variables – Part 3: Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
3951.5	Sampling procedures for inspection by variables – Part 5: Sequential sampling plans indexed by acceptance quality limit (AQL) for inspection by variables (known standard deviation)
4427	Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply
4435	Plastics piping systems for non-pressure underground drainage and sewerage – Unplasticised poly(vinyl chloride) (PVC-U)
8772	Plastics piping systems for non-pressure underground drainage and sewerage – Polyethylene (PE)
8773	Plastics piping systems for non-pressure underground drainage and sewerage – Polypropylene (PP)
13229	Thermoplastics piping systems for non-pressure applications – Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings – Determination of the viscosity number and K-value
13259	Thermoplastics piping systems for underground non-pressure applications – Test method for leaktightness of elastomeric sealing ring type joints
13266	Thermoplastics piping systems for non-pressure underground drainage and sewerage -- Thermoplastics shafts or risers for inspection chambers and manholes -- Determination of resistance against surface and traffic loading
13267	Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics inspection chamber and manhole bases — Test methods for buckling resistance
13272	Plastics piping systems for non-pressure underground drainage and sewerage – Unplasticised poly(vinyl chloride) (PVC-U), polypropylene (PP), polypropylene with mineral modifiers (PP-MD) and polyethylene (PE) – Specifications for manholes and inspection chambers in traffic areas and underground installations
21138-1	Plastics piping systems for non-pressure underground drainage and sewerage – Structured-wall piping systems of unplasticised poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) – Part 1: Material specifications and performance criteria for pipes, fittings and system
21138-2	Plastics piping systems for non-pressure underground drainage and sewerage – Structured-wall piping systems of unplasticised poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) – Part 2: Pipes and fittings with smooth external surface, Type A
21138-3	Plastics piping systems for non-pressure underground drainage and sewerage – Structured-wall piping systems of unplasticised poly (vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) – Part 3: Pipes and fittings with non-smooth external surface, Type B
ISO/IEC	
Guide 28	Conformity assessment – Guidance on a third party certification system for products
WSAA	
WSA 01	Polyethylene Code of Australia

1.5 DEFINITIONS

1.5.1 *Average service temperature*

The average of sustained temperatures (T_{ms}) that a maintenance shaft, maintenance chamber or maintenance hole is exposed to during service can be calculated from the following equation:

$$T_{ms} = \frac{2T_{sew} + T_{soil}}{3}$$

where

T_{sew} = average sewage temperature assessed over summer and winter months

= $0.5T_{sew-summer} + 0.5T_{sew-winter}$

T_{soil} = average soil temperature assessed over summer and winter months

= $0.5T_{soil-summer} + 0.5T_{soil-winter}$

The average temperature for the sewage and soil in contact with the maintenance shaft, maintenance chamber or maintenance hole is the weighted average of the temperatures, as assessed in proportion to the time spent at each temperature during a given period under operational conditions.

NOTE: For practical purposes, this should be taken to be the average of temperatures to which a maintenance shaft, maintenance chamber or maintenance hole may be exposed internally and externally during the summer and winter of a typical operational year, which may be taken to be two equal 6 monthly periods. For non-wastewater applications, T_{sew} may be taken as the average seasonal temperature assessed for the particular fluids involved.

1.5.2 *Effective seal*

That part of the interface between an elastomeric seal and the spigot and socket where the contact pressure is greater than 0.4 MPa for vulcanised seals and 0.47 MPa for thermoplastic seals.

1.5.3 *Effective sealing length*

1.5.3.1 *Socket-mounted seals*

The distance between the cross-sectional centre of the elastomeric sealing ring installed in the socket and the root of the socket.

1.5.3.2 *Spigot-mounted seals*

The distance from the position of effective seal of the elastomeric sealing ring to the mouth of a socket or the point at which the mouth of a socket flares.

1.5.4 *Maintenance chamber*

Structure with a moulded and channelled or spherical base with up to three inlets ≤DN 300 or one DN 375 inlet in the straight 180° profile at the base, a riser of nominal size DN 600 – DN 800 and a removable cover constructed on a sewer that allows limited change of grade and/or direction and provides access to the sewer for inspection and most maintenance equipment from the surface. . Base configurations may include in-line, bend or junction.

1.5.5 *Maintenance shaft*

Structure with a moulded and channelled or spherical base with up to three inlets ≤DN 250 (inlets at the base only), a riser of nominal size DN 225 – DN 450 and a removable cover constructed on a sewer that allows limited change of grade and/or direction, and provides access to the conduit for inspection and some maintenance equipment from the surface. . Base configurations may include in-line, bend, junction or terminating. A maintenance shaft at the end of a reticulation sewer is known as a terminal maintenance shaft.

1.5.6 *Maintenance hole*

Structure with a moulded and channelled or spherical base with, up to three inlets ≤ DN375at the base, a riser having an internal diameter not less than DN/ID 1000, an adaptor providing an entry diameter ≥ DN600 and a removable cover constructed on a sewer that allows limited change of grade and/or direction and provides access to the sewer for inspection and maintenance equipment, which may include permitted entry of a person.

1.5.7 *Maintenance shaft, maintenance chamber and maintenance hole base*

A sewerage fitting used to connect, and/or to change the direction of sewers. A base comprises a floor with formed channels for conveying fluids, walls and soffit. A base may include benching.

1.5.8 *Riser*

A component, usually circular in cross-section, that provides service access to the base component from ground surface level. A riser may be an integral component of the maintenance shaft, maintenance chamber or maintenance hole assembly or a separate circular shaft that is securely jointed to the base.

NOTES:

1. The primary maintenance shaft, maintenance chamber and maintenance hole structure, typically, terminates at a level close to but beneath finished surface level. A suitably designed access cover, frame (and concrete surround where specified) duly supported by installed embedment in accordance with WSA 02 requirements is typically provided above this level.
2. Riser diameter is typically in the range DN 225 – DN 450 for maintenance shafts, DN 600 – DN 800 for maintenance chambers and an internal diameter not less than DN/DI 1000 for maintenance holes.

1.5.9 *Cone*

A tapered adaptor placed at the top of a riser to reduce the diameter of the primary riser shaft, chamber or base to a smaller riser diameter .

1.5.10 *Cap*

A removable component attached to the top of a maintenance shaft or maintenance chamber riser to prevent infiltration of ground or surface water and for the purposes of routine operational and maintenance activities and equipment.

NOTE: Caps can be either a locking type or a type that will permit flow relief.

1.5.11 *Telescopic part*

Part of a shaft or chamber assembly that accommodates differential settlement or movement after installation and allows appropriate re-adjustment of riser, cone and cap height.

1.5.12 *Inlet connector*

A component that allows single or multiple conveyance pipes to be connected to a riser shaft. An inlet connector may form an integral part of a riser or it may be mechanically jointed to a riser wall.

NOTE: Inlet connectors may be installed before, during or after construction.

1.5.13 *13 Installation Depth (H)*

Depth from finished surface level to pipe invert level.

1.5.14*14 Maximum installation depth (H_{max})*

The installation depth nominated by the manufacturer, within the depth constraints of Clause 1.1.

