Assets Planning and Delivery Group
Engineering

DESIGN STANDARD 95

Selection, Preparation, Application, Inspection and Testing of Protective Coatings on Water Corporation Assets

VERSION 3
REVISION 3

JULY 2022

FOREWORD

Design Standards are prepared to ensure that the Corporation's staff, consultants and contractors are informed as to the Corporation's design standards and recommended practices. Design standards are intended to promote uniformity simplify design and drafting practice and have as their ultimate objective the provision of safe and functional plant at minimum whole of life cost.

The Corporation design standards and recommended practices described in this design standard have evolved over a years as a result of design and field experience and these have been investigated and documented.

Deviation, on a particular project, from the design standards and recommended practices may be permitted in special circumstances but only after consultation with and endorsement by the Team Leader Asset Durability in the Corporation's Engineering Business Unit. Users are invited to forward submissions for continuous improvement to the Team Leader Asset Durability, Water Corporation who will consider these for incorporation into future revisions.

This document contains colour pictorials. For optimum resolution colour printing is recommended.

Head of Engineering

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Any interpretation of anything in the Standards/Specifications that deviates from specific Water Corporation Project requirements must be referred to, and resolved by, reference to and for determination by the Water Corporation's project manager and/or designer for that particular Project.

REVISION STATUS

The revision status of this standard is shown section by section below:

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
1	1/0	12/12/12	All	New Version	KR	BG
2	2/0	14/03/18	42-50	Tables and references updated	GP	GP
3	3/0	01/08/2021	ALL	Document revised and updated	JF	GP
1.2	3/1	09/05/2022	11	Minor wording change from 'Corrosion control' to 'Protection Coating and Concrete Repair'	GP	SS
19	3/2	10.06.22	52	New Jotun coating added to Appendix 3 - Jotamastic 90 * (Off White)	JF	SS
19	**3/3**	**11/07/22**	**52**	**Multiple updates to table in section 19, Appendix 3**	**JF**	**SS**

ABBREVIATIONS

Paint/Coating Associations

ACA	Australasian Corrosion Association
ANSI	American National Standards Institute
AS/NZS	Australian Standards
ASTM	ASTM International
ISO	International Standards Organisation
NATA	National Association of Testing Authorities
NACE	National Association of Corrosion Engineers
NSF	National Sanitation Foundation
SSPC	Society for Protective Coatings (Formerly Steel Structures Painting Council)

Corrosion/Coating Abbreviations

CP	Cathodic Protection
CS	Carbon steel
DFT	Dry Film Thickness
GRP	Glass Reinforced Plastic
HDG	Hot-Dip Galvanised
GF	Glass Flake
ITP	Inspection and Test Plan
UHB	Ultra-High Build
NDT	Non-Destructive Testing
TDFT	Total Dry Film Thickness
µm	Micron
WFT	Wet Film Thickness

Basic coating Formulas

WFT (microns)	=	DFT x 100 ÷ % Volume Solids
WFT (microns)	=	DFT x (100 + % thinner added) ÷ % Volume Solids
Theoretical Coverage (m^2/litre)	=	$\frac{\%\ \text{volume solids x } 10}{\text{DFT (microns)}}$
WFT (microns)	=	$\frac{1000}{\text{Coverage } (m^2/\text{litre})}$
% Volume Solids	=	$\frac{\text{DFT (microns) x Coverage } (m^2/\text{litre})}{10}$
Amount of Paint (Litres)	=	$\frac{\text{Area } (m^2)}{\text{Coverage } (m^2/\text{litre})}$
Volume (Litres)	=	$\frac{\text{Area } (m^2) \text{ x DFT (microns) x } 10}{\%\ \text{Volume Solids x } (100 - \%\ \text{losses})}$

Basic conversions

Pressure

1 psi	=	6.9 kPa
1 atmosphere	=	101.3 kPa
1 kPa	=	0.145 psi
1 MPa	=	145 psi

Linear

1 mm	=	1000 micron
1 Thou (mil)	=	25.4 micron

DESIGN STANDARD 95
Selection, Preparation, Application, Inspection and Testing of Protective Coatings on Water Corporation Assets

1 Scope

The scope of this standard is to provide Water Corporation designers, asset maintainers, design consultants and coating contractors with information to assist with the selection, design, monitoring and maintenance of coating systems for the conveyance, storage and treatment of potable and wastewater, and associated infrastructures.

The standard is intended to:

1. Ensure consistency in the application of coating systems on all relevant classes of assets.
2. Ensure that designs meet Water Corporation requirements and comply with relevant Australian Standards and International Standards.
3. Provide for standardisation of coating testing procedures including methods of recording and reporting results.
4. Provide consistency in the interpretation of coating measurement results thus minimising the possibility of errors, disputes of results and rework.
5. Provide procedures for personnel involved in the operation and maintenance of coating.

Promote co-operation between all interested parties through a common understanding of the complex principles and practices associated with coating applications.

This standard shall be used in conjunction with Water Corporation coating specifications Group A-M. This document also refers to, and shall be used in conjunction with, relevant Australian Standards (AS/NZS), International Standards Organisation (ISO), National Association of Corrosion Engineers (NACE) and Society for Protective Coatings, formerly Steel Structures Painting Council (SSPC) standards.

For technical queries regarding coating issues, contact Team leader – Asset Durability.

Table 1: Glossary of Terms

Item	Description	Definition
1	Principal	Water Corporation *
2	Principal's Representative	Nominated person(s) by the principal to act as the Principal's Representative, on their behalf.
3	Contractor	Supplier / Subcontractor / Coating Applicator / Coating Contractor Design Engineer / Consultant / Construction Contractor Supplier / Vendor
4	Coating Inspector	Water Corporation's approved Coating Inspector

*For developer projects when Water Corporation is not the Principal and the works are to be handed over back to the Water Corporation, (e.g. Metronet / MRWA projects etc.), the works will need to be conducted to Water Corporation's project standards and specification.

1.1 Purpose of the Document

The asset designer pre-qualified painting contractor and asset maintainer shall use this document to specify, select and apply the appropriate coatings. If the designer, applicator or maintainer intends to deviate from this Design Standard, then the proposed deviations should be approved in writing by the Team Leader – Asset Durability.

1.2 Approved Applicators

Surface preparation and coating application shall be undertaken by an approved Water Corporation Protective Coating and Concrete Repairs Panel Services member, unless approved otherwise by the Team Leader – Asset Durability.

1.3 Coating Inspector

The coatings contractor shall nominate a certified coating inspector to perform inspections and maintain appropriate records for the work performed. Coating Inspector engaged in testing, monitoring and verification of surface preparation and coating application shall hold relevant inspection qualifications and current certifications (e.g. NACE or ACA) or approved by the Principal.

1.4 Quality Assurance

The coatings contractor shall nominate a competent person to prepare Quality Assurance documentation to meet the specified standards given herein and the required acceptance criteria.

1.5 Abrasive Blasting and Coating Applicators - VOC

A Verification of Competency (VOC) is a method of assessment that is used to verify abrasive blasting and coating applicator's ability to operate equipment and/or undertake the responsibilities of their role. Suitable competency verification records shall be maintained by the Contractor.

1.6 Contractor's Responsibilities.

1. Contractor shall perform all inspections as necessary to ensure that all work performed work is performed in accordance with this Specification, relevant statutory requirements or other references as approved by Water Corporation.

    a. Ensure sufficient checks are carried out to monitor overall coating quality and confirm it meets the specified standards provided in this specification.

    b. Any non-conforming surface preparation, coating or lining deficiencies shall be recorded and repaired.

2. Water Corporations authorised inspector(s) shall be given adequate notice (minimum 24 hours) prior to the start of surface preparation and coating application and witness or repeat any of these inspection functions as necessary.

    a. Inspection by Water Corporation does not relieve the Contractor of their responsibilities to ensure compliance to the relevant specified coating system.

3. Where the work is performed at the Contractor's blast/coating facility, the Contractor shall ensure that coated items are loaded for delivery to site in such a manner that ensures minimal damage in transit.

4. Contractor shall provide all the required inspection equipment necessary to maintain compliance to specification and testing requirements.

    a. All relevant inspection equipment shall have current calibration certificates.

1.7 Coatings in Contact with Drinking Water

Any coating in contact with drinking water shall be certified to comply with AS/NZS 4020 by a NATA accredited laboratory. All coatings applications including those with AS/NZS 4020 certificates or overseas coatings tested and approved with ANSI/NSF 61 or BS 6920 certificates or equivalent shall be submitted to the Water Corporation Drinking Water Quality Branch. This will be referred to the Department of Health for acceptance of the product in the specific application prior to use. Design consultants, asset maintainers and coating contractors shall refer to Schedule 5-List of products approved for use in Drinking Water issued by the Department of Health, Western Australia requested through the Water Corporation.

1.8 Cathodic Protection (CP) System Compatibility

If the structure to be protected has a CP system installed on it, then the coating system nominated shall be suitable for use on CP applications. For more information on CP, reference shall be made to Water Corporation Design Specification DS 91- Cathodic Protection of Steel Structures.

