

Amendments to the 2021 Water System External Corrosion Control Standards

Description	Section Modified	Approval Date
Bonded Dielectric Coating Revisions	Part 2, Table 3. Corrosion Control Requirements and Part 4 Bonded Dielectric Coating	8/10/22
2021 Update of the Water System External Corrosion Control Standards	None	7/28/21

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CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com




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Deputy Manager and Chief Engineer 

TO: WHOM IT MAY CONCERN

FROM: ERNEST Y. W. LAU, P.E.
MANAGER AND CHIEF ENGINEER 

SUBJECT: WATER SYSTEM EXTERNAL CORROSION CONTROL STANDARDS
AMENDMENTS

The following amendment to the 2021 Water System External Corrosion Control Standards is **effective immediately for Oahu only**:

1. In PART 2 – EXTERNAL CORROSION CONTROL REQUIREMENTS, delete **Table 3. Corrosion Control Requirements** in its entirety and replace with **Table 3. Corrosion Control Requirements (REVISED 8/2022)** – Attached.

Revises the bonded dielectric coating to 99 to 100% solids polyurethane or epoxy, revisions noted in bold.

2. Delete **PART 4. BONDED DIELECTRIC COATING** in its entirety and replace with **PART 4. BONDED DIELECTRIC COATING (REVISED 8/2022)** – attached.

Allows the ductile iron pipe to be