1.5.15 *Nominal size, DN*

An alphanumeric designation of size for components of a pipeline system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number, which is indirectly related to the physical size, in millimetres, of the inside diameter (DN/ID) or outside diameter (DN/OD) of the end connections

1.6 ABBREVIATIONS

%	percentage
ºC	degree Celsius
AQL	acceptable quality level
AS	Australian Standard
AS/NZS	Australia and New Zealand Standard
DN	nominal size
DN/ID	nominal size, inside diameter related
DN/OD	nominal size, outside diameter related
g	gravitational constant
h	hour
HALS	hindered amine light stabiliser
IEC	International Electrotechnical Commission
ISO	International Standards Organisation
JAS-ANZ	Joint Accreditation System of Australia and New Zealand
kg	kilogram
kN	kilonewton
kPa	kilopascal
m	metre
MFR	melt mass-flow rate
mm	millimetre
min	minute
MPa	megapascal
N	Newton
N/m/m	Newtons per metre per metre
PE	polyethylene
PP	polypropylene
PP-MD	polypropylene with mineral modifiers
PVC	polyvinylchloride
PVC-U	Poly(vinyl chloride) unplasticised
PVT	process verification test
R	rating factor for the durability test
TT	type test
WSAA	Water Services Association of Australia

2 MATERIAL REQUIREMENTS

2.1 GENERAL

This section specifies minimum performance requirements for PVC-U, PE, PP and PP-MD maintenance shaft, maintenance chamber, maintenance hole, elastomeric seals and solvent cement components. It also specifies requirements for finished product freedom from defects, packaging, storage and transport.

NOTE: Different components of maintenance shaft, maintenance chamber and maintenance hole assemblies may be manufactured from one or more of the base polymeric materials covered by the scope of this standard.

2.2 MATERIALS

2.2.1 *General*

Additives containing compounds based on lead (Pb), cadmium (Cd) or mercury (Hg) shall not be used in the manufacture of any components. Recycled PVC-U material containing these compounds may be used in the core of a sandwich construction PVC-U shaft or chamber component.

2.2.2 *Materials for bases*

2.2.2.1 *Standard materials*

When a material satisfying the material requirements of one of the Standards listed in Table 2.1 is used for manufacturing bases for maintenance shafts maintenance chambers or maintenance holes it shall, in addition, exhibit no cracks when tested for 1,000 h in accordance with Appendix B using the buckling resistance test specified in ISO 13267. The durability test shall be performed at a negative internal pressure of $-\frac{10H_{max}}{R}$ kPa and at the appropriate temperature given in Table B1 of Appendix B.

Note: R is the rating factor listed in Table B1 for PVC-U, PE, PP and PP-MD.

2.2.2.2 *Non-standard materials*

When a material other than that complying with the material requirements of the Standards listed in Table 2.1 is proposed for use in bases for maintenance shafts, maintenance chambers or maintenance hole, it shall, for acceptance, exhibit no cracks when tested for 3,000 h in the buckling resistance test specified in ISO 13267. The durability test shall be performed at a negative internal pressure of $-\frac{10H_{max}}{R}$ kPa and at the appropriate temperature given in Table B1 of Appendix B. Non-standard materials shall also be characterised and tested in accordance with Clause B5 of Appendix B.

2.2.3 *Materials for risers and cones and inlet connectors*

2.2.3.1 *Standard materials*

Materials complying with the Standards listed in Table 2.1 or complying with Clause 2.2.2.2 that may be used for manufacturing risers, cones and inlet connectors without additional material requirements. Pipes complying with the requirements of AS/NZS1477, AS/NZS 4441 or AS/NZS 4765 for an appropriate stiffness rating may also be used as riser components.

2.2.3.2 *Non-standard materials*

When a material not complying with either Table 2.1 or Clause 2.2.2.2 is used to manufacture risers, the material shall comply with Clause B5 of Appendix B.

2.2.3.3 *Elastomeric Components*

Elastomeric components forming part of an inlet connector shall comply with AS 1646 and AS EN 681.1 or AS EN 681.2.

TABLE 2.1

STANDARD MATERIALS

Material	Standard
PVC-U	AS/NZS 1260, ISO 4435, ISO 21138.1, ISO 21138.2, ISO 21138.3,
PE	AS/NZS 4131, AS/NZS 5065, ISO 4427, ISO 8772, ISO 21138.1, ISO 21138.2, ISO 21138.3, A coloured or natural material that is: • fully pre-compounded • produced from a base resin used to produce a compound complying with AS/NZS 4131 • contains a minimum of 0.2% of a hindered amine light stabiliser (HALS) • has additives evenly dispersed, having a rating of appearance of not worse than Micrograph B in Annex B of AS/NZS 1462.28 and the arithmetic average of the maximum sizes of pigment agglomerations or foreign bodies shall not exceed 60 µm (corresponding to Grade 3 of AS/NZS 1462.28 • has an MFR, when measured in accordance with ISO 1133 Condition T, not greater than 2.0
PP	AS/NZS 5065, ISO 8773, ISO 21138.1, ISO 21138.2, ISO 21138.3,
PP-MD	EN 14758-1

2.2.4 *Rework*

Clean rework material, which is generated from the manufacturer's own production of shaft and chamber components in accordance with this Standard, may be used provided that it is derived from the same material as that used in compliant product manufacture.

When rework material is added to a production run, the manufacturer shall treat this run as a new batch. For new batches of rotational moulding materials, the oxidation induction time and MFR shall be re-characterised in accordance with Clause B5 of Appendix B.

2.2.5 *Elastomeric seals*

Elastomeric seals shall comply with AS 1646 and AS 681.1 or AS 681.2.

2.2.6 *Solvent cements and priming fluids*

Solvent cements and priming fluids used for jointing PVC-U assemblies shall comply with AS/NZS 3879.

2.3 FREEDOM FROM DEFECTS

2.3.1 *General*

When viewed without magnification, the finished internal and external surfaces of maintenance shaft, chamber and hole components shall be smooth, clean and free from defects likely to impair conformity with this Standard. Components shall not have any blisters, voids, burnt particles or heat marks. Where grooves, wrinkles, rippling, dents or projections are present, the components shall comply with the specified dimensional requirements. Where defects are present and the product is submitted for acceptance, the manufacturer shall be able to demonstrate conformance to this Standard.

NOTE: Some products have grooves intentionally moulded into the surfaces of components for hydraulic reasons, which should not be cause for rejection.

2.3.2 *Pipe ends*

Pipe ends or spigots on maintenance shafts, maintenance chambers and maintenance hole shall be cleanly cut square with the axis of the ends of the component and within any cutting zone in accordance with the pipe manufacturers recommendations.

2.3.3 *Cleanliness*

Maintenance shaft, maintenance chamber and maintenance hole components shall be internally clean and free from swarf and other manufacturing debris.

NOTE: The defects described in Clauses 2.3.1, 2.3.2 and 2.3.3 cannot be completely quantified. Where the presence, size or frequency of any such defects are considered to be of concern, appropriate arrangements for product acceptability (or not) should be made between the purchaser/approving authority/conformance assessment body (as appropriate), and the manufacturer. This may be achieved by the provision of acceptable type samples or repair/replacement alternatives.

2.4 DIMENSIONS

2.4.1 *Sockets and spigots*

The dimensions of socketed and spigoted maintenance shafts, maintenance chambers and maintenance hole components shall be wholly compatible with the product Standard for the pipes to which they are intended to be connected.

2.4.2 *Effective sealing length*

The effective sealing length of a socketed or spigoted (pipe) connection component designed for elastomeric seal jointing, when measured in accordance with AS/NZS 1462.1 shall be not less than the value specified in the relevant pipe product Standard. Where that Standard specifies a length of engagement rather than an effective sealing length, the length of connection engagement, when measured in accordance with AS/NZS 1462.1, shall be not less than the length of engagement specified.