1.9 Referenced Documents

Australian Standards	
AS/NZS 1580	Paints and related materials— Methods of test
AS/NZS 1627.1	Cleaning using liquid solvents and alkaline solutions
AS/NZS 1627.2	Power tool cleaning
AS/NZS 1627.4	Abrasive blast cleaning
AS/NZS 1627.5	Pickling, descaling and oxide removal
AS/NZS 1627.7	Hand tool cleaning of metal surfaces
AS/NZS 2312.1	Guide to the protection of structural steel against exterior atmospheric Corrosion by the use of protective coating -Paint coating.
AS/NZS 2312.2	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coating- -Hot dip galvanizing
AS/NZS 2700	Colour standards for general purposes
AS 3894.1	Non-conductive coatings - Continuity testing - High voltage (‘brush’) method
AS 3894.2	Non-conductive coatings - Continuity testing - Wet sponge method
AS 3894.3	Determination of dry film thickness
AS 3894.4	Assessment of degree of cure

AS 3894.5	Determination of surface profile
AS 3894.6	Determination of residual contaminants
AS3894.7	Determination of surface temperatures
AS 3894.9	Determination of adhesion
AS 3894.10	Inspection report-Daily
AS 3894.11	Equipment report
AS 3894.12	Inspection report-Coating
AS3894.13	Inspection and Daily Report
AS/NZS 4020	Testing of products for use in contact with drinking water
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 4352	Tests for coating resistance to cathodic disbonding
AS4361.1	Guide to hazardous paint management – Part 1 lead and other hazardous metallic pigments in industrial applications
AS/NZS 4680	Hot dip galvanized (zinc) coatings on fabricated ferrous articles

American Society for Testing and Materials (ASTM) Standards

ASTM D 4285 – 83	Standard Test Method for indicating Oil or Water in Compressed Air
ASTM D4263	Standard Test Method for Indication Moisture in Concrete.
ASTM D 4262	Test Method for PH of Chemically Cleaned or Etched Concrete Surfaces.
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM C1583/C1583M	Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)

International Organization for Standardization (ISO)

ISO 11126	Preparation of steel substrates before application of paints and related products: Specifications for non-metallic blast-cleaning abrasives - Part 10: Almandite garnet
ISO 8501-1	Preparation of steel substrates before application of paints and related products- Visual assessment of surface cleanliness
ISO 8502-3	Test for Particulate Contamination
ISO 8501-3	Preparation grades of welds, edges and other areas with surface imperfections

Steel Structures Painting Council (USA) Standards

The following, except for visual (Vis) standards, are published in Steel Structures Painting Manual, Volume 2

SSPC SP1	Solvent cleaning
SSPC SP2	Hand tool cleaning
SSPC SP3	Power tool cleaning
SSPC SP5	White metal blast cleaning
SSPC SP6	Commercial blast cleaning
SSPC SP7	Brush-off blast cleaning
SSPC SP8	Pickling
SSPC SPl0	Near-white blast cleaning
SSPC SP11	Power tool cleaning to bare metal
SSPC-SP 13	Surface Preparation for Concrete
SSPC- SP 16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and NF Metals
SSPC Vis 1	Reference photographs for steel surfaces prepared by dry abrasive blast cleaning
SSPC Vis 3	Reference photographs for steel surfaces prepared by power and hand tool cleaning
SSPC PA2	Measurement of dry paint thickness with magnetic gauges

2 Conditions of Steel Surfaces

New or used unpainted steel may be categorized in any one of four general conditions, described and illustrated in pictorial standards SSPC-Vis 1 and ISO 8501-1. The general conditions are Rust Grades A, B, C, and D, as described in the following

Table 2: General Conditions of Rust Grades

Rust Grade A	Steel surface largely covered with mill scale, but little or no rust
Rust Grade B	Steel surface covered with both mill scale and rust that has begun to flake off
Rust Grade C	Steel surface completely covered with rust; little or no pitting visible
Rust Grade D	Steel surfaces completely covered with rust; pitting visible

3 Surface Preparation Standards

The primary purpose of surface preparation is to produce a surface that is clean and free of any material which may cause premature failure of the coating (e.g. Osmotic Blister). If the surface has contamination such as mill-scale, rust, salt, moisture or oil, then any subsequent coating will not be as adherent to the surface. Mill-scale remaining on the surface can cause Galvanic Corrosion.

Another aspect of surface preparation is to produce an adequate profile to the substrate. This is a measure of the height and depth of the “Hills and Valleys” produced on the surface. The greater the profile, the more surface that is presented to the coating for it to adhere to, so the better the adhesion. The roughness also allows the coating to lock into or key into the surface. However, if the profile is greater than the coating thickness, then peaks will protrude from the surface allowing spot rusting to occur. Profile must be in the correct range for the coating type and its thickness.

The most common way and preferred surface preparation method of producing a suitable profile and to remove rust, mill scale, or other surface contaminants is by abrasive blast cleaning. This is achieved by projecting a highly concentrated stream of relatively small abrasive particles at high velocity against the surface to be cleaned. The abrasives used for blast cleaning shall comply with stringent requirements of ISO11126-10. The surface preparation by substrate is given in Table 3.

All Water Corporation coating surface preparation standards shall comply with White Metal Blast, Sa3 in accordance with AS/NZS 1627.4. The surface profile shall be determined in accordance with AS 3894.5.

Bristle Blasting (MBX) can be considered as an alternative surface preparation method usually for smaller surface areas and maintenance work in situations where grit blasting is impractical or cannot be used.

Visual standards (ISO 8501-1) are used as pictorial examples that can be used to judge and compare blast cleaned standards with work on site.

Table 3: Surface Preparation by Substrate Material Type.

Substrate Cleaning	Cast Iron or Steel	Galvanized	Aluminium	Plate Metals (e.g. Tin plate)	Stainless Steel	Non-Ferrous	Plastic PVC/FRP	Concrete	Previously Painted Surfaces
SSPC-SP1 Solvent Clean	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSPC-SP2 Hand Tool Cleaning	✓	✓	×	×	×	×	×	×	✓
SSPC-SP3 Power Tool Cleaning	✓	✓	×	×	×	×	×	✓	✓
SSPC-SP11 Power Tool Cleaning	✓	×	×	×	×	×	×	×	✓
SSPC-SP7/NACE 4 Brush-Off Blast (Whip)	✓	✓	✓	✓	✓	✓	×	✓	✓
SSPC-SP6/NACE 3 Commercial Blast Cleaning	✓	×	×	×	×	×	×	×	✓
SSPC-SP10/NACE 2 Near-White Blast Cleaning	✓	×	×	×	×	×	×	×	✓
SSPC-SP5/NACE 1 White Metal Blast Cleaning	✓	×	×	×	×	×	×	×	✓
SSPC-SP12/NACE 5 High and Ultra high-Pressure Water Jet	✓	×	×	✓	×	×	✓	✓	✓
SSPC-SP13/NACE 6 Surface Prep. of Concrete	×	×	×	×	×	×	×	✓	×

4 Surface Contamination Analysis Test on the Blast Cleaned Surface

4.1 Surface Contamination Test

Soluble salt testing, of the prepared surface, shall be conducted on all coating systems on assets that will be immersed, buried or on-site structures that will be exposed to corrosivity categories of C4 or higher in accordance with AS 3894.6.

The maximum permitted total concentration of soluble salt(s) on carbon steel and stainless-steel surfaces after abrasive blasting and before coating application are:

- Immersion service - 3µg/cm2
- Ambient service - 5µg/cm2

Structures that are due for recoating in a marine environment (C4 and C5) should additionally be re-tested for chloride contamination prior to recoating.

4.2 Particulate contamination

Abrasive blasted surfaces shall be tested for the presence of particulate contamination before coating application in accordance ISO 8502-3 (pressure-sensitive tape method).

Frequency should be a minimum once per 100 m^2 or once per shift (whichever occurs first). The dust quantity level shall not exceed rating 2 and class 2 for dust particle size. Alternatively, surfaces to be coated shall be tested for the presence of particulate and spent abrasive in accordance with AS 3894.6 – Method C, Determination of Surface Dust.

The dust quantity level shall not exceed rating 2 by visual reference standard. Non-conforming of particulate contamination quantity shall be cause for further cleaning. In the event that particulate contamination of production abrasive blasted surfaces persists, the surface shall be blown down with clean air until a conforming rating has been achieved.

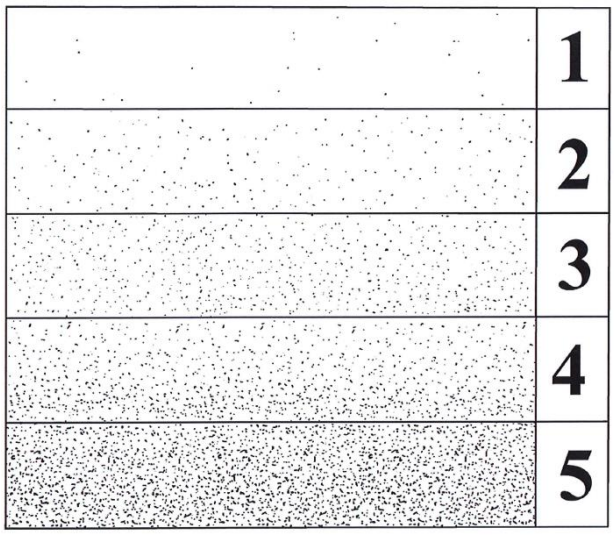

Figure 1: Pictorial references corresponding to dust quantity ratings 1, 2, 3, 4 & 5 (Extracted from ISO 8502-3)

4.2.1 Moisture

Visual assessment is employed to determine the presence of moisture. Also, pressing clean absorbent paper on the surface and visually examining may show the presence of moisture.

