



**WATER SERVICES**  
ASSOCIATION OF AUSTRALIA

# **INDUSTRY STANDARD**

**FOR CURED-IN-PLACE PIPES (CIPP) USED  
FOR THE RENOVATION OF DRINKING  
WATER PIPES**

WSA 150-2021

First Edition

Version 1.0

2021

## ACKNOWLEDGEMENTS

---

The Australian Government, through the Cooperative Research Centre, provided funding for the Smart Linings for Pipe and Infrastructure Project that produced this Water Industry Standard. The CRC Program supports industry-led collaborations between industry, researchers and the community.



Australian Government  
Department of Industry,  
Innovation and Science

**Business**  
Cooperative Research  
Centres Program

The WSAA Board would like to express its appreciation to the project participants, all of whom contributed expertise, labour, funding, products or trial sites to assist in the delivery of this Water Industry Standard. In particular the following organisations deserve a special mention for their productive work and commitment to the development of this Water Industry Standard:

Abergeldie	Insituform	The Australasian Society for Trenchless Technology
Alan Whittle	Interflow	The University of Sydney
Bisley	Melbourne Water	The University of Technology Sydney
Calucem	Metrocorp	The Water Research Foundation
Central Highlands Water	Monash University	UKWIR
City West Water	Nuflow	Unity Water
Coliban Water	Parchem	Urban Utilities
Downer Group	SA Water	Ventia
GeoTree	Sanexen	Water Corporation
Hunter Water	South East Water	Wilsons Pipe Solutions
Icon Water	Sydney Water	Yarra Valley Water

### About WSAA

The Water Services Association of Australia (WSAA) is the peak industry body representing the urban water industry. Our members provide water and sewerage services to over 24 million customers in Australia and New Zealand and many of Australia's largest industrial and commercial enterprises.

### ACKNOWLEDGEMENT OF COUNTRY

The Water Services Association of Australia acknowledges and pays respect to the past, present and future Traditional Custodians and Elders of this nation. We recognise their continuing connection to land and waters and thank them for protecting our waterways and environment since time immemorial.

ISBN 978-0-6489242-8-9

### Disclaimer

This water industry standard is issued by the Water Services Association of Australia Ltd and individual contributors are not responsible for the results of any action taken on the basis of information in this water industry standard, nor any errors or omissions. While every effort has been made to ensure the accuracy of that information, the Water Services Association of Australia (WSAA) does not make any claim, express or implied, regarding it.

**Copyright**

© Water Services Association of Australia Ltd, 2021

**ALL RIGHTS RESERVED**

This document is copyrighted. Apart from any use as permitted under the Copyright Act 1968, no part of this document may be reproduced or transmitted in any form or by any means, electronically or mechanical, for any purpose, without the express written permission of the Water Services Association of Australia Ltd.

For more information please contact [info@wsaa.asn.au](mailto:info@wsaa.asn.au)

Extract

## **PREFACE**

This Standard was prepared by the Water Services Association of Australia (WSAA).

The objective of this Standard is to provide performance requirements for cured-in-place pipe (CIPP) intended for the renovation of pipeline systems used for the supply of drinking water.

**NOTE:** Products complying with this Standard may also be suitable for the renovation of water pipes used for other applications such as recycled water, fire services and irrigation.

Selection, design, installation and commissioning requirements are covered by WSAA Manual for selection and application of cured-in-place pipe (CIPP) and spray liners for use in water pipe.

EXTRACT

## CONTENTS

FOREWORD.....	7
1. SCOPE AND GENERAL .....	8
1.1 SCOPE .....	8
1.2 CONFORMITY REQUIREMENTS .....	8
1.3 LIMITATIONS.....	8
1.4 NORMATIVE REFERENCES .....	9
1.5 TERMS AND DEFINITIONS .....	12
1.6. SYMBOLS AND ABBREVIATED TERMS .....	14
2. MATERIAL REQUIREMENTS “M” STAGE .....	15
2.1. RESIN SPECIFICATION .....	15
2.2. CARRIER MATERIAL AND REINFORING LAYERS .....	16
2.3. CIRCUMFERENCE OF THE LINING TUBE.....	16
2.4. STORAGE AND TRANSPORT .....	17
2.5. MARKING.....	17
2.6. FITTINGS AT THE “M” STAGE .....	17
3. MATERIAL REQUIREMENTS “I” STAGE .....	18
3.1. MATERIALS SPECIFICATION – LINER (I = INSTALLED AND CURED).....	18
3.2. EFFECT ON DRINKING WATER .....	19
3.3. SURFACE IRREGULARITIES .....	19
3.4. SPANNING OF EXISTING HOLES AND GAPS .....	19
3.5. ACCEPTABLE BEND RADIUS .....	19
3.6. OTHER MATERIALS .....	19
4. MECHANICAL PROPERTIES .....	20
4.1. GENERAL.....	20
4.2. TENSILE PROPERTIES .....	20
4.3. FLEXUAL PROPERTIES .....	21
4.4. BURST PRESSURE .....	21
4.5. ADHESION.....	22
4.6. VACUUM.....	22
4.7. THERMAL EXPANSION/CONTRACTION .....	23
4.8. TENSILE RUPTURE STRENGTH.....	23
4.9. TENSILE CREEP MODULUS.....	24
4.10. FLEXURAL CREEP MODULUS.....	25
4.11. FATIGUE STRENGTH .....	25
4.12. TESTING AND CONDITIONING TEMPERATURES.....	26

