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Interim Australian/New Zealand Standard™

Polyethylene maintenance shafts



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New Zealand Water & Waste Association
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PREFACE

This Interim Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PL-006 Polyolefin pipe systems.

This Interim Standard has been developed from a water industry standard WSA 102: *Polyethylene maintenance shafts* published by the Water Services Association of Australia.

The objective of this Interim Standard is to provide performance requirements for manufacturers and purchasers of moulded polyethylene maintenance shafts (MSs) for sewerage systems.

In-service performance of a MS is strongly dependent on a supportive embedment. It should be recognized 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 minimize 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.

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 WSA 02, *Sewerage Code of Australia*, Part 3: *Standard Drawings*.

The test criteria specified apply to a maintenance shaft at the time of manufacture, and should not be used to assess the results from tests on MS, that have been in service.

The terms ‘normative’ and ‘informative’ have been used in this Interim Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard. Other notes are for information and guidance only.

Australian and New Zealand Standards generally do not—

- (a) restate the duties of employers, employees, designers and installers;
- (b) determine the applicability of regulatory limitations; and
- (c) determine appropriate health and safety practices.

Standards Australia/New Zealand invites comment on this Interim Standard from persons and organizations concerned with this subject. The date of expiry is two years after publication, at which time this Interim Standard will be confirmed or revised in the light of public comment. The closing date for comment is 18 months after publication at which time the Committee will consider the need for its revision in the light of public comment, with the view to the publication of a Joint Australian/New Zealand Publication before the expiry date.

During the life of this Interim Standard the Committee will monitor all comments as it is received.

Attention is drawn to the fact that this document is an Interim Joint Australian/New Zealand Publication only and should be regarded as a developmental Publication and liable to future alteration.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	5
1.2 LIMITATIONS	5
1.3 REFERENCED DOCUMENTS	5
1.4 DEFINITIONS	7
SECTION 2 GENERAL REQUIREMENTS	
2.1 SCOPE	9
2.2 MATERIAL	9
2.3 THERMAL STABILITY	9
2.4 TENSILE PROPERTIES	9
2.5 SLOW CRACK GROWTH RESISTANCE	9
2.6 MATERIAL DATA SHEETS	9
2.7 WEATHERING RESISTANCE FOR HANDLING AND STORAGE	10
2.8 CARBON BLACK	10
2.9 DISPERSION	10
2.10 FREEDOM FROM DEFECTS	10
2.11 REQUIREMENTS FOR ELASTOMERIC SEALS	11
2.12 ADHESIVE JOINTS	11
2.13 REQUIREMENTS FOR MS RISER SECTIONS	11
2.14 PACKAGING, STORAGE AND TRANSPORTATION	11
SECTION 3 DESIGN	
3.1 GENERAL	12
3.2 ACCESSIBILITY	12
3.3 CHAMBER WALL THICKNESS	12
3.4 STRUCTURAL INTEGRITY OF THE CHAMBER	12
3.5 RISER	13
SECTION 4 MANUFACTURE	
4.1 CONFIGURATIONS	14
4.2 DIMENSIONS AND TOLERANCES	14
4.3 WELDING	14
SECTION 5 PERFORMANCE REQUIREMENTS	
5.1 GENERAL	16
5.2 VACUUM TEST	16
5.3 ACCESSIBILITY	16
5.4 WELDED JOINTS	17
5.5 ELASTOMERIC SEAL JOINTS	17
5.6 VACUUM—BATCH RELEASE TEST (BRT)	18
5.7 THERMAL STABILITY—BATCH RELEASE TEST (BRT)	18
SECTION 6 MARKING REQUIREMENTS	
6.1 MARKING	19
6.2 ADDITIONAL MARKING WITH ADHESIVE LABEL	19

APPENDICES

A	COMPLIANCE WITH THIS STANDARD.....	20
B	REQUIREMENTS FOR STRUCTURAL ANALYSIS.....	25
C	METHOD FOR LOAD TESTING.....	27
D	METHOD FOR DESIGN VERIFICATION BY TYPE TESTING.....	29

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Interim Australian/New Zealand Standard Polyethylene maintenance shafts

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Interim Standard specifies design and manufacture requirements for a polyethylene maintenance shaft (MS) comprising a moulded chamber and riser in one-piece seamless construction, or a moulded chamber jointed to a riser (normally a pipe) manufactured from a compatible material.

MSs are intended for installation in sewerage systems (up to DN 300) for transportation of sewage at atmospheric pressure and average service temperatures up to 25°C. They are intended for buried vertical installation at depths up to 6 m, without buckling collapse and without exceeding long-term diametral distortion and stress limits as specified. Long-term design criteria limits are 50 year extrapolated or predicted values. Provided installation and operating conditions conform to the guidelines in this Standard, life expectancy may exceed 50 years.

The test requirements specified in this Standard may be achieved by alternative test methods if such methods can be shown to provide equal or greater accuracy than those specified herein. In all cases of dispute, the methods specified in this Standard shall be considered the reference test methods.

Methods for demonstrating compliance with this Interim Standard are given in Appendix A.