4.2.2 Oil and Grease

Oil and grease are difficult to detect visually. Under normal backlighting, oil and grease will appear as translucent spots. Oil may fluoresce when viewed under UV light. AS 3894.6 describes the method to determine the extent of oil and grease on the blast cleaned surfaces.

4.2.3 Mill Scale

Mill scale is normally visible to the naked eye and extra tests are not usually required. On completely clean surfaces (Class 3 blast) residual mill scale is revealed as black patches if the surface is swabbed with a pad containing slightly acidified 4% copper sulphate solution. The surface must be washed with potable grade water and re-blasted after carrying out this test. This test is described in AS 3894.6.

4.2.4 Moisture content of concrete surfaces

Moisture content testing of any concrete surface which requires the application of a protective coating surface shall also be undertaken utilising moisture meter with a sufficient range. The maximum moisture content shall be less than 5% before the application of the protective coating system.

4.3 Surface Preparation Specification

For any protective coating scheme, suitable surface preparation is important. The surface preparation is to remove oil, grease, old coatings and surface contaminants (such as mill scale and rust on steel, laitance on concrete and zinc salts on galvanised surfaces).

4.3.1 Steel or Cast-Iron

Surface preparation of Steel or Cast-Iron substrates shall be carried out to Class 3 cleanliness using either steel shot/grit or new garnet. Australian Manufactured Garnets with maximum allowable total chlorides of 10-15 ppm (max 25 ppm) shall be used.

The blast abrasive shall clean deep into the cavities and pitted areas down to bare metal, thoroughly removing all rust, soluble salts and other contaminants. The abrasive used shall achieve a surface profile in accordance with the requirements of the relevant coating to be applied, and garnet shall not be re-used. The abrasive batch certificates must be made available for review by the Water Corporation or its representative.

4.3.2 Concrete

Concrete, prior to the application of protective coatings shall undergo moisture content testing. Moisture meters must be used to give quantitative assessments of the moisture content.

Concrete surfaces shall be free of contamination from mould releases; form oils; curing compounds; and other greases, oils and debris before application of protective coatings.

Concrete shall be cured for a minimum 28 days old or can be longer as required and approved by the Principal, with a moisture content at the time of protective coating application below 5% and the maximum value specified by the product manufacturer for the coating system used. Before protective coating application, all concrete shall be suitable prepared before application of protective coatings ensuring all laitance is fully removed and any holes or voids be patched. Concrete surfaces shall also be free of any curing compounds before the application of the protective coating system.

List of Water Corporation surface preparation specifications are given in Table 4 and detailed surface preparation specifications are available under the design Standards on the Water Corporation website.

Table 4: List of Water Corporation Surface Preparation

System Designation	Surface Preparation Specification
A1	Surface Preparation for the Application of Protective Coating on Steel or Cast Iron
A2	Surface Preparation for the Application of Aesthetic Coating on Stainless Steel
A3	Surface Preparation for the Application of Protective Coating on Galvanised Steel
A4	Surface Preparation for the Application of Protective Coating on Aluminium
A5	Surface Preparation for the Application of Protective Coating on Concrete
A6	Surface Preparation for the Application of Protective Coating on Plastics
A7	Surface Preparation for the Application of Protective Coating on Fusion Bonded Polyethylene (Sintakote®)

4.4 Safety Considerations during Abrasive Blasting

Prior to undertaking blast cleaning of coatings on existing assets, especially where the age of the coating is estimated to be over 30 years, notwithstanding the coating age it is solely the contractor's responsibility to have the coating tested for the presence of lead. Initially the coating shall be tested by removing a layer of the coating down to the substrate and testing the area using a lead paint test kit (available from hardware stores). If the test is positive to the presence of lead then appropriate controls shall be put in place as per the requirements of AS4361 – Guide to hazardous paint management.

5 Coating Inspection

Coating inspection gauges shall be calibrated in accordance to the manufacturer's recommended practices and interval. Calibration certificates shall be witnessed by the Water Corporation representative prior to the start of the inspection.

All the inspection and test equipment used for execution of the works under contract must be available on the job site, be suitably calibrated and be available for use by the Water Corporation representative at time of inspection at no additional cost to the Water Corporation.

Proper and effective control of the environment and conditions during the curing stage of all coating layers are to be maintained. Ideal air temperature for painting is between 15°C and 30°C. It is important to note that final surface preparation and/or coating application shall not take place when any one of the following conditions are exist:

1. The relative humidity is above 85%;
2. The substrate temperature is less than 3°C above the dewpoint;
3. The substrate temperature is below 10°C;
4. The substrate temperature is above 55°C;
5. The surface to be coated is wet or damp;
6. The full prime coat application cannot be carried out before the specified cleanliness of the surface deteriorates;
7. The weather is deteriorating or is unfavourable for application or curing; or
8. The pot life of the paint has been exceeded.

5.1 Surface Profile of the Blast Cleaned Surface

Surface profile is the determination of the roughness of the surface and for painting purposes involves depth of the profile, peak density and angularity of the profile.

To determine the profile height or anchor pattern of an abrasive blast cleaned surface, one of the more commonly used methods is the Replica Tape method (TESTEX PRESS-O-FILM) as described in AS 3894.5 (Figure 2).

Surface profile ranges for the specified coating shall be achieved to comply with manufacturer's recommendations.

Figure 2: Blast Cleaned Surface Profile Measurement using TESTEX Tape

6 Coating application

1.0 Coating materials used for attaining the specified standard shall be selected in accordance with Appendix 3 - commonly used coatings in potable water and wastewater infrastructures unless approved otherwise by the Team Leader – Asset Durability. This approval is required before coating commences.

2.0 Coating specifications and Inspection Test Plans (ITPs) submitted by the paint suppliers shall be reviewed and approved by the Principal prior to the application.

3.0 Prior to the application of coating, oil or dirt shall be removed prior to any blast cleaning operations and surfaces not required to be coated shall be protected with masking materials. After the completion of the coating operation, masking shall be completely removed by the Contractor.

4.0 Coating shall not be applied to any prepared surface(s) exhibiting “flash corrosion” or that has been abrasive blasted more than 4 hours ago. Mixing, thinning, application and curing of protective coating materials shall be in accordance with the protective coating manufacturer's recommended practice for the on-site conditions. Applied coatings shall be protected from rain or moisture until cured.

5.0 Any inaccessible surface shall be brought to the attention of Water Corporation Team Leader – Asset Durability.

6.0 The coating components shall be thoroughly mixed in the specified proportions. Material so prepared shall be used within the “pot-life” period claimed by the manufacturer.

7.0 The finished coating shall be of uniform thickness, colour, appearance and gloss. It shall be fully cured, insoluble, adherent, and free from mud cracking, inclusions of foreign contaminates, amine blush/bloom, pinholes, holidays, laps, sags, blistering, checking, wrinkling, overspray, patchiness and any other defects that may impair the performance and/or appearance of the coating.

8.0 Where a coating system requires more than one product to be used (e.g. Primer and topcoat), all products shall be from the same supplier/manufacturer unless approved otherwise by the Team Leader, Asset Durability.

7 Stripe Coating

To ensure correct total Dry Film Thickness (DFT) of the coating, all welding slag, weld spatter, sharp edges and any other surface irregularities which may impair the appearance or performance of the protective coating shall be removed. Sharp edges shall be radiused to a minimum of 2mm.

1.0 Welds, edges, crevices, seams, joints, bolts and corners shall be brush stripe coated on each coat of a multi coat system before commencement of spray application of the coating. These areas are required to have at least the minimum specified film thickness and to ensure continuity of the coating.

2.0 The exception is inorganic zinc silicates (IOZS) primer which is exempt from this requirement.

8 TESTS ON APPLIED COATING

8.1 Wet Film Thickness Measurement

A Wet Film Thickness (WFT) gauge is required during paint application to minimise the possibility of low dry film thicknesses.

WFT is usually checked with a notch or comb gauge. The gauge should be used in accordance with AS 3894.3 Appendix C to measure the WFT.

8.2 Dry Film Thickness Measurement

The Dry Film Thickness (DFT) is defined as the thickness of the coating measured, at any location of the coated substrate above the peak of the profile **[**Refer Figure 3**]**. The DFT readings should be taken and recorded in accordance with AS 3894.3 and with reference SSPC-PA 2.

Dry film thickness measurements are made using a dry film thickness gauge which has been selected and calibrated in accordance with AS 3894.3 Appendix D.

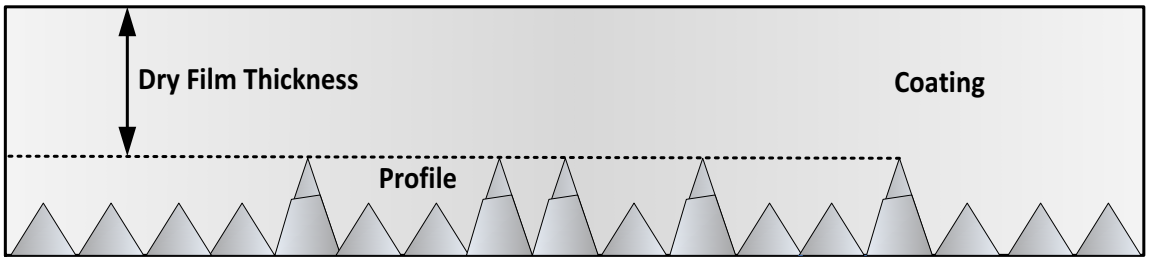

Figure 3: Schematic drawing on the DFT of the coating.