2.5 PACKAGING, STORAGE, HANDLING AND TRANSPORTATION

Maintenance shaft, maintenance chamber and maintenance hole components and assembled components shall be transported, handled and stored in accordance with the manufacturer’s recommendations in a manner that prevents damage, deterioration or excessive distortion.

Finished assemblies or the separate components of an assembly may be transported to site separately for installation or for assembly and installation respectively.

Maintenance shafts, maintenance chambers, maintenance holes components and assembled components shall be stacked in a manner that minimises ovalisation and protects ends, seals and projections from damage due to handling and installation impacts and superimposed loads.

Maintenance shaft, maintenance chamber or maintenance hole components and assembled components shall not be stored near motors, generators or other heat-emitting equipment.

Maintenance shaft, maintenance chamber or maintenance hole components or assembled components made of the following materials may tolerate exposure to direct sunlight for up to 2 years:

- PVC-U that contains ≥1.5 parts of rutile titanium dioxide (TiO2) pigment per 100 parts by mass of PVC content;
- PE, PP or PP-MD containing 2.0 to 2.5% of carbon black in accordance with AS/NZS 4131 or AS/NZS 5065;
- PE or PP containing ≥ 0.2% HALS in accordance with AS/NZS 4131 or AS/NZS 5065.

Maintenance shaft, maintenance chamber and maintence hole components and assembled components of other materials shall not be exposed to direct sunlight.

If extended exposure to direct sun for extended periods is anticipated, maintenance shaft chamber and hole assemblies and components shall be stored under cover in a manner that facilitates all round ventilation and air movement and that prevents heat entrapment.

3 PERFORMANCE REQUIREMENTS

3.1 GENERAL

This section specifies the performance requirements applicable to maintenance shafts, maintenance chamber and maintenance hole assemblies and components for installation depths up to 6 m. Maintenance shaft, chamber and hole assemblies shall be designed to be structurally sound and wholly resistant to buoyancy uplift by acceptable (nominated) margins of safety for all burial depths up to 6 m and for all water table levels up to finished surface level.

NOTE: The need to match maintenance shaft riser, base and inlet connector size to automated (truck mounted/controlled) utility CCTV and jet washing equipment may require consideration of a shaft assembly design option with DN 225 inlet connectors with appropriate taper fittings for connection to smaller (< DN 225) conveyance pipes.

3.2 STRUCTURAL INTEGRITY OF BASE

When tested for not less than 1,000 h at 20 to 25°C and negative internal pressure of -10*H* +0.5, −0 kPa in accordance with Appendix C and ISO 13267, the base shall not collapse nor show any signs of cracking. The predicted 50 year vertical H deformations shall be ≤5% of the main sewer pipe outside diameter. The predicted 50 year horizontal W deformation shall be ≤10% of the main sewer outside diameter.

3.3 IMPACT RESISTANCE OF BASE

When tested at 23±2°C in accordance with Appendix E using a striker of 1,000 +10,-0 g mass having a radius of 50 mm and a drop height of 2500 + 25 -0 mm the base shall not exhibit any cracks or other damage that impairs the function of the base.

3.4 RING STIFFNESS OF RISER

When tested in accordance with AS/NZS 1462.22 the ring stiffness of the riser shall be ≥4,000 N/m/m (SN4).

3.5 HIGH TEMPERATURE STRESS RELIEF OF PVC-U COMPONENTS

When tested at a temperature of 150 ±4°C for 30 +3, -0 min in accordance with AS/NZS1462.11, PVC-U injection moulded components shall comply with the following requirements:

(a) There shall be no evidence of inclusions or voids of size greater than 20% of the wall thickness up to a maximum of 1 mm.

(b) Delamination or damage at the injection point shall not have reduced the wall thickness to less than 50% of the nominated minimum wall thickness.

(c) The weld line shall not open up to a depth of more than 50% of the wall thickness.

NOTE: The weld line is likely to become prominent and the fitting distorted, but this does not constitute failure.

(d) Not more than 5% of the total internal and external surface area of the chamber shall exhibit blisters and/or surface delamination.

3.6 ACCESSIBILITY TEST

A maintenance shaft, maintenance chamber or maintenance hole shall be assembled with a 1 m length of riser pipe in a vertical position and with 1 m lengths of sewer pipe connected to each sewer pipe connection port. A proving tool of standard shape A, with dimensions as shown in Table 3.1 and Figure 3.1, shall be attached to cables and inserted through the riser pipe and pulled out through each of the sewer pipe connections in turn. This procedure shall

also be repeated for a proving tool of standard cylindrical shape B, with dimensions as shown in Table 3.1.

The standard shapes A and B shall be capable of insertion with diameter D1 as the leading edge and shall pass, without restriction, through all of the connection ports of the maintenance shaft, maintenance chamber or maintenance hole and into the connecting sewer pipes using a pulling force not exceeding 250 N.

The standard shapes shall be manufactured from steel or aluminium alloy with all sharp edges removed.

TABLE 3.1

DIMENSIONS OF STANDARD PROFILES

Inlet-outlet sewer nominal size[1] DN	Standard Shape A (see figure 3.1)			Standard shape B	
	Length, *L*	Diameter D_1	Diameter D_2	Length, *L*	Diameter D_1
100 / 110	300	90	65	400	75
150 / 160	400	135	90	400	125
175 /200	400	170	100	500	125
225 / 250	500	210	120	500	125
300 / 315	500	270	120	500	125
375 / 400	500	270	120	500	125

NOTE:

1. In accordance with the appropriate product Standard. Refer also to Clause 3.1 NOTE for considerations that may apply to the suitability of maintenance shafts for connection to smaller (> DN 225) pipes.

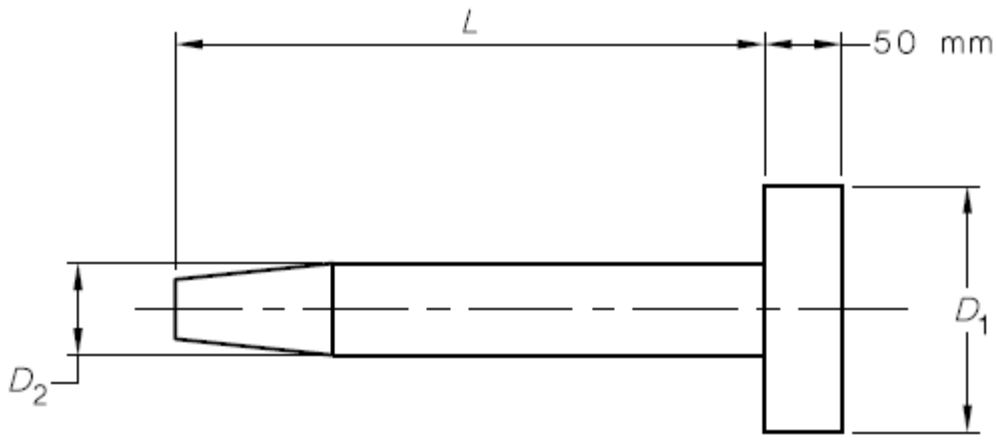

FIGURE 3.1 STANDARD SHAPE A

NOTE: This shape is indicative of a range of utility maintenance and condition assessment equipment (CCTV tractors and jet washers) but may not fully replicate accessibility to some modern automated equipment that is connected to a truck mounted viewing console by a semi-flexible multi-functional ‘umbilical’ conduit containing electrical and signal cables and hydraulic power hoses. Accessibility can be further impaired where base/riser shafts are vertical and small in diameter, where inlet connector diameters are also small (< DN 225) and where installation depth presents higher risks of equipment damage or loss. Demonstration of accessibility fitness-for-purpose accessibility may require specific installation trials that use the type of utility equipment described above. Alternate profile shapes may alternatively be nominated and tested by agreement between the manufacturer and asset owner.