1.2 LIMITATIONS

This Interim Standard covers MSs intended for use at pressures encountered in a gravity sewerage system. Special design considerations not covered in this Interim Standard should be given to MSs subject to superimposed mechanical forces, such as seismic forces and to average service temperatures in excess of 25°C.

It should be recognized 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 minimize the risk of long-term failure.

In-service performance of a maintenance shaft is strongly dependent on a supportive embedment. The design criteria of AS/NZS 2566.1 provide guidance.

NOTE: Installation should be in accordance with WSA 02, Part 3.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1145	Determination of tensile properties of plastics materials
1199	Sampling procedures for inspection by attributes

AS

- 1646 Elastomeric seals for waterworks purposes
- 1646.1 Part 1: General requirements
- 1646.2 Part 2: Material requirements for pipe joint seals used in water and wastewater applications—Specifies by prescriptive formulation
- 1646.3 Part 3: Material requirements for pipe joint seals used in water and wastewater applications with the exception of natural rubber and polyisoprene compounds
- 1745 Outdoor weathering of plastics in the Australian environment
- 1745.2 Part 2: Guide for design purposes

AS/NZS

- 1260 PVC-U pipes and fittings for drain, waste and vent application
- 1462 Methods of test for plastics pipes and fittings
- 1462.1 Method 1: Method for determining the dimensions of pipes and fittings
- 1462.8 Method 8: Method of test for infiltration
- 1462.10 Method 10: Method for hydrostatic pressure testing of fittings and elastomeric seal joints for non-pressure applications
- 1462.13 Method 13: Method for the determination of elastomeric seal joint contact width and pressure (Interim Standard)
- 1462.22 Method 22: Method for the determination of pipe stiffness
- 1462.25 Method 25: Determination of slow-crack-growth of PE (Polyethylene) resins—Notched, Constant Ligament-Stress (NCLS) test method
- 1462.26 Method 26: Determination of weathering resistance of plastics pipes for external storage
- 1462.27 Method 27: Determination of toluene extract of carbon black
- 1462.28 Method 28: Method for the assessment of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds
- 1477 PVC pipes and fittings for pressure applications
- 2299 Occupational diving operations
- 2299.1 Part 1: Standard operational practice
- 2566 Buried flexible pipelines
- 2566.1 Part 1: Structural design
- 2566.2 Part 2: Installation
- 2566.1 Supp 1 Supplement 1: Structural design—Commentary
- 4130 Polyethylene (PE) pipes for pressure applications
- 4131 Polyethylene (PE) compounds for pressure pipes and fittings
- 4401 High-density polyethylene (PE-HD) pipes and fittings for soil and waste discharge (low and high temperature) systems inside buildings - Specifications
- 4441 Oriented PVC (PVC-O) pipes and fittings for pressure applications
- 4765 Modified PVC (PVC-M) pipes for pressure applications
- 5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
- SA
- HB 18 Guidelines for third-party certification and accreditation
- HB 18.28 Guide 28: General rules for a model third-party certification scheme for products
- (ISO/IEC Guide 28)

ISO

- 1133 Plastics—Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics
- 2859 Sampling procedures for inspection by attributes
- 2859-1 Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
- 3951 Sampling procedures and charts for inspection by variables for percent nonconforming
- 6964 Polyolefin pipes and fittings—Determination of carbon black content by calcination and pyrolysis—Test method and basic specification
- TR 10837 Determination of thermal stability of polyethylene (PE) for use in gas pipes and fittings

ASTM

- D 2990 Test methods for Tensile, Compressive and Flexural Creep and Creep-Rupture of Plastics
- D 3849 Test Method for Carbon-Black—Morphological Characterization of Carbon Black using Electron Microscopy

WSAA

- WSA 02 Sewerage Code of Australia (Part 3: Standard Drawings)

1.4 DEFINITIONS**1.4.1 Maintenance shaft (MS)**

A maintenance shaft consists of a chamber and riser with ends suitable for connection to a sewerage system and sealing of the riser. A MS—

- (a) permits maintenance of sewers by operators working from the surface using commonly used maintenance and inspection equipment;
- (b) permits condition assessment of sewers; and
- (c) does not permit persons to enter the sewer through the riser, which is limited to a maximum internal entry diameter of 300 mm.

1.4.2 Maintenance shaft chamber

A maintenance shaft chamber comprises a chamber floor, walls and soffit. The chamber floor may contain a formed, graded channel for the passage of sewage.

1.4.3 Maintenance shaft riser

A maintenance shaft riser consists of an integral or non-integral circular pipe made out of PVC or other compatible material.

1.4.4 Average service temperature (T_{ms})

The average service temperature (T_{ms}), is the average temperature that a MS will attain during service

where

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

where

$$T_{sew} = 0.5T_{sew - summer} + 0.5T_{sew - winter} \text{ (average sewage temperature assessed over summer and winter months)}$$

$$T_{soil} = 0.5T_{soil - summer} + 0.5T_{soil - winter} \text{ (average soil temperature assessed over summer and winter months)}$$

The average temperature for the sewage and soil in contact with the MS shall be the weighted average of the temperatures, as assessed in accordance with percentage of time spent at each temperature under operational conditions.