If the measured DFT is less than three times the profile height, a Magnetic Base Reading (MBR) should be subtracted from the DFT reading. To achieve the MBR, the following steps should be applied:

- Zero the DFT gauge on the smooth steel surface (As per AS 3894.3) and;
- Take a number of readings on the blasted surface to obtain an average reading. This average reading is known as the Magnetic Base Reading (MBR). If MBR is not recorded, then the acceptable approximation is one third of the profile height.

Note: For thicker coatings the above procedure is not required.

Table 5: Dry Film Thickness Definitions

Dry Film thickness (DFT)	Dry film thickness specified for each coating layer or for the whole coating system
Minimum Dry Film thickness	Minimum acceptable dry film thickness for each coating layer or for the whole coating system.
Maximum Dry Film thickness	Highest acceptable dry film thickness for each coating layer or for the whole coating system above which the performance of the coating layer or system could be compromised.
Gauge "Spot" measurement	A single DFT reading taken at one point.
Gauge, "mean" measurement	Arithmetic average of three gauge readings made within a circle of approximately 12 cm diameter.

8.2.1 DFT - Severe Environments

For surfaces that are to be exposed to severe environments such as immersed, buried or subjected to severe chemical or marine environment, the minimum film thickness specified shall be achieved. This means any area outside specification should be marked for restoration.

8.2.2 DFT - Atmospheric Environment

AS 3894.3 and SSPC PA2 require the average of the five spot readings taken over 10 m^2 as described above, to be greater than the specified coating thickness. No single point reading should be less than 80% of the specified thickness.

In all cases the minimum specified thickness stated with this specification is the absolute minimum spot thickness in any area measured. A single point reading below the specified but not below 80% of the specified thickness may be acceptable so long as the spot measurement (average of 3 single point readings within a 12mm diameter) are above the minimum specified thickness, except for protective coatings that are to be either buried or immersed, where no point or spot reading is acceptable below the specified thicknesses.

If three readings were averaged to produce a point reading, an individual reading may be less than 80% of the coating thickness.

Figure 4: Measurement of DFT using electronic gauge.

8.2.3 DFT Measurement Frequency

For areas of flat or uniformly curved coated surfaces, five separate point readings, evenly spaced throughout, should be made in each 10 m^2 area examined. The 10 m^2 inspection areas should be selected as shown in Table 6:

Table 6: Large and Small Surface Areas and DFT Measurement

No.	Area of the Structure	DFT Measurement
1	Less than 30 m^2	Each 10 m^2 area
2	Structures not exceeding 100 m^2	Three 10 m^2 areas should be chosen at random
3	Structures exceeding 100 m^2	First 100 m^2 area should be measured in accordance with Option (2), and for each additional 100 m^2 area, a 10 m^2 area should be chosen at random
5	For critical or small surface areas	More readings will be required [discretion of the Principal & Contractor]
6	For flat areas less than 10 m^2	Minimum of 3 point readings for each m^2
7	Pipework	Based on pipe diameter, 2, 4 or 6 point readings should be taken every metre of pipe run, evenly round the circumference **[Refer Table 5]**.
8	Beams and angles	One reading should be taken on each flat face less than 300 mm width for each linear metre.
9	If the total area of pipework, beams or angles exceeds 10 m^2	Five separate point readings, evenly spaced throughout, should be made in each 10 m^2 area examined.

Note:

If the coating thicknesses measurement for any 10 m^2 area, chosen in accordance with option (2) or (3) does not meet the required specification, then each 10 m^2 area of surface should be measured.

Table 7: Nominal Pipe Size and DFT Measurement

Nominal pipe size, mm	Number of Circumferential readings
≤150	**2**
>150≤300	**4**
>300≤600	**6**
≥600	**10**

8.3 Testing and Repairs for Coating Film Continuity

A fully cured coating subjected to immersed, marine, or buried environments shall be tested for film continuity and for defects such as pin holes, misses and damage. There are two methods of continuity testing: (1) Low Voltage & (2) High Voltage.

Defects such as pinholes, cracks, blisters, voids, foreign inclusions, and "rogue" peaks shall be marked for repair and retested when the repair coating is fully cured.

8.4 Low Voltage Continuity Testing

Non-conductive coatings of thickness up to 250 microns should be tested using wet sponge method in accordance with AS 3894.2 – Continuity Testing – Wet Sponge Method.

Figure 5: Low Voltage Test Continuity Test using Wet Sponge method

8.5 High Voltage Continuity Testing (Spark Testing)

Where required, non-conductive coatings of thickness above 150 microns shall be tested in accordance with AS 3894.1 – Continuity Testing High Voltage (Brush) Method or coating manufacturer's recommendations using a high voltage test unit. In this method voltages up to 20,000 volts or more can be applied. The test voltages are selected in accordance with the following equation:

$$\mathbf{V} = \frac{250\sqrt{T}}{F}$$

Where,

V = test voltage applied, in volts
T = specified dry film thickness of cured coating, in micrometres
F = rating of a coating's generic type and the volume solids content (Refer Table 8**)**.
Where the actual film thickness exceeds the specified film thickness (T) by 25 %, the test voltage (V) should be recalculated using the actual thickness of that area.

Table 8: Coating film rating (F) from coating type and volume solids content

Type of Coating	Volume Solids % (V/V)	Rating (F)
Chlorinated rubber, Vinyl	15 to 39	4
Low-build epoxy, Tar epoxy	40 to 59	3
High-build epoxy, Tar epoxy	60 to 79	2
Polyester-vinyl ester, Solventless epoxy	80 and greater	1

Note 1: For thermal bonded polymeric coatings (thermoplastic and thermosetting coating) continuity testing shall be carried out on buried, marine or immersed coatings in accordance with Table 3.3 from AS4158 below.

Table 9: Extracted from AS 4158 (Table 3.3)

TABLE 3.3

ACCEPTANCE LIMITS FOR CONTINUITY TESTING/VISUAL INSPECTION

Region	End result	Repair limitations	Test requirements
Internal wetted surface	No holidays	Maximum holiday area 25 mm^2 per holiday, with a maximum of 3 repairs per coated product or 3 repairs per 100 000 mm^2 of coated surface which ever is the greater.	AS 3894.1 at 5V per micrometre of the specified minimum thickness of the coating system.
External surface	No visual defects	Maximum holiday area 1000 mm^2 per holiday, with a maximum of 6 repairs per coated product or 6 repairs per 100 000 mm^2 of coated surface which ever is the greater.	Visual

Note 2: High Voltage Spark Tester accuracy must be verified using a calibrated Crest meter prior to use for detecting pin holes in the coatings.

Figure 6: High Voltage Spark Tester calibrated using a Crest meter.

Figure 7: Pin holes detected during the spark testing

8.6 Degree of Curing of the Coating

Test methods for the determination of the degree of cure of coatings are given in AS 3894.4 and AS/NZS 1580. The most commonly used test for curing of the coating within the Water Corporation is the Solvent Rub test [AS 3894.4 Method C].

8.7 Adhesion Test of the Coating

On immersed, buried or where nominated by Water Corporation, the adhesion strength of the coating shall be carried out in accordance with AS 3894.9 and AS/NZS 1580. Various methods are associated with this standard and can be referenced in Table 10. The most commonly used and preferred adhesion test in the Water Corporation is the Pull-off (dolly) test [AS/NZS 1580 Method 408.5].

Table 10: Methods of Adhesion Test

Methods of Adhesion Test	Australian Standard	Coating Thickness (microns)
Parallel cut method	AS/NZS 1580 Method 408.2 Method A	> 100 microns
Intersecting cut method	AS 3894.9 Method A	Any thickness
Cross-cut test	AS 3894.9 Method B	Up to 125 microns
Pull-off (dolly)	AS 3894.9 Method C	Any thickness

A test reference panel coated at the same time as the item can be used for the means of conducting adhesion testing, provided that the test reference panel surface preparation and coating application (with the same batches of coating material and abrasives etc.) are used to prevent any repairs after testing on the recently completed coating system.

If the test reference panel is not prepared and coated at the same time as the work piece(s), or if the coating adhesion is either questionable or in any dispute, the Water Corporation reserve the right to request that adhesion testing be completed on the work piece and subsequent repairs be conducted at no additional cost to the Water Corporation.

9 Adhesion Test of the Coating – Pull-off (Dolly)

Pull-off adhesion testing is used to measure the force required to pull a specified diameter of coating away from its substrate. This measured pull-off force provides a direct indication of the strength of adhesion between the coating and the substrate.

Adhesion testing is only required on the following assets: Tanks, & Pressure Vessels or as otherwise specified.

The test location and number of test points shall be agreed upon by the Contractor and the Principal prior to the start of attaching the dollies to the substrate or if applicable on the test reference panel.

The report shall include test results, general failure modes categorised substrate failure, adhesion failure, cohesion failure and glue failure. Water Corporation preferred mode of failure for coatings on concrete is “substrate failure” and “cohesive failure” for steel.