3.7 ELASTOMERIC SEAL JOINTS

3.7.1 *General*

Elastomeric seal joints for joining base to pipes or to risers shall comply with the following requirements for hydrostatic pressure, liquid infiltration and contact width and pressure.

3.7.2 *Water tightness of pipe joints between a pipe and the base of a maintenance shaft, maintenance chamber or maintenance hole*

When tested in accordance with ISO 13259, Condition D, and configured as shown in Table 3.2, the joints shall not leak during the internal positive pressure tests and the pressure shall remain at least 3 kPa greater than the negative test pressure during the negative pressure test.

3.7.3 *Watertightness of the base to riser connection*

When tested in accordance with ISO 13259, Condition A, and configured as shown in Table 3.2, the joints shall not leak during the internal positive pressure tests and the pressure shall remain at least 3kPa greater than the negative test pressure during the negative pressure test under the following conditions, the joints shall not leak.

TABLE 3.2

WATER TIGHTNESS TEST CONFIGURATIONS

Test Configuration	Pipe to base	Base to riser
Test temperature	23 ± 5°C	23 ± 5°C
Pipe diametral deflection	≥10%	N/A
Joint socket deflection	≥5%	N/A
Joint angular deflection	2 -0, +0.2° for DN ≤315 1.5-0, +0.2° for 315 <DN ≤630 1 -0, +0.2° for DN >630.	N/A
Low postive test pressure	5.0 + 0.5 - 0 kPa	5.0 ± 0.25 - 0 kPa
High positive test pressure	$[(H_{Max} + 10)] \pm 2\ kPa$	$[(H_{Max} + 10)] \pm 2\ kPa$
Negative test pressure	$[(H_{Max} - 10)] \pm 2\ kPa$	$[(H_{Max} - 10)] \pm 2\ kPa$

3.7.4 *Watertightness of riser assembly components between riser and accompanying components*

Maintenance shaft, chamber and hole assemblies, including telescopic riser sections, riser cones and riser inlet pipe connectors, where incorporated into the assemblies, shall sustain watertightness testing for 15 +5, −0 minutes by the application of a test pressure of $[(H_{Max} + 10)] \pm 2\ kPa$ without leakage.

3.7.5 *Elastomeric joint seal effectiveness*

This requirement applies to all elastomeric seal joints between shaft and chamber components (e.g. base to riser body and base to inlet connectors).

When determined in accordance with AS/NZS 1462.13, elastomeric seals manufactured to:

(a) AS 1646 and AS 681.1 shall have a contact pressure $\geq$ 0.4 MPa over a continuous width of ≥4 mm.

(b) AS 1646 and AS 681.2 shall have a contact pressure $\geq$ 0.47 MPa over a continuous width of ≥4 mm.

3.8 INTEGRITY OF THE LID AND SEAL

3.8.1 *General*

The lid assembly used to close the top of the riser shall comply with liquid infiltration requirements. The lid assembly shall be prepared for testing in the same configuration as proposed for field installation.

3.8.2 *Liquid infiltration test*

When tested in accordance with AS/NZS 1462.8, but without angular deflection or diametric distortion, the lid assembly shall not leak, when subjected to an internal vacuum corresponding to a gauge pressure of −50 to −55 kPa for 60 +5, −0 min.

3.9 CHARACTERISATION OF ROTATIONALLY MOULDED PRODUCT SUBMITTED FOR PERFORMANCE TESTING

The initial product weight of rotationally moulded products, prior to any machining and/or installation of fittings, submitted for performance testing according to this Standard shall be determined before the testing is performed. The individual item weight of subsequent production shall be maintained to within the limits shown in Table 3.3.

TABLE 3.3

CHARACTERISATION OF ROTATIONALLY MOULDED PRODUCTS

Initial product weight kg	Subsequent production %
< 10	> 96
≥ 10 ≤ 50	> 97
> 50	> 98

3.10 RISER AND RISER JOINT LOAD RESISTANCE

3.10.1 *General*

Riser and riser joint(s) shall be designed to withstand typical mechanical impact and frictional down-drag forces generated by embedment surround and backfill installation procedures and by subsequent post-installation movement by demonstrating the stability of joint seal integrity and disposition.

A design shall be considered adequate for this purpose where it incorporates a telescopic riser or an elastomeric seal jointed system that demonstrates acceptable joint movement tolerances (e.g. > 30 mm) and resistance to movement.

Alternatively, joint design shall be verified by type testing in accordance with Clause 3.10.2.

3.10.2 *Type testing*

When loaded in accordance with Appendix D, then subjected to an internal vacuum, an assembled maintenance shaft, maintenance chamber or maintenance hole shall not display any sign of buckling and no joints shall display any evidence of leaking.

Changes in external dimensions shall not exceed the following:

(a) 4% when measured through and at right angles to the centroid of the shaft, chamber or maintenance hole and the riser.

(b) ±5 mm from a straight line or a flat plane along the invert of the shaft, chamber or maintenance hole.

3.11 NEAR SURFACE COMPONENTS

3.11.1 *General*

Upper assembly components of maintenance shafts, maintenance chambers and maintenance holes shall be designed to withstand surface and traffic loading.

Note Upper assessbly components may include riser shaft, cone and telescopic joints

3.11.2 *Load bearing resistance*

When subjected to load test in accordance with ISO 13266 the upper assembly components should not exhibit any cracks, collapse or other similar form of structural failure likely to impair performance.

The classification of application shall be in accordance with AS 3996 and WSA 132.

Note The maximum load is not to be confused with the test loads in AS 3996 and WSA 132.

3.12 MAINTENANCE HOLE STEPS

3.12.1 *Load bearing resistance*

When tested in accordance with EN 13101 with a vertical load of 2 kN the deformation of steps under load shall be ≤ 10 mm and the residual deformation shall be ≤ 5 mm.

3.12.2 *Pull-out resistance*

When tested in accordance with EN 13101 with a horizontal force of 1 kN there shall be no pull-out of the steps.

Applicable only to maintenance holes with steps.

4 MANUFACTURE

4.1 DIMENSIONS OF THE BASE AND RISER

The wall thickness of the base, measured in accordance with AS/NZS 1462.1, shall not be less than the benchmark design wall thickness nor less than the wall thickness specified in the relevant product standard, as appropriate.

4.2 WELDING

4.2.1 *PVC*

Where hot-air (rod) welding is performed, all welds shall be partial penetration welds to at least 75% of the wall thickness of the sections being welded. All welding procedures shall be pre-qualified.

4.2.2 *PE and PP*

Where welding is required for fabrication of components butt welding, extrusion welding or electrofusion welding may be used. All welding procedures shall be pre-qualified.