4.13.	TEST REQUIREMENTS .....	26
5.	SAMPLING .....	27
6.	ADDITIONAL CHARACTERISTICS .....	27
6.1.	RECONNECTION TO THE EXISTING NETWORK.....	27
6.2.	RECONNECTION OF EXISTING SERVICES.....	28
6.3.	CONNECTION OF NEW SERVICES .....	28
6.4.	CONNECTION OF NEW OFFTAKES.....	28
6.5.	REPAIR OF RENOVATED PIPELINE .....	28
6.6.	OTHER.....	28
7.	PRODUCT DOCUMENTATION .....	28
7.1.	GENERAL.....	28
7.2.	PRODUCT DATA.....	29
7.3.	INSTALLATION INSTRUCTIONS.....	29
	APPENDIX A - MEANS FOR DEMONSTRATING CONFORMITY WITH THIS STANDARD .....	31
	APPENDIX B - STRUCTURAL CLASSIFICATION OF LINERS.....	35
	APPENDIX C - DESIGN METHODOLOGY FOR A CIPP LINER .....	36

## FOREWORD

This Standard addresses the performance requirements of Cured-in-place pipe (CIPP) materials and finished products used in the renovation of drinking water pipelines. It is intended to provide manufacturers and specifiers with a means of demonstrating fitness for purpose.

This Standard differs from those applicable to conventionally installed piping systems in that it is required to verify certain characteristics of the components as manufactured as well as in the installed condition. In accordance with ISO terminology these have been identified as the “M” stage for the collective materials used to fabricate the liner and the “I” stage for the liner as installed.

ISO terminology has also been adopted for describing the structural classification with Class A being fully structural, Classes B and C being semi-structural and Class D providing an internal barrier layer (refer to appendix B for class requirements).

The service life of products conforming to this Standard will be dependent upon the condition of the host pipe, the quality of the liner material and its application and the service conditions. The material and process selection should therefore be in accordance with the requirements of the asset owner with respect to extending the service life of the host pipeline.

Neither the type of polymer used nor the reinforcement is specified in the Standard. All materials used are required to meet the performance requirements of this Standard including effect on drinking water.

As part of its product appraisal process, WSAA may request details of previous successful installations or require contractors to undertake trial installations. In addition to the test records described in this Water Industry Standard, WSAA may ask suppliers to include:

- The host pipe diameter and length, material and service conditions;
- The water off time (time from water off to supply restoration);
- Disinfection regime;
- Contractor details and date of installation;
- Results of pressure or leak tests;
- Where relevant, details of any subsequent rectification work applied to the renovation; and
- All quality control testing undertaken including CCTV examination of the lined pipe, joints and liner ends.

## **1. SCOPE AND GENERAL**

### **1.1 SCOPE**

This Standard specifies the performance requirements and test methods for products used in the renovation of pipelines conveying drinking water, by cured-in-place pipes (CIPP). It is applicable to the CIPP lining of host pipes including but not limited to asbestos cement, cement mortar lined metallic pipes, metallic pipes and reinforced concrete.

The Standard is applicable to fully structural, Class A, and semi-structural, Class B and Class C, liners as defined in Appendix B. Note the Class D classification is provided for information only. It is not covered by this Standard.

It is applicable to lining systems typically comprising of a fibrous carrier impregnated with a thermosetting resin and intended to be installed in accordance with the WSAA Manual for selection and application of cured-in-place (CIPP) and spray liners for use in water pipe.

The pipe liner, in the form of a resin-impregnated tube may be pulled directly into the host pipe or inverted as it is inserted. Water pressure, swabs, steam or air may be used to inflate the tube so it expands tightly against the host pipeline before being cured in place.

Curing may be carried out by the application of heat, UV radiation, visible light, or at ambient temperature.

The diameter range for which a CIPP product can be used shall be established as part of the product appraisal process.

The service temperature range for which a CIPP product can be used shall be established as part of the product appraisal process.

#### **NOTES:**

- (i) No minimum pressure rating is specified for CIPP products as the appropriate pressure rating will be stipulated by the Water Agency on a case-by-case basis.
- (ii) This Standard does not set requirements for abrasion resistance or impact resistance.