Minimum acceptable adhesion value of Epoxy coating or elastomeric polyurethane on Concrete and Steel shall be 3 MPa and 5 MPa respectively.

Coatings with unacceptable adhesion test results shall be removed and reinstated at no additional cost to The Water Corporation. The Contractor shall spot repair all areas subject to adhesion testing, if a test reference panel is not used, and retest upon full cure of the repair coating.

For further details on the theory and requirements of pull-off testing refer ASTM D 4541, AS1580, AS3894.9, ASTM D7234 and ASTM C1583/C1583M-04 standards.

Note: References shall be made to the pull-off test requirements of individual coating specifications.

10 Records and Inspection Report

The contractor shall keep detailed records and reports covering all environmental conditions and on-site tests carried out on painted work, as required by the applicable specification. To supplement these records, prior to any works commencing, an Inspection Test Plan (ITP) shall be forwarded to the Water Corporation for review a minimum of **ten** working days prior to the commencement of work.

The contractor inspector's responsibility is to audit the coating inspection documents for conformance to relevant Australian Standards. The following items should be included, but not limited to, in the standard report:

10.1 Ambient Conditions

The report shall include details of prevailing weather conditions, including surface temperature, relative humidity, dew point and general weather observations etc., during the application process, in accordance with AS 3894.10. Ambient conditions shall be recorded at least 4 times per shift at minimum and more frequently when the ambient conditions become close to being unfavourable to conduct surface treatment or coating application.

10.2 Equipment Report

The report shall include details of all production and test equipment used during application and inspection in accordance with AS 3894.11.

10.3 Coating Inspection Report

The report shall include details of all coatings applied, the results of quality control testing for all paints, coatings and their component parts including solvents and thinners, for each stage of the work in accordance with AS 3894.12.

11 Protective coating colour

Protective coatings colour shall comply with AS/NZS 2700 - Colour Standards for General Purposes. All work shall comply with AS/NZS 2700 colour code as shown in Table 11. Equivalent German colour code (also known as RAL colour space system) is also included in Table 11. It should be noted that colours will be displayed differently depending upon the computer and screen settings. Therefore, they should be treated as a guide only.

If a suitable approved colour is not available, then the proposed colour shall be referred to the Water Corporation for acceptance prior to use. Also, references shall be made to Water Corporation colour code drawing **No. EG71-1-1,** REV E for details for treatment plants.

Table 11: Pipeline Colour Code Identification

Pipeline Identification	AS/NZS 2700 Colour	RAL Colour Space System*	Colour Reference
Potable Water (plant)	**G21** Jade	RAL 6032	
Water (Country sites)	**N43** Pipeline Grey	RAL 7001	
Handrails if" safety yellow" specified	Y14 Golden Yellow	RAL 7032	
Chemicals	P23 Lilac	RAL 310 50 15	
Fire Services	R13 Signal Red	RAL 3001	
Air	B25 Aqua	RAL 220 60 20	
Non-Potable Water	**N61** Black	RAL 9011	

* RAL is a colour matching system used in Europe.

12 WATER CORPORATION COATING SPECIFICATIONS

12.1 DS 95 Compliance

Design Standard DS 95 is aligned with AS/NZS 2312 for both Atmospheric and Non-Atmospheric type coatings. Atmospheric environments are classified into corrosivity categories (Very Low - A to Inland Tropical - F) based on the corrosion rates of mild steel given in International Standard Organisation (ISO) 9223. Non-atmospheric environments fall into the category of potable water immersion, sewerage immersion, soil etc.

The alignment of DS 95 to AS/NZS 2312 will assist corrosion engineers, design consultants and coating inspectors to understand and select the correct specification for the various Water Corporation applications. To further assist asset designers and maintenance planners a library of surface preparation and coating specifications have been developed for typical Water Corporation applications and are included in **Appendix 2 and 3.** It is the intention of the Asset Durability team to expand on this list of specifications based on future requirements.

12.2 Choosing the Right Specification

In order to choose the right specification for various Water Corporation assets, atmospheric and non-atmospheric conditions are sub-divided into immersed or non-immersed microenvironments. In simple terms, coating systems consisting of metallic zinc or compounds of zinc are used only for non-immersed environments with or without top colour coat.

On the other hand, coating systems such as high build epoxies and elastomeric urethanes, where no zinc is present are applied for immersed environments without topcoats. There are exceptions where a coating system can be used in both the immersed and non-immersed environments e.g. Epoxy Mastic.

Careful consideration shall be given to some coating systems where the specified nominal dry film thickness is greater than the AS/NZS 2312 or equivalent to the ISO 9223 standard.

Also, when selecting a coating system suitable for the environmental classification, the coating system shall have a minimum design life to first minor maintenance of 10 years, which is categorised as no more than 1% of the total surface area having corrosion of the parent metal.

Atmospheric corrosivity categories per the requirements of AS/NZS 2312, may not include coatings which are to be immersed, buried or in any macro/microenvironment which may differ from atmospheric corrosion conditions such as the internal of tanks etc.

The atmospheric categories for coating system selection shall be as follows;

- C1 – Very Low. Environments in this category are mostly found inside heated or air-conditioned buildings with clean atmospheres.
- C2 – Low. Environments in this category include dry rural areas as well as other regions remote from the coast or sources of pollution.
- C3 – Medium. This category mainly covers coastal areas with low salinity.

- C4 – High. This category occurs mainly on the coast.
- C5 – Very High (Industrial and Marine). This category is common offshore and on the beachfront in regions of rough seas and surf beaches.

For any coatings subject to buried, immersion or macro/micro environmental conditions, the Team Leader – Asset Durability shall be contacted for any special requirements regarding protective coating system selection.

12.3 Coating Thickness Deviation

It is the responsibility of the design consultant to ensure that the specified thickness in the specification will not impede the tolerances and clearances of various mechanical components. The design consultant should discuss the coating requirement thickness with the Team Leader – Asset Durability.

The Water Corporation recommends use of the following coating types on potable/wastewater infrastructures.

12.4 Group B - Inorganic Zinc Silicate

Inorganic Zinc Silicate also known as IZS consists of finely divided metallic zinc dispersed in a self-curing inorganic alkyl (ethyl) silicate medium. IZS coatings react with steel to form a chemical bond.

The zinc dust metal provides galvanic corrosion protection to the mild steel substrate. If the IZS coating is damaged, the zinc silicate film repairs itself and protects steel substrate by sacrificial cathodic protection. IZS coating are mainly used for non-immersed environments.

Too thick a coating of IZS, will result in “Mud Cracking”.

12.5 Group C - Zinc Rich Epoxy Primer

Zinc Rich Epoxy primer is an organic coating and depends on physical rather than chemical bonding to steel. It contains zinc in powdered metallic form dispersed in organic base (Epoxy) and curing agent (Polyamide).

Zinc rich epoxy is easier than IZS to apply without mud cracking. Topcoat is easier to apply and cures at a faster rate compared to IZS. The advantage of zinc rich epoxy is that it is more surface tolerant compared to IZS. Zinc Rich Epoxy primers are mainly used for non-immersed environments.

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12.6 Group D – High Build Epoxy

Epoxies consists of an epoxy base with an amine adduct or polyamide curing agent as the resin binder. The colour range is limited, usually flat or low gloss. May be used as finish coat but their main disadvantage is they chalk and discolour with UV radiation, but this has little detrimental effect on performance. This can be overcome by applying a polyurethane or acrylic epoxy topcoat to give a glossy finish for extra protection.

Epoxies are hard, tough coatings with good chemical and solvent resistance. In situations, where more than 1000 microns thickness of coating is required then Ultra High Build Epoxy is preferred. High Build Epoxies are mainly used for potable water and wastewater immersed environments.

12.7 Group E – Epoxy Mastic

Consists of an epoxy resin base with an adduct or polyamide curing agent with evaporative hydrocarbon and alcohol, or ketone or glycol ether solvent (or combinations of each). Hand or power tool cleaned steel substrate can be coated with Epoxy Mastic and hence referred to as 'surface tolerant epoxy'. Epoxy Mastic coatings can be brushed or rolled.

Epoxy Mastics are mainly used as maintenance coatings and can be used for both immersed and non-immersed potable water and wastewater environments.

12.8 Group F – Mineral Filler Epoxy

Mineral flake coatings contain microns thick mineral flakes which make the coating much tougher than ordinary industrial paint. Glass flake particles form dense, inert barriers within the paint film. Overlapping layers of glass resist water and chemicals permeating into the paint film. The addition of glass also increases the flexibility, hardness and abrasion resistance of coatings.

Glass flake coatings can be used for both immersed and non-immersed potable water and wastewater environments.

12.9 Group G - Fusion Bonded Epoxy Powder

FBE powder coating is applied on the surface by pre-heating the substrate. The epoxy resin forms cross-linking reaction which is irreversible i.e. after the curing, the coating cannot be returned to its original form by any means.

The coating can be used for pipelines buried in soil, immersed and non-immersed environments in both potable water and wastewater assets.

12.10 Group H – Galvanising

Galvanising is the process of applying a protective zinc coating to steel or iron, to prevent rusting. The zinc coating protects the substrate by the Galvanic method and is mainly used for non-immersed environments.