4.2.3 *Training and certification*

Only duly certified welders shall perform welding of components. The welding of components shall be carried out and supervised by qualified accredited personnel who have successfully undertaken an acceptable (e.g. internationally recognised) plastics welding course or who has undertaken the following Units of PMB07 – Competence of Plastics, Rubber and/or Cable making training package appropriate to the welding processes used:

(a) PMBPROD287B—Weld plastics materials.

(b) PMBWELD301B—Butt weld polyethylene plastic pipelines.

(c) PMBWELD302B—Electrofusion weld polyethylene pipelines.

(d) PMBWELD309B—Weld plastics using extrusion techniques.

‘Successfully undertaken’ shall mean an award of a ‘Statement of Attainment’ for all the relevant units of competence.

4.3 SOLVENT CEMENT JOINTING

Where solvent cement jointing of a PVC-U pipe or fitting component is required, it shall be performed in accordance with the procedures outlined in AS/NZS 2032. The gap filling cement nominated by the fittings supplier shall be used when jointing PVC-U pipe fittings with parallel sockets.

4.4 MAINTENANCE HOLE STEPS AND LADDERS

Steps or ladders forming part of the maintenance hole construction shall comply with either EN 13101 or EN 14396 as appropriate.

When fitted, steps shall have a minimum projection of 120 mm from the face of the riser shaft. Double steps shall be placed vertically above each other within the range 250 mm to 350 mm. Single steps shall be fixed alternatively with a tolerance of ± 10 mm at the step centres in the vertical plane and offset within the range of 270 mm to 300 mm. The offset is measured where the centreline of the steps intersects with the chamber wall.

NOTE: Curvature of the shaft should be taken into account when specifying minimum wall clearance for step irons.

5 MARKING REQUIREMENTS

5.1 GENERAL

Maintenance shafts, maintenance chambers, maintenance holes and components shall be legibly and permanently marked with the following:

(a) Manufacturer's name or registered trademark.

(b) Date of manufacture identified by at least the month and year.

(c) Material identification in the form 'PVC-U' (or 'PVC'), 'PE', 'PP' or 'PP-MD' as appropriate.

(d) Nominal size in the form 'DN 100' or '100' for connections and 'DN 300' or '300' for risers.

(e) Configuration if the base includes a junction or change in direction.

(f) Identification of the place of manufacture if the manufacturer is producing the product in more than one location either nationally or internationally. The manufacturer's code is acceptable, e.g. 'P1'.

(g) Maximum installation depth in the form H_{Max}

(h) The number of this Industry Standard.

Risers shall be marked in accordance with the appropriate product Standard listed in Table 2.1, or as for maintenance shafts, maintenance chambers and maintenance hole above.

Marking shall not be by means of sharp instruments that could potentially initiate cracks or other types of defects and hence adversely affect the performance of the maintenance shaft, maintenance chamber or maintenance hole.

Marking by indentation shall ensure that wall thickness is never reduced by more than 0.25 mm.

The size of the marking shall be such as to be clearly visible without magnification aids.

NOTE: Manufacturers making a statement of compliance with this Standard on a product, packaging, or promotional material related to that product should ensure that such compliance is capable of being verified.

5.2 ADDITIONAL INFORMATION

The manufacturer shall nominate configuration and installation parameters on which product design was based including:

(a) Worst case permissible soil classification/grading and compactive density.

(b) Highest permissible vehicular traffic loading impacts (e.g. Class D or 240 kN ultimate loading as defined in AS 3996).

(c) Specified cover solution.

(d) Size and material specifications for the pipes to which the shaft/chamber is intended to be connected.

(e) Drawing of typical shaft/chamber product assemblies - including near-surface – components with all primary dimensions nominated.

APPENDIX A

MEANS OF DEMONSTRATING COMPLIANCE WITH THIS STANDARD

(Normative)

A1 SCOPE

This Appendix sets out two means by which compliance with this Standard shall be demonstrated by a manufacturer, as follows:

(a) The use of a product certification scheme

(b) The use of a minimum sampling and testing frequency plan.

A2 RELEVANCE

The long-term performance of pipeline systems is critical to the operating efficiency of water agencies in terms of operating licences and customer contracts. The long-term performance of plumbing systems is similarly critical to the durability of building infrastructure, protection of public health and safety and protection of the environment.

A3 BATCH

A3.1 Acceptable quality level (AQL)

When a continuous series of lots or batches is considered, the quality level which for the purpose of sampling inspection is the limit of a satisfactory process average (see AS 1199.1 and ISO 3951 Parts 1, 2, 3 and 5).

NOTE: The designation of an AQL does not imply that a manufacturer has the right to knowingly supply any non-conforming unit of product.

A3.2 Batch

A3.2.1 Material or compound batch

A defined quantity of a homogeneous material or compound produced under uniform conditions. The batch is defined and identified by the material or compound producer.

A3.2.2 Pipes or fittings batch

Schedule of pipes or fittings, all the same nominal diameter, wall thickness and marking, manufactured from the same material or compound on the same machine. The batch is defined and identified by the pipe or fitting manufacturer.

A3.3 Batch release test

A test performed on a sample from the batch or lot to confirm conformance to the requirements of this Standard before the batch can be released.

A3.4 Inspection level

The relationship between the lot or batch size and the sample size (see AS 1199.1).

A3.5 Lot

A clearly identifiable subdivision of a batch for inspection purposes.

A3.6 New formulation

A change in material or compound formulation that exceeds the limits given in Clause A6.

A3.7 Process verification test (PVT)

A test performed on a sample at specific intervals to confirm conformance to the requirements of this Standard before further batches can be released.

A3.8 Sample

One or more units of product drawn from a batch or lot, selected at random without regard to quality.

NOTE: The number of units of product in the sample is the sample size.

A3.9 Sampling plan

A specific plan that gives the number of samples and the frequency of inspection or testing.

A3.10 Type test (TT)

A test performed on a sample to confirm conformance to the requirements of this Standard before any batches can be released.

A4 PRODUCT CERTIFICATION

A4.1 Products claiming conformity with this Standard shall be certified.

NOTE Product certification is an impartial third-party attestation that the products conform to this Standard.

A4.2 The certification scheme to undertake the production certification shall:

(a) be based on ISO/IEC TR 17026, Conformity assessment -- Example of a certification scheme for tangible products;

(b) include type testing from independently sampled production;

(c) require the manufacturer's production process to be covered by a quality management system that fulfils the requirements of AS/NZS ISO 9001, Quality management systems - Requirements; and

(d) include subsequent verification of conformance that the manufacturer maintains effective production control, at no greater than 12 monthly interval.

NOTE: The certification scheme serves to indicate that the products consistently conform to the requirements of this Standard.

The frequency of the sampling and testing plan, as detailed in Clause A5, shall be used by the certifying body for product compliance auditing. However, where the manufacturer can demonstrate adequate process control to the certifying body, the frequency of sampling and testing nominated in the manufacturer's quality and/or documented procedures shall take precedence for the purpose of product certification.

Product certification shall be conducted by a certification body that is accredited as fulfilling the requirements for AS/NZS ISO/IEC 17065, Conformity assessment - Requirements for bodies certifying products, processes and services, by a signatory member of the International Accreditation Forum (IAF) Multilateral Arrangement (MLA), with a relevant scope of accreditation to cover the products being certified.

NOTE In Australia, the signatory member of the IAF MLA is the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

A5 MINIMUM SAMPLING AND TESTING FREQUENCY PLAN

A5.1 General

Table A1 sets out the minimum sampling and testing frequency plan for a manufacturer to demonstrate compliance of product(s) to this Standard.