### **1.2 CONFORMITY REQUIREMENTS**

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

Product certification, when required, shall be undertaken in accordance with WSA TN-08.

Note: The word 'shall' is used in this Standard to designate a mandatory requirement.

### **1.3 LIMITATIONS**

This Standard applies to CIPP lining products which are either Class A (fully



structural) or which rely on a degree of structural integrity of the host pipe to both withstand external loads and resist internal pressure, Class B and C (semi-structural). Refer to appendix B for liner class details.

## 1.4 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

### AS

681.1 Elastomeric seals- Material requirements for pipe joint seals used in water and drainage applications Part 1: Vulcanized rubber.

1145.4 Determination of tensile properties of plastics materials - Test conditions for isotropic and orthotropic fibre-reinforced plastic composites

1199.1 Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection.

1646 Elastomeric seals for waterworks purposes.

1210 Pressure Vessels

2345 Dezincification resistance of copper alloys

4321 Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings

3894.9 Site testing of protective coatings - Determination of adhesion

4041 Pressure piping

4087 Metallic flanges for waterworks purposes.

### AS/NZS

2566.1 Buried flexible pipelines – Structural Design

2566.2 Buried flexible pipelines - Installation

3500 Set (Parts 0-4) Plumbing and drainage Set

3571.2 Plastics piping systems - Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin Pressure and non-pressure water supply (ISO 10639:2004, MOD)

4020 Testing of products for use in contact with drinking water.

4158 Thermally-bonded polymeric coating on valves and fittings for water industry purposes.

**AS ISO/IEC**

17025 General requirements for the competence of testing and calibration laboratories.

**ASTM**

D570 Standard Test Method for Water Absorption of Plastics

D638 Standard Test Method for Tensile Properties of Plastics

D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

D2290 Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe

D2369 Standard Test Method for Volatile Content of Coatings

D2992 Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings

D3039 Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials

D3567 Standard Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

D7028-07 Standard Test Method for Glass Transition Temperature (DMA T<sub>g</sub>) of Polymer Matrix Composites by Dynamic Mechanical Analysis (DMA)

D7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

E831 Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis.

F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)

**AWWA**

Structural Classifications of Pressure Pipe Linings – Suggested Protocol for Product Classification

## **EPA (USA)**

Method 24 Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings

Method 1311 Toxicity Characteristic Leaching Procedure

## **ISO**

62 Plastics — Determination of water absorption

527-4 Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites

899-1 Plastics — Determination of creep behaviour — Part 1: Tensile creep

3126 Plastics piping systems — Plastics components — Determination of dimensions

7509 Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of time to failure under sustained internal pressure

8513 Plastic piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of longitudinal tensile properties

8521 Plastic piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the apparent initial circumferential tensile strength

ISO 8521:1998, Plastic piping systems – Glass-reinforced thermosetting plastics (GRP) pipes – Determination of the apparent initial circumferential tensile strength

10639 Plastics piping systems for pressure and non-pressure water supply — Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP) — Specifications for pipes, fittings and joints.

10928 Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use.

11295 Classification and information on the design and applications of plastics lining systems used for renovation and replacement.

11296-4 Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 4: Lining with cured-in-place pipes

11297-4 Plastics piping systems for renovation of underground drainage and sewerage networks under pressure — Part 4: Lining with cured-in-place pipes

11298-1 Plastics piping systems for the renovation of underground water supply networks – Part 1 General

11298-4 Plastics piping systems for the renovation of underground water supply networks – Part 4 Lining with cured-in-place pipes

13002 Carbon fibre — Designation system for filament yarns

13003 Fibre-reinforced plastics — Determination of fatigue properties under cyclic loading conditions

11359-2 Plastics – Thermomechanical analysis (TMA) – Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature

14125 Fibre-reinforced plastic composites — Determination of flexural properties

15306 Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the resistance to cyclic internal pressure

## **WSAA**

TN-08 Product conformity assessment requirements.

### **1.5 TERMS AND DEFINITIONS**

For the purpose of this standard, the following terms and definitions apply.

- 1.5.1 **Carrier material**  
porous component of the liner, which carries the liquid resin system during insertion into the pipe being renovated and forms part of the installed lining system once the resin has been cured.
- 1.5.2 **Composite**  
combination of cured resin system, carrier material and/or reinforcement excluding any internal or external membranes.
- 1.5.3 **Curing**  
process of resin polymerization, which may be initiated or accelerated by the use of heat or exposure to light.
- 1.5.4 **Declared value**  
limiting value of a characteristic declared in advance by the lining system supplier, which becomes the requirement for the purposes of assessment of conformity.
- 1.5.5 **Design thickness**  
the minimum thickness of the resin impregnated carrier material plus any reinforcing layer(s) intended for use in design calculations.