12.11 Group I – Elastomeric Polyurethanes (Polyurea etc.)

Polyurea is a type of elastomer that is derived from the reaction product of an isocyanate component and a synthetic resin blend.

Polyurethane and polyurea elastomeric membranes are exceptionally tough and flexible to compensate for the movement and cracking of substrates – particularly concrete. They are mainly used for potable water and wastewater immersed environments.

12.12 Group J – Anti-graffiti Coating

Anti-graffiti coatings try to prevent the permanent adherence of graffiti on painted surfaces, where once the surface has been tagged maintenance personal can remove the unwanted graffiti without damaging the original protective coatings. The anti-graffiti coating should be resistant to the solvents typically used for the removal of the graffiti without permanent damage of the anti-graffiti coating system.

12.13 Group K – Water Based Acrylic Coating

Water based coatings can be applied to damp surfaces and are used for decorative purposes. Also used to maximise resistance to weathering and hence retain colour well with time. These paints also emit low amounts of Volatile Organic Compounds (VOCs), which is good for the environment. The disadvantage is if there is excessive moisture on the material being coated, then the adhesion of the paint is reduced resulting in failure of paint due to blistering.

12.14 Group L – Tape Wrapping and Heat Shrink Sleeve

Tape wrapping is a form of corrosion protection for pipelines, valves, gear boxes etc. \ It is fast and relatively simple to apply by hand.

Heat Shrink Sleeves are heat shrinkable polyethylene sleeves which provide extremely tough anti-corrosion protection for welded pipeline joints and factory coating repairs. They are compatible with all commonly used pipe coatings and are suitable for operation from -20°C up to 80°C.

12.15 Group M – Miscellaneous Coating

The above type of coating systems are applied to pipework, pipelines and other assets that encounter concrete and other types of assets. **Appendix 2** shows the Water Corporation coating specifications that are suitable for various potable and wastewater assets.

13 COATING SYSTEMS FOR NEW WATER CORPORATION ASSETS

Table 12**,** Table 13 and Table 14 provide appropriate coating systems for the common structures found in Water Corporation, water and wastewater treatment facilities. The tables also contain the assets common materials of construct and their typical exposure condition. Some assets may not have been listed or may be known by some other name.

If a substrate is left uncoated or a coating is intended for protection against specific chemicals, ensure that the material has an adequate corrosion resistance for the specific environment.

Pipes, valves, fittings that have factory-applied fusion bonded external/internal coating or suitable cement lining typically do not require additional coatings.

Any coating in contact with drinking water shall be certified to comply with AS/NZS 4020by a NATA accredited laboratory. Design consultants, asset maintainers and coating contractors shall refer to Schedule 5 – List of products approved for use in Drinking Water issued by the Department of Health, Western Australia requested through the Water Corporation.

If there is any doubt in the selection of coatings, then the matter should be referred to the Team Leader – Asset Durability.

Refer **Appendix 3** for commonly used coatings in potable water and wastewater infrastructures. The coating industry technical terms are included in **Appendix 4**.

Table 12: Examples of typical coatings for assets associated with potable water

	Item	Substrate	Surface Prep. Specification	Coating Specification	Micro Environment	Environment Classification	Comments
1	Handrails	Galvanised Steel		H2	Above Ground	C1 – C3	If colour coat is required refer item2
2	Handrails	Galvanised Steel	A3	E4	Above Ground	C4 – C5	
3	Handrails	Aluminium			Above Ground	N/A	No Coating Required
4	Pipes	Carbon Steel	A1	B1	Above Ground	C1 – C4	
5	Pipes	Carbon Steel	A1	C2	Above Ground	C1 – C5	If top colour coat is required for aesthetic purposes
6	Pipes	Fusion Bonded Polyethylene (Sintakote)	A7	E5	Above Ground	C1 – C5	If top colour coat is required for aesthetic purposes on Sintakote pipe/fittings
7	Pipes	Fusion Bonded Polyethylene (Sintakote)			Below Ground	N/A	No Coating Required. Bare steel sections to be wrap in accordance with L1 or L2

Table 13: Examples of typical coatings for assets associated with potable water (continued…)

Item	Substrate	Surface Prep. Specification	Coating Specification	Micro Environment	Environment Classification	Comments
Pipework	PVC	A6	K1	Above Ground	C1 – C5	To protect against UV rays
Building Structural Steel	Carbon steel		H2	Above Ground/ Non-Immersed	C1 – C4	Contact Durability team for alternative options
Concrete Tanks (for existing assets)	Concrete	A5	I1	Immersed/non-Immersed	AS 3735, Class B1-B2	Only for existing assets and only when specified for coating remediation.

Table 14: Examples of typical coatings for assets associated with Wastewater

Item	Substrate	Surface Prep. Specification	Coating Specification	Micro Environment	Environment Classification	Comments
Handrails	Galvanised Steel		H2	Above Ground or Non-Immersed	C1 – C2	No Coating Required
Handrails	Aluminium	A4		Above Ground	C1 – C4	No Coating Required
Pipework	PVC	A6	K1	Above Ground	C1 – C5	To protect against UV rays
Steel Tank internal	Carbon steel	A1	D1	Immersed	N/A	
Steel Tank external	Carbon steel	A1	C2	Above Ground/Non-Immersed	C1 – C5	
Concrete Tank with odour cover	Concrete	A5	D3	Immersed/Non-Immersed	AS 3735 Class B2-D	Coating shall extend down to a level 500 mm below the lowest service water level in the structure
Chemical storage bund	Concrete		CR5	Non-Immersed	AS 3735 Class B2-D	Refer to Spec.CR5

14 PIPELINES COATING – BURIED & EXPOSED (ATMOSPHERIC)

14.1 Buried Pipework

14.2 Buried Pipework (Workshop Manufacture)

Where MSCL pipes with fusion bonded polyethylene coating (Sintakote®) are used to fabricate pipe fittings the coating shall be stripped back a minimum of 75mm away from the actual weld. On completion of welding the stripped areas in the case of Sintakote pipe or fittings fabricated from rolled plate shall be coated as per the requirements shown in Table 15.

14.3 Coating Requirements (Workshop Manufacture)

Prior to application of the protective coating system, surfaces shall be prepared such that rust and any other deleterious material are removed, in accordance with the coating manufacturer's requirements.

In all circumstances, clean and prepare the surface to be protected. The minimum surface preparation requirements shall be degreasing and mechanical wire brushing to obtain Class 2 cleanliness in accordance with AS/NZS1627 Part 2 for heat shrink sleeve and tape wrapping installation. Heat shrink sleave products as shown in Table 15 and Table 16are suitable for both workshop and field installations.

A Class 3 blast finish is required for the application of Epoxy spray applied coatings in accordance with AS/NZS1627 Parts 4 and 9.

Fusion bonded medium density polyethylene coatings shall be applied in accordance with AS/NZS 4321 by steel Mains and or approved applicators only. *Contractors* seeking to use other applicators shall seek approval from the Team Leader – Asset Durability before surface treatment is commenced.

Table 15: External Coating Buried Pipework – Workshop Fabricated fittings

	APPLICABLE COATINGS			
	Option 1 Note 4	**Option 2** Note 4	**Option 3** Note 4	**Option 4** Note 4
FITTING TYPE	**Sintakote® Coating**	**Heat Shrink Sleeve (L2)**	**Epoxy Coated (Spray Applied)**	**Tape Wrapping**
Straight Section Joints & Bends (Fabricated from Sintakote Pipe or rolled plate)	Yes Refer Note 3	Yes Canusa-CPS®, AQW-HS® Refer Note 3	NA	NA
Flanged Connections (straight section)	NA	NA	NA	Yes (Specification L1 System B) Refer Note 2 &3
Crotch Plated Tees	Yes Refer Note 3	NA	Yes Refer Note 3	NA
Valve to Pipe Flanges	NA	NA	NA	Yes (Specification L1 System B) Refer Note 2 &3
Access / Inspection Opening	Yes (Note 1 & 3)	NA	Yes Refer Notes 1 & 3	Yes (Specification L1 System B) Refer Note 2 &3
Air Valve Off-take / spigot	Yes (Note 1 & 3)	NA	Yes Refer Notes 1 & 3	NA
Scours Off-take / spigot	Yes (Note 1 & 3)	NA	Yes Refer Notes 1 & 3	NA

Notes:

1. Scours, inspection openings and air valve fittings where ‘Sintakote’ coated or epoxy mastic coated shall be coated to within 75 mm of the rear face of the flange.
2. The Petrolatum 4 step system comprises of the application of a primer, packing with mouldable / profiling mastic, wrapping with grease-impregnated tape and final wrapping with a self-adhesive PVC overwrap. Profiling Mastic shall be used for flange connections. Petrolatum wrappings shall be applied as per the manufacturer’s recommendation.

3. Pipe work assemblies that are corrosion protected as per Table 15 above and where the period of storage on site exceeds 6 months shall be adequately protected against ultraviolet and direct sunlight to prevent the coating systems from deterioration.

4. Options for coatings shall be selected in the order of priority, Option 1 being the most effective and Option 4 the least effective. Option 1 shall be adopted, unless product is unavailable.