A5.2 Retesting

In the event of a test failure, the products manufactured since the previous test(s) conforming to the requirements outlined in Table A1 shall be quarantined as a batch. A further set of samples shall be selected randomly from the quarantined batch using a sampling plan to AS 1199.1 for an AQL of 2.5 and an inspection level of S3, unless otherwise specified. If the

retest requirements are met, the batch may be released and compliance with this Standard for the quarantined batch may be claimed. Should a failure occur on retesting, then the quarantined batch shall be rejected and claims and/or marking indicating compliance to this Standard shall be suspended until the cause of the failure has been identified and corrected.

A5.3 Rejection after test

In the event of a quarantined batch being rejected after retesting in accordance with the procedures set out in Clause A5.2, it may be subjected to 100% testing for the failed requirement(s), and only those items found to comply may be claimed and/or marked as complying with this Standard.

TABLE A1

MINIMUM SAMPLING AND TESTING FREQUENCY PLAN

Type tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Material requirements				
Materials General	2.2.1	No lead, cadmium or mercury based additives	Process control records	At any change in material formulation, design or process
Materials for bases	2.2.2	Material compliance of standard materials Material compliance of non-standard materials Durability of standard and non-standard materials: no cracks after 1000 h or 3000 h as appropriate	Confirm third party certification for any materials or components for which compliance with Table 2.1 is claimed Compliance with Clause B5 of Appendix B ISO 13267 and Appendix B	
Materials for risers, cones and caps	2.2.3	Material compliance of standard materials Material compliance of non-standard materials	Confirm compliance with Clause 2.2 or third party certification for any risers for which compliance with AS/NZS 1477, AS/NZS 4441 or AS/NZS 4765 is claimed Compliance with Appendix B Clause B5	
Rework	2.2.4	Confirmation that only rework from manufacturer's own production is used.	Process control records	

Type tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Elastomeric seals	2.2.5	Compliance with AS 1646 and AS 681.1 or AS 681.2	Product certification to AS 1646 and AS 681.1 or AS 681.2	
Solvent cements	2.2.6	Compliance with AS/NZS 3879	Product certification to AS/NZS 3879	
Material requirements				
Freedom from defects	2.3	Structural and surface defects, condition of sockets and spigot ends, smoothness of internal joints, condition of elastomeric seals.	Visual examination	At any change in material formulation, design or process
Dimensions of sockets and spigots and effective sealing length	2.4	Compliance with appropriate product Standard, drawing or specification	AS/NZS 1462.1	At any change in material formulation, design or process
Packaging, storage, handling and transportation	2.5	Specific requirements for storage depending on material properties Stacking to maintain dimensions and protects ends and projections	Review of manufacturer's instructions and visual verification of storage conditions	
Performance requirements				
Structural integrity of base	3.2	50 year predicted vertical deflections ≤5% and horizontal deflections ≤10%	Appendix C and ISO 13267	At any change in material formulation, design or process
Impact resistance of base	3.3	No cracks or other damage that impairs the function of the base	Appendix E	
Ring stiffness of riser	3.4	Ring stiffness ≥4,000 N/m/m	AS/NZS 1462.22	
High temperature stress relief	3.5	No voids, contaminations or delaminations etc. as described in Clause 3.5	AS/NZS 1462.11	
Accessibility test	3.6	Passes appropriate proving tool(s) through all connection ports	3.6	
Elastomeric seal joints between pipe and base	3.7.2	No leakage	ISO 13259 Condition D	
Elastomeric seal joints between the riser and base	3.7.3	No leakage	ISO 13259 Condition A	

Type tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Performance requirements				
Watertightness between the riser and accompanying components	3.7.4	No leakage	No leakage after 15 min when assembly filled with water.	At any change in material formulation, design or process
Watertightness of telescopic section of riser	3.7.4	No leakage	No leakage after 15 min when assembly filled with water	
Watertightness of cone section	3.7.4	No leakage	No leakage after 15 min when assembly filled with water	
Watertightness of Riser inlet connector	3.7.4	No Leakage	No leakage after 15 min when assembly filled with water	
Effective seal	3.7.5	Contact pressure ≥0.4 MPa for vulcanised seals and 0.47 MPa for thermoplastic elastomeric seals over a contact width >4 mm	AS/NZS 1462.13	
Integrity of lid and seal – liquid infiltration test	3.8.2	No leakage	AS/NZS 1462.8	At any change in material formulation, design or process
Characterisation of rotationally moulded product.	3.9	Weight variation In accordance with Table 3.3	Weighing machine with a precision of at least 0.5% of the product weight	
Riser and riser joint load resistance	3.10	Withstand frictional down-drag forces of surrounding soil	By design or testing in accordance with Appendix D	
Load bearing capacity of cone and near surface components	3.11.2	No visable cracking, collapse, or other similar form of structural failure.	ISO 13266	
Maintenance hole steps – load bearing resistance	3.12.1	Deformation under load ≤ 10 mm. Residual deformation ≤ 5 mm	EN 13101	
Maintenance hole steps – pull-out resistance	3.12.2	No pull-out with an applied horizontal force of 1 kN	EN 13101	
Manufacture				
Dimensions of base and riser	4.1	Not less than the design thickness or thickness of relevant Standard as appropriate	AS/NZS 1462.1	At any change in material formulation, design or process.
Welding	4.2	In accordance with Clause 4.2.3 and Clause 4.2.1 or 4.2.2 as appropriate	Visual verification and process control	

Type tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Solvent cement jointing	4.3	AS/NZS 2032	Visual verification and process control	

Batch release tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Freedom from defects	2.3	Structural and surface defects, condition of sockets and spigot ends, smoothness of internal joints, condition of elastomeric seals.	Visual verification	At start up and once per shift
Dimensions of sockets and spigots and effective sealing length	2.4	Compliance with appropriate product Standard, drawing or specification	AS/NZS 1462.1	Once per shift or once per batch, whichever is the more frequent
Packaging, storage, handling and transportation	2.5	Compliance with appropriate installation Standard, product drawing or specification	Visual examination	Once per shift
Ring stiffness of riser	3.4	Ring stiffness ≥ 4,000 N/m/m	AS/NZS 1462.22	At start up and once per week or once per batch, whichever is the more frequent
High temperature stress relief (PVC-U)	3.5	No voids, contaminations or delaminations etc. as described in Clause 3.5	AS/NZS 1462.11	At start up and once per shift
Weight of rotationally moulded products	3.9	Table 3.3	Weighing machine with a precision of at least 0.5% of the product weight	
Dimensions of base and riser	4.1	Wall thickness not less than design wall thickness or relevant product Standard as appropriate	AS/NZS 1462.1	At start up and once per shift
Welding	4.2	Welding to be in accordance with nominated specification	Visual verification	
Solvent cement jointing	4.3	Evidence of application of primer and absence of excess cement and joint made in accordance with AS/NZS 2032	Visual verification	

Batch release tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Marking	5	Complete, legible and permanent	Visual examination and comparison with production records	Each assembly Injection mouldings once per shift