NOTE: For practical purposes, this should be taken to be the average temperature of sewage flowing through the MS during the summer and winter months, which should be taken to be equal 6 monthly periods.

1.4.5 Depth

The distance from the finished surface level after the pipeline installation to the invert of the chamber of the MS, in millimetres.

1.4.6 Effective seal

That part of the interface between the elastomeric seal and the spigot and socket, where the contact pressure is greater than 0.4 MPa.

1.4.7 Effective sealing length

1.4.7.1 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.

1.4.7.2 Spigot-mounted seals

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

SECTION 2 GENERAL REQUIREMENTS

2.1 SCOPE

This Section specifies the minimum material requirements applicable to the manufacture of polyethylene MSs, and requirements for freedom from defects, elastomeric seals, riser sections and packaging, storage and transportation.

2.2 MATERIAL

Polyethylene MSs shall be manufactured from polyethylene materials containing antioxidants, UV stabilizers and pigments necessary for manufacture into chambers or risers or both. Colour pigments may be added to natural compounds during processing.

2.2.1 Reprocessable and recyclable polyethylene material

Only rework material of the same composition generated from the manufacturer's own production of product made to this Standard may be used. When rework material is added to a production run, the manufacturer shall treat this run as a new batch.

2.2.2 Heat fusion compatibility

Where heat fusion compatibility is required, MS components shall be made from materials with an MFR complying with the following when evaluated in accordance with ISO 1133, Condition 12:

$$0.2\text{g}/10\text{ min} \leq \text{MFR (190/5)} \leq 1.1\text{g}/10\text{min (Temperature: 190}^{\circ}\text{C; loading mass 5.0kg)}$$

2.3 THERMAL STABILITY

Polyethylene compounds shall contain antioxidants either singly or in combination, such that when determined in accordance with ISO/TR 10837, the oxidation induction time shall be not less than 40 min. at a test temperature of 200°C or a demonstrated equivalent time at a higher temperature.

2.4 TENSILE PROPERTIES

When PE compound is tested in accordance with AS 1145 at a strain of 50 mm/min., the following attributes shall be quantified:

- (a) Ultimate stress.
- (b) Yield stress.
- (c) Secant modulus at 1%.
- (d) Specimen type.

2.5 SLOW CRACK GROWTH RESISTANCE

The average time of failure of 5 specimens, when tested at a constant ligament stress level of 15% yield in accordance with AS/NZS 1462.25, shall be not less than 24 hours.

2.6 MATERIAL DATA SHEETS

A material data sheet shall be available for each compound and shall include the following:

- (a) Raw material name and Standard or Code.
- (b) Relevant short- and long-term physical properties.
- (c) Poisson's ratio.

Material test data shall be derived from independently verifiable testing conducted in accordance with published Standards, e.g., ASTM D 2990.

Where data is required for structural analysis, it shall be determined in accordance with Appendix B.

2.7 WEATHERING RESISTANCE FOR HANDLING AND STORAGE

The weathering resistance test shall apply to all compounds other than black PE compounds. The weathering resistance, including resistance to ultraviolet radiation, of PE compounds determined in accordance with AS/NZS 1462.26, on samples exposed to at least 3.5 GJ/m² total global radiation shall be such that—

- (a) the thermal stability has been established as above; and
- (b) the mean elongation at break is $\geq 350\%$, which shall not change by more than 50% of the value of the unexposed material.

NOTE: The intent of the weathering test is to provide assurance of resistance to weathering encountered during storage and transport of the MS and its component pipe. The test does not provide similar assurance for installations exposed to the elements long term. Reference should be made to AS 1745.2 for typical incident energy at various sites around Australia.

2.8 CARBON BLACK

When determined in accordance with ISO 6964, black polyethylene compounds shall contain $2.25 \pm 0.25\%$ by mass of carbon black.

When determined in accordance with ASTM D 3849 or equivalent, the average particle size of carbon black shall be in the range of 10 to 40 nm

When determined in accordance with AS/NZS 1462.27, the toluene extract of carbon black shall be not greater than 0.1%.

2.9 DISPERSION

Antioxidants, ultraviolet light stabilizers and pigments including carbon black shall be evenly dispersed in the compounds.

When compounds containing carbon black or other pigments are tested in accordance with AS/NZS 1462.28, the rating of appearance shall not be worse than Micrograph B in 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). In addition, individual maximum sizes shall not exceed 100 μm , corresponding to Grade 5 of AS/NZS 1462.28.

NOTE: Because the dispersion of antioxidants and ultraviolet light stabilizers is difficult to assess, it is assumed that if the pigment is evenly dispersed, the other components will also be evenly dispersed.

2.10 FREEDOM FROM DEFECTS

NOTE: The defects described in Clauses 2.10.1, 2.10.2 and 2.10.3 cannot be completely quantified. Where the presence, size or frequency of any of these are considered to be of concern, arrangements should be made between the purchaser/approving authority/certifying body (as appropriate), and the manufacturer. This may be achieved by the provision of acceptable type samples.