Table 16: External Coating Buried Pipework – Field Applied

	APPLICABLE COATINGS	
	Option 1 Note 4	**Option 2** Note 4
FITTING TYPE	**Heat Shrink Sleeve (L2)**Note 3	**Tape Wrapping (L1)**Note 3
Straight Section Joints & Segmented Bends (Fab. from Sintakote Pipe or rolled plate)	Yes Canusa- CPS®, AQW-HS®	Yes Densopol 80® (Rockrap 4000®) (As per note 2)
Flanged Connections	NA	Yes Specification L1 Petrolatum 4® step System (Note 1)
Valve To Pipe Flanges	NA	Yes Specification L1 Petrolatum 4® step System (Note 1)
Access / Inspection Opening	NA	Yes Specification L1 Petrolatum 4® step System (Note 1)
Air Valve & Off-take / Spigot	NA	Yes (Specification L1 Petrolatum 4® step System (Note 1)
Scour Off-take / Spigot	NA	Yes Specification L1 Petrolatum 4® step System (Note 1)
Magflow Meter Flanges (Only)	NA	Same as for Valve to pipe flange
Field Patch Repairs	Yes Canusa CRP® (Repair Patches)	NA

Notes:

1. The Petrolatum 4 step system comprises of the application of a primer, packing with mouldable / profiling mastic, wrapping with grease-impregnated tape and final wrapping with a self-adhesive PVC overwrap. Profiling Mastic shall be used for all flange connections. Petrolatum tape wrapping shall be applied as per the manufacturer's recommendation.

2. The following coating strip widths shall apply:
   - ≤ DN 300 Radius Bends - Strip Width equals 50 mm;
   - ≥DN 300 ≤ DN 600 Radius Bends - Strip Width equals 100 mm;
   - ≥DN 600 Radius Bends - Strip Width equals 150 mm.

3. Reference to Water Corporation Specifications.

4. Options for coatings shall be selected in the order of priority, Option 1 being the most effective.

1. Heat shrink sleeves shall only be installed by accredited and trained applicators. *Contractors* seeking to use other suppliers of heat shrink sleeves shall seek approval from the *Principal*. Heat shrink sleeves shall be applied in accordance with *Corporation's* Technical Specification L2 Heat Shrink Sleeve Requirements.

2. Epoxy coatings shall be applied to fittings and large assemblies as shown in Table 15. The coating shall be applied as per the *Corporation's* surface preparation specification "A1" and the paint manufacturer's recommendation.

3. The epoxy coating thickness shall be 2000 microns DFT minimum. Epoxy coating shall overlap Sintakote coatings on pipe sections by 100 mm. Epoxy coatings shall be selected in accordance with Appendix 3 - commonly used coatings in potable water and wastewater infrastructures unless approved otherwise by the Team Leader – Asset Durability and shall not be susceptible to cathodic dis-bonding.

4. Coating data sheets shall be provided to the *Principal* for coating acceptance and approval, a minimum of 2 weeks prior to the commencement of work. Coating data sheets shall verify that the proposed epoxy coatings have been tested in accordance with AS/NZS 4352 – Testing for coating resistance to cathodic dis-bonding.

5. Coatings shall be spray applied. Epoxy coated fittings shall be thoroughly inspected prior to installation on-site to identify transportation and construction damage to the coating. All site coating repairs shall be undertaken by an approved applicator and spark tested to the test parameters noted in Table 17.

6. Tape wrapping shall be carried out as per the Corporation's specification 'L1' as applicable. The wrapping shall overlap the polyethylene coating (Sintakote) by a minimum of 100 mm.

7. During fabrication, the internal cement mortar lining shall be stripped back to a minimum of 50 mm away on either side of the actual weld to prevent damage to the existing lining. On completion of welding the internal cement lining shall be reinstated in accordance with the Water Corporation's specification M8.

8. Temporary lifting lugs shop welded to assist with manufacture and transportation of pipe fittings shall be removed and dressed back prior to field coating/wrapping.

9. Fittings that are not covered in Table 15 schedule and cannot be epoxy coated or heat shrink sleeve wrapped shall be Petrolatum tape wrapped as per Option 4.

10. All coatings, wrappings and shrink sleeves shall be spark tested by the Contractor and witnessed by the Principal using high voltage brush methods to AS 3894.1 prior to backfilling. Spark testing equipment shall be within 2 years of calibration. Spark testing Voltage parameters shall be as per Table 17.

14.3.1 Buried Pipework (Field Applied)

Prior to application of the protective coating system, surfaces shall be prepared such that rust and any other deleterious material are removed in accordance with the coating manufacturer's requirements. Refer Table 15 for requirements of typical coating applications.

1. In all circumstances, clean and prepare the surface to be protected. The minimum surface preparation requirements shall be degreasing and mechanical wire brushing to obtain a St2 cleanliness in accordance with AS/NZS 1627 Part 2.

2. Coating for straight section -surfaces at field welded butt joints, SSJ, RRJ, RRJ-WR, flat and convex banded connections (Per AY58-19-1) shall be made using the Canusa-CPS® Aquashield AQW-HS® product or tape wrapping as per Table 16. Application of heat shrink sleeves shall be in accordance to the Corporation's specification M2.

3. Joints in 'Uneven' surfaces that will result in voids under the protective coating such as bends, tees, flanges, flange bolts and valve body assembly bolts shall be tape wrapped. The area with abrupt profile changes shall be filled with a mouldable mastic to obtain a smooth even profile.

4. Where pipe transitions from below ground to above ground exist, tape wrapping shall extend to 100mm above finished ground level. Tape wrapping shall be in accordance to the Corporation's specification L2.

5. Damaged Sintakote pipe coatings and or heat shrink sleeves shall be repaired using the Canusa CRP® (Coating Repair Patches), patch repairs shall be made following the manufacturer's recommended practice. Damaged epoxy coating shall be repaired using the same products and procedures as used in the workshop manufacturing process.

6. Additionally, minor nicks and scratches in the factory applied Sintakote coating can be repaired using extrusion welding. Personnel carrying out the repair shall be trained and competent to PMB01 (Plastic Welding) competency and certificated by a nationally accredited training organisation.

7. All wrappings and shrink sleeves shall be spark tested by the Contractor and witnessed by the Principal using high voltage brush methods to AS 3894.1 prior to backfilling. Spark testing equipment shall be within 2 years of calibration.

Table 17: Spark Testing Parameters

Coating Process	Test Voltage (Min.)	Tolerance
Medium Density PE Coating	12 kV	Per AS 3894.1
Heat Shrink Sleeves	12 kV	Per AS 3894.1
Epoxy Coating (D4)	8 Kv	Per AS 3894.1
Densopol 80 (Wrapping)	12 kV	Per AS 3894.1
Petrolatum 4 Step System	NA	NA

14.4 Exposed Pipework

Where pipes and fittings are to be installed above ground, they shall be coated with a suitable system to suit the environmental classification and surrounding corrodents, refer to Coating specification M1

14.4.1 IZS Primed Pipes &

Where bare steel pipes are to be IZS coated they shall be coated in *the works*hop in accordance with Water Corporation Specifications A1 and B1.

Where inorganic zinc silicate (IZS) are damaged during transit and installation, they shall be reinstated using Water Corporation specification H3.

Where a colour topcoat is specified on the drawings, coating specification A1 and C2 shall be use instead of IZS.

14.5 Sintakote Coated Pipes & fittings

Where Sintakote coated pipe and fittings are specified for above ground application, the Sintakote shall be whip blasted to remove the gloss surfaces and provide a surface profile in accordance with Water Corporation Specification A7. The prepared surfaces shall be coated in accordance with Water Corporation specification M2. For welded joints, the joints shall be coated in accordance with Water Corporation specification M2.

Finish coating colour shall be in accordance with the AS/NZS 2700 and the Corporation's Drawing EG71-1-1 Rev E.

14.6 Miscellaneous Pipework Configuration Coating

For below ground to above ground pipe transitions the coating application shall be in in accordance with Water Corporation coating specification M1. The coating procedure for clean skin pipe when permanently exposed to atmosphere shall be coated in accordance with Water Corporation coating specification M3.

When pipe sections are joined by coupling joints (e.g. Straub®, Gibault®, Viking Johnson®, Klamflex®), then the coating shall be applied in accordance with Water Corporation coating specification M4.

Coating of steel pipes and the Sintakote® pipes at the concrete interface shall be carried out in accordance with Water Corporation specifications M5 and M6 respectively. Decorative coatings on galvanised steel shall be carried out in accordance with Water Corporation specification M7. For the cement mortar relining, references shall be carried out in accordance with Water Corporation specification M8.

Finish coating colour shall be in accordance with the AS/NZS 2700 and the Corporation's Drawing EG71-1-1 Rev E.

15 VALVES COATING

15.1 Coating of Valves

The purpose behind coating a valve is to extend its service life. All new valves shall be coated in accordance with the relevant Water Corporation Strategic Product Specification (SPS).

Refurbished valves shall be coated as follows:

1. DN 600 and below control valves are coated with High Build Epoxy or Fusion Bonded Epoxy (FBE) in accordance with Water Corporation coating specifications E2 and G2 respectively.

2. Above DN600, control valves are coated with two or more coats of a two pack Epoxy coating system in accordance with Water Corporation coating specification E2.

3. All sizes of Non-return valves, coating shall be carried out in accordance with Water Corporation coating specification E2.

4. For hard wearing applications (where abrasion, impact and chemical resistance are required), control valves are coated with high build ceramic filled epoxy coatings in accordance with Water Corporation specification F2.

5. For Butterfly valves including Seal on Disc and Seal on Body, coating shall be applied by the application of two or more coats of High Build Epoxy in accordance with Water Corporation coating specification D2.

16 PUMPS COATING

16.1 Coating of Pumps

For the wetted areas of new and existing pumps, coating shall be carried out using High Build Ceramic Filled Epoxy in accordance with Water Corporation coating specification F3.

17 APPENDIX 1 – INSPECTION, TESTS AND PLAN (ITP)

Contractor shall submit Inspection and Test Plan (ITP) documentations for each nominated coating system. Please see below link for the minimum requirement of ITP documentations.

The Contractor shall submit their Inspection and Test Plan (ITP) documents as proposed for each coating system at least ***10 working days*** prior to commencing work

Examples of ITP templates for D1, A1 and C2 can be found on the link below:

https://www.watercorporation.com.au/About-us/Suppliers-and-contractors/Resources/Design-standards

18 APPENDIX 2 - SURFACE PREPARATION AND PROTECTIVE COATING SPECIFICATIONS

SYSTEM DESIGNATION	COATING SPECIFICATIONS
GROUP – A (SURFACE PREPARATION)	
A1	Surface Preparation for the Application of Protective Coating on Steel or Cast Iron
A2	Surface Preparation for the Application of Aesthetic Coating on Stainless Steel
A3	Surface Preparation for the Application of Protective Coating on Galvanised Steel
A4	Surface Preparation for the Application of Protective Coating on Aluminium
A5	Surface Preparation for the Application of Protective Coating on Concrete
A6	Surface Preparation for the Application of Protective Coating on Plastics
A7	Surface Preparation for the Application of Protective Coating on Fusion Bonded Polyethylene (Sintakote®)

SYSTEM DESIGNATION	COATING SPECIFICATIONS
GROUP – B (INORGANIC ZINC SILICATE)	
B1	Inorganic Zinc Silicate Coating on Steel or Cast Iron
GROUP – C (ZINC RICH EPOXY PRIMER)	
C1	Zinc Rich Epoxy Primer Coating on Steel or Cast Iron
C2	Zinc Rich Epoxy Primer, Epoxy Mastic Coat, Polyurethane Top Coating on Steel or Cast Iron
C3	Zinc Rich Epoxy Primer, Epoxy Mastic Coat on Steel or Cast Iron
C4	Zinc Rich Epoxy Primer, Polyurethane Top Coat on Steel or Cast Iron
GROUP – D (HIGH BUILD EPOXY)	
D1	High Build Epoxy Coating on Steel or Cast Iron
D2	High Build Epoxy Coating on Butterfly Valves
D3	High Build Epoxy Coating on New and Old Concrete

SYSTEM DESIGNATION	COATING SPECIFICATIONS
D4	Ultra High Build Epoxy Coating on Steel or Cast Iron
GROUP – E (EPOXY MASTIC	
E1	Epoxy Mastic Coating on Steel or Cast Iron
E2	Epoxy Mastic Polyurethane Top Coat on Control Valves
E3	Epoxy Mastic, Polyurethane Top Coat on Steel or Cast Iron
E4	Epoxy Mastic, Polyurethane Top Coat on Galvanised Steel
E5	Epoxy Mastic, Polyurethane Top Coat on Fusion Bonded Polyethylene (Sintakote)
GROUP – F (MINERAL FILLER EPOXY)	
F1	Glass Flake Epoxy Mastic Coating on Steel or Cast Iron
F2	g High Build Ceramic Filled Epoxy Polyurethane Top Coat Coatings For Repair Of Control Valves
F3	High Build Ceramic Filled Epoxy Coating on Pumps
GROUP – G (THERMAL BONDED POWDER)	
G1	Thermostatically Applied Polyester Powder Coating for Aluminium Sheet Metal Cabinets
G2	Thermal Bonded Polymeric Coating On Valves And Fittings for Water Industry Purposes
GROUP – H (GALVANISING)	
H1	Repair of Galvanised Coating
H2	Hot-Dip Galvanising of Steel Structures
H3	Repair of Inorganic Zinc Silicate (IZS) Coated Structures
GROUP – I (ELASTOMERIC POLYURETHANE)	
I1	Elastomeric Polyurethane Protective Coating on Concrete
GROUP – J (ANTI-GRAFFITI)	
J1	Anti-Graffiti Coating on New and Old Steel Structures
J2	Anti-Graffiti Coating on New and Old Concrete Structures

SYSTEM DESIGNATION	COATING SPECIFICATIONS
GROUP - K (WATER BASED ACRYLIC)	
K1	Aesthetic Finish Coating on Above Ground Plastic Pipes and Fittings
GROUP L - WRAPPING AND HEAT SHRINK SLEEVE	
L1	Tape Wrapping Requirements
L2	Heat Shrink Sleeve Procedure
GROUP - M (MISCELLANEOUS)	
M1	Above Ground to Below Ground Pipeline Transitional Area and Concrete Encasement Coating Procedure
M2	Coating Procedures for Above Ground Sintakote® Pipe and Steel Pipe Joints
M3	Coating Procedures for Clean Skin Pipe Permanently Exposed to Atmosphere
M4	Coating Procedure for Coupling Jointed Joints
M5	Coating Procedure for Steel Pipe at the Concrete Interface
M6	Coating Procedure For Steel Pipe at the Concrete Interface & Sintakote® Pipe Joint
M7	Coating Procedure on Galvanised Steel for Decorative Purposes in Low Corrosive Environments
M8	Cement Mortar Lining Requirement
M9	Grouting Convex Band in Pipelines

19 APPENDIX 3 - COMMONLY USED COATINGS IN POTABLE WATER AND WASTEWATER INFRASTRUCTURES

Code	Jotun Paints	International Paints	Dulux Paints	Hempel (Wattyl) Australia	PPG
IZS	Resist 86 AU	Interzinc 22	Durezinc i90	Galvit ES600/Galvosil 15700	Ameron D9
ZRE	Barrier Barrier Plus	Interzinc 52e	Zincanode 202 Zincanode 402	Avantguard 750	SigmaZinc 109 HS Sigmazinc 68HS
EP	Penguard Express ZP Penguard Special	Intergard 345 Interline 982*	Durepon EZP Duremax GPE ZP	Epinamel PR250	SigmaCover 256 SigmaPrime 200
EM	Jotamastic 90*(valve blue) Jotamastic 90*(off white)	Interseal 670HS Interplus 1180 Interplus 356 (MIO)	Durebild STE Durebild STE (MIO)	Epinamel 985* &985 MIO	SigmaCover 350 Amerlock 400 Amerlock 400 (MIO)
HBE	Tankguard 412** Marathon 550	Interline 975P** Interzone 954	Duremax HBE Duremax GPE w Quickturn* Duremax GFX*	Epinamel TL770SF** Epinamel 985*	Sigmaguard CSF 575** SigmaShield 880
UHB	Jotacote UHB	Interzone 485	Luxapoxy UHB	Epinamel UHB1000	Sigmashield 880XS Sigmashield 880
GFE	Marathon Jotamastic 90 GF	Interzone 954GF	Duremax GFX*	Hempadur Multi 35560	Amerlock 400GF
EPUR	N/A	Polibrid 705-E**	Flexituff** Flexituff DM8		N/A
PUR	Hardtop AX Hardtop Flexi Hardtop XPL (Matt Finish)	Interthane 990	Luxathan HPX Weathermax HBR	Poly U400	SigmaDur 550
AG		Interfine 878	Weathermax HBR Acrathane IF	Poly U400 Antigraffiti Clear	PSX700
WBA	N/A	Intercryl 988	Weathershield Gloss	Solagard	Taubmans All Weather Gloss
ZRP	Barrier (2-pack)	Interzinc 52	Zincanode 202 Zinc Rich 1P	Avantguard 750	Sigmazinc 109 HS Amercoat 68HS

CODE

IZS	In-Organic Zinc Silicate	**EM**	Epoxy Mastic	**GV**	Galvanised	**UHB**	Ultra High Build Epoxy
ZRE	Zinc Rich Epoxy	**GFE**	Glass Flake Epoxy	**EPUR**	Elastomeric Polyurethane		
PUR	Polyurethane	**FBP**	Fusion Bonded Powder	**AG**	Anti-Graffiti		
HBE	High Build Epoxy	**TBP**	Thermal Bonded Polymer	**WBA**	Water Based Acrylic		
EP	Epoxy Primer	**ZRP**	Zinc Repair	**EM (MIO)**	Epoxy Mastic (Micaceous Iron Oxide)		

Notes:

[1] * Complies with AS/NZS 4020- Testing of products for use in contact with drinking water. Contractor to confirm the validity of AS/NZS 4020 certification with coating supplier before ordering.

[2] ** Complies with AS/NZS 4020- Is 100% Volume Solids for use in potable water utilities eg: water tanks and surge vessels and clarifiers

[3] Where a coating system requires more than one product to be used (e.g. Primer and topcoat) both products shall be from the same supplier unless approved otherwise by the Team Leader Asset Durability

[4] The Water Corporation cannot be held responsible for the claims or performance guarantees offered by coating product suppliers.

[5] Due to continuous product development, coating contractors shall check with product suppliers to confirm that the product names and numbers are current at the time of ordering.

END OF DOCUMENT