Process verification tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Materials General	2.2.	Material compliance	Confirm third party certification for any materials or components for which compliance with Table 2.1 is claimed	Once per 2 years
Durability of standard and non-standard materials for bases	2.2.2.1 and 2.2.2.2	No cracks	Appendix B and ISO 13267	Once per year
Characterisation of non-standard materials for risers, cones and caps	2.2.3.2	Table B2	Appendix B Clause B5	
Rework	2.2.4	Confirmation only rework from manufacturer's own production is used	Process control records	
Elastomeric seals	2.2.5	Compliance with AS1646	Product certification to AS 1646	Once per 2 years
Solvent cements	2.2.6	Compliance with AS/NZS 3879	Product certification to AS/NZS 3879	
Impact resistance of maintenance base	3.3	No cracks or other damage that impairs the function of the base	Appendix E	
Elastomeric seal joints between pipe and base	3.7.2	No leakage	ISO 13259 Condition D	
Elastomeric seal joints between the riser and base	3.7.3	No leakage	ISO 13259 Condition A	Once per 2 years
Water tightness between the riser and accompanying components	3.7.4	No leakage	No leakage after 15 minutes when assembly filled with water	
Water tightness of telescopic section of riser	3.7.4	No leakage	No leakage after 15 minutes when assembly filled with water	
Water tightness of cone section	3.7.4	No leakage	No leakage after 15 minutes when assembly filled with water	
Watertightness of Riser inlet connector	3.7.4	No Leakage	No leakage after 15 min when assembly filled with water	

Process verification tests				
Characteristics	**Clause**	**Requirement**	**Test method**	**Frequency**
Integrity of lid and seal – liquid infiltration test	3.8	No leakage	AS/NZS 1462.8	
Riser and riser joint load resistance	3.10	Withstand frictional down-drag forces of surrounding soil	By design or testing in accordance with Appendix D	
Load bearing capacity of cone and near surface components	3.11.2	No visable cracking, collapse, or other similar form of structural failure.	ISO 13266	Once per 5 years
Maintenance hole steps – load bearing resistance	3.12.1	Deformation under load ≤ 10 mm. Residual deformation ≤ 5 mm	EN 13101	Once per 2 years
Maintenance hole steps – pull-out resistance	3.21.2	No pull-out with an applied horizontal force of 1 kN	EN 13101	

A6 NEW FORMULATION

A change in the material / compound formulation occurs when the dosage level of ingredients exceeds the tolerances in Clauses A6.1, A6.2 or A6.3 as appropriate.

A6.1 Material specification of PVC-U

For the purposes of this Standard, the material specification consists of a formulation which defines the K value of the PVC, the nature of the additives and their dosage levels. The dosage level of ingredients of a PVC formulation shall not exceed the tolerance bands given in Table A2.

If any level exceeds the dosage band or if an ingredient type is changed, this variation in formulation constitutes a change in material.

Rework material from the manufacturer’s own production that involves like materials shall be permissible.

The values of the parts X added to 100 parts by mass of PVC shall be specified in the manufacturer’s production quality plan.

TABLE A2

FORMULATION SPECIFICATION FOR PVC

Ingredients	Type	Band
PVC resin	Nominal K value: as specified	± 3 units
Type and content of stabiliser or master batch	1) Ça-Zn 2) Sn 3) Ca-Sn 4) others	X1: ± 25%
Lubricants	All	X2: ± 50% for X2 <0.2 X2: ± 0.1 parts for X2 >0.2
Fillers	1) $CaCO_3$ 2) others	X3: ± 3 parts X4: ± 25%
Impact modifiers	All	X5: ± I part
Flow agents/ processing aids	All	X6: ± 25% for X6 ≤2 X6: ± 0.5 parts for X6 >2
Pigments		No requirement
Others	To be specified by the manufacturer	X7: ± 25%

NOTE : X is the original determined value, specified in the manufacturer's production quality plan.

A6.2 Material specification for PP and PP-MD

For the purposes of this Standard, a PP or PP-MD material consists of a compound having a recognised trade name and additives with known dosage levels.

Rework material from the manufacturer's own production that involves like materials shall be permissible.

A change of commercial compounds utilised in the manufacture of maintenance shaft/chamber/hole components shall require re-certification of the production components affected.

A6.3 Material specification for PE

For the purposes of this Standard, a PE material consists of a compound having a recognised PE trade name and additives with known dosage levels.

Rework material from the manufacturer's own production that involves like materials shall be permissible.

APPENDIX B

DURABILITY AND MATERIAL TESTING

(Normative)

B1 SCOPE

This appendix sets out the requirements for determining the durability of standard and non-standard materials and the material characteristics of non-standard materials used in specific maintenance shaft, maintenance chamber and maintenance hole designs.

B2 APPLICATION

This appendix is applicable to maintenance shafts, maintenance chamber and maintenance hole bases manufactured from standard materials and bases, risers, cones and caps manufactured from non-standard materials (refer to Clauses 2.2.2 and 2.2.3).

B3 SAMPLES

Two maintenance shafts, maintenance chambers or maintenance holes shall be selected for testing. The base of one shaft/chamber shall be subjected to the durability test and the components of the other used to determine the material properties.

B4 TEST PROCEDURE

The durability of maintenance shaft, maintenance chamber or maintenance hole bases shall be determined in accordance with ISO 13267 and the test parameters and rating factors given in Table B1. At the duration of the test the base shall be cooled to room temperature, inspected and deemed conforming where no cracking is evident.

TABLE B1

TEST PARAMETERS

Material	Test temperature °C	Rating Factor R (applicable to standard and non-standard materials)
PVC-U	60 ± 2	3.5
PE	80 ± 2	4.1
PE rotational moulded	80 ± 2	3.6
PP	80 ± 2	3.4
PP rotational moulded	80 ± 2	3.6

B5 NON-STANDARD MATERIAL CHARACTERISTICS

Material taken from the other (second) maintenance shaft, maintenance chamber or maintenance hole sample shall be tested for the appropriate characteristics in Table B2. Where a mixture of non-standard materials is used for bases, risers, cones and caps, each non-standard material shall be separately tested for conformity.

TABLE B2

MATERIAL CHARACTERISTICS

Characteristics	Test method	Requirement	Rotational moulded		Injection moulded		
			PE	PP	PE	PP[2]	PVC-U
Density[1]	ISO 1183-1 or ISO 1183-2	Maximum deviation from agreed value (kg/m^3)	±25	±25	±25	±25	±25
Oxidation induction time (OIT) at 200°C	ISO 11357-6	(minutes)	≥10	≥8	≥10	≥8	NA
K value[3]	ISO 13229		NA	NA	NA	NA	±3
MFR[4]	ISO 1133[5]	Maximum upper deviation from agreed value	*X*[6] >1.5: +20% *X* ≤1.5 +0.3 g/10min				NA

'NA' denotes 'Not applicable'.

NOTES

1 Not required for PE complying with AS/NZS 4131, PVC-U complying with AS/NZS 1260 or low pressure moulding materials.

2 For low pressure injection moulded PP components, (melt pressure less than 14000 kPa) the maximum upper deviation can be 100% for MFR <2.0.

3 Not required for PVC-U complying with AS/NZS 1260.

4 No lower limit is placed on the deviation of the MFR.

5 For moulded or fabricated PE use condition T, for rotational moulded PE use condition D and for PP use condition M.

6 *X* is the original determined value.

APPENDIX C

STRUCTURAL INTEGRITY OF BASE

(Normative)

C1 GENERAL

The structural integrity of bases shall be determined as the predicted 50 year deflection at ambient temperatures as described below.

C2 TEST PROCEDURE

The structural integrity of bases shall be determined in accordance with the test procedure given in ISO 13267.

C3 EVALUATION OF DATA

The 50-years deformation can be calculated as described in ISO 13267.

NOTE 1: For the predicted final deformation in the vertical, and the horizontal directions respectively, the final result according to this method of calculation is as follows:

$(\delta/d)\ v = Y50,v/d$ and $(\delta/d)h = Y50,h/d$.

where d is the nominal width of the flow profile.

If the predicted 50 years vertical deformation is higher than 2% or the horizontal deformation is higher than 4%, the correlation coefficient shall at least be 0.9. In all other cases, the correlation coefficient shall be ignored.

NOTE 2: When the deformation in the horizontal direction (width of flow profile) is less than 10%, normal inspection and cleaning equipment can be entered in the sewer system. When the deformation in the vertical direction is less than 5%, effects on flow performance can be neglected.

APPENDIX D

METHOD FOR LOAD TESTING

(Normative)

D1 SCOPE AND GENERAL

D1.1 Scope

This Appendix sets out a method for the load testing of a maintenance shaft, maintenance chamber or maintenance hole to demonstrate its ability to adequately resist riser movement during and after installation. Following application of the test load, the maintenance shaft maintenance chamber or maintenance hole shall be tested for hydrostatic resistance to leakage and structural resistance to buckling by means of an applied negative internal pressure. Riser and riser joint(s) shall be designed to withstand typical mechanical impact and frictional down-drag forces generated by embedment surround and backfill installation procedures and by subsequent post-installation movement by demonstrating the stability of joint seal integrity and disposition.

A design shall be considered adequate for this purpose where it incorporates a telescopic riser or an elastomeric seal jointed system that demonstrates acceptable joint movement tolerances (e.g. > 30 mm) and resistance to movement.

D1.2 Relevance of test

Maintenance shaft, maintenance chamber or maintenance hole risers are required to withstand typical mechanical impact and frictional down-drag forces generated by embedment surround and backfill installation procedures and by subsequent post-installation movement.

D1.3 Preparation of test assemblies

Each test assembly shall comprise a maintenance shaft, maintenance chamber or maintenance hole assembled with a riser and connecting ‘pipe’ stubs at least 300 mm in length.

D2 TEST PROCEDURE - LOAD TESTING

D2.1 Principle

A test assembly is subjected to a load and then a partial internal vacuum.

D2.2 Apparatus

The following apparatus is required:

(a) Testing stand—A structurally rigid stand, to be used as a support for the test assemblies.

(b) Supports—At each end of the maintenance shaft, maintenance chamber or maintenance hole, the centre-line of the collar shall be supported by a cradle of matching radius with an arc subtending an angle of 90°. Each cradle shall have a width of 50 mm and be mounted on a pinned roller support.

(c) Bearing block—A sufficiently rigid bearing block, to ensure that the load on the riser cap is evenly distributed.

(d) Testing device—A device or other means of load application, such as a hydraulic testing machine or pre-weighed elements, such as ingots, sand-filled bags or other suitable means, for applying the load. The device shall be capable of applying a load greater than the specified test load.

D2.3 Procedure

The procedure shall be as follows:

(a) Secure and condition the test assembly at 20–25°C for 2 +0.5, −0 h within the test stand, so that the load may be applied to the riser cap.

(b) Place the bearing block on the riser cap.

(c) Apply a test load of 15 +0.5, −0 kN, without shock, to the assembly through the bearing block.

(d) Sustain the load for a minimum of 5 min.

(e) Measure the change in external dimensions in accordance with AS/NZS 1462.1.

(f) Release and/or remove the test load.

(g) Inspect and record any evidence of damage including any bucking or collapse and for maintenance shafts, maintenance chambers and maintenance holes with reinforcement, any separation between the maintenance shaft or maintenance chamber and its reinforcement, and any delamination, cracking or splitting of the reinforcement.

(h) Within 24 h, continue the vacuum testing in accordance with Clause D3.

D3 TEST PROCEDURE - VACUUM

D3.1 Principle

A test assembly is subjected to an internal vacuum. The assembly is then inspected for distortion.

D3.2 Apparatus

The following apparatus is required:

(a) End connections—Vacuum-tight connections shall be made to the test assembly within the socket, or on the external surface. Provision shall be made for connection to the vacuum system or venting of the pipe of specimen to atmosphere as required. Vacuum shall be applied through one of the end connections.

(b) Pressurising system—A system capable of producing and maintaining the test vacuum pressure.

D3.3 Procedure for vacuum test

The procedure shall be as follows:

(a) Secure and condition the test assembly at 20–25°C for 2 +0.5, −0 h.

(b) Gradually apply an internal vacuum corresponding to a gauge pressure of 80 kPa to 85 kPa for 15 +1, -0 minutes.

(c) At the completion of the test period measure the changes in external dimensions.

(d) At the completion of the test period recording any buckling or collapse and for maintenance shafts, maintenance chambers or maintenance holes with reinforcement any separation between the maintenance shaft or maintenance chamber and its reinforcement, and any delamination, cracking or splitting of the reinforcement.

D4 TEST REPORT

The following information shall be reported:

(a) The unique identification of each maintenance shaft, maintenance chamber or maintenance hole assembly tested.

(b) The test temperature (°C).

(c) The test load applied to the assembly and the duration of the load test.

(d) All changes in external dimensions due to the applied test load.

(e) The vacuum test pressure applied to the assembly and the duration of the vacuum test (kPa).

(f) All evidence of leakage detected during the vacuum test.

(g) All changes in external dimensions due to the applied test vacuum (mm) pressure.

(h) All evidence of structural buckling (or collapse) for each assembly with reinforcement

(i) All evidence of separations between assembly component materials and material reinforcement and all evidence of delamination, cracking or splitting of material reinforcement.

(j) Reference to this test method.

APPENDIX E

IMPACT RESISTANCE OF BASE

(Normative)

E1 TEST EQUIPMENT

The test equipment shall be as given in ISO 3127.

E2 RELEVANCE OF TEST

The impact test is carried out under controlled and reproducible test laboratory conditions to provide a measure of the resistance of a base component to impact damage. The base component is not tested in an ‘as installed’ (or embedded in soil) configuration in order to assure its installed performance, with a serviceability safety factor to cover unknown and unpredictable conditions on various installation sites.

E3 TEST PROCEDURE

The procedure shall be as follows:

(a) Place the complete maintenance shaft, maintenance chamber or maintenance hole base unit on a vee block in such a way that at least a 30 mm gap between base and block is achieved at point of impact.

The test apparatus shall be modified as necessary to accommodate larger bases. The vee block may be eliminated, provided that a 30 mm gap remains between the end of the guiding pipe and point of impact and between the ground and the base unit at the point of impact.

(b) Secure and condition the base at 20–25°C for 2 +0.5, −0 h.

(c) Use a straight pipe with an internal diameter of 100 mm to 106 mm and a length of 2.5 m. Place one end of this pipe in the middle of the main flow profile of the base in a vertical position, perpendicular to the base.

(d) Drop a striker type d90 (see ISO 3127) with mass 1 kg, from 2.5 m.

(e) Inspect the impacted area for any evidence of cracking and other damage that might impair the function and performance of the base.

E4 TEST REPORT

The following information shall be reported:

(a) The unique identification of each maintenance base unit tested.

(b) The test temperature (°C).

(c) The striker mass (kg).

(d) The drop height (m).

(e) The date of test.

(f) All evidence of cracking or other damage that might impair the function and performance of the base.

(g) Reference to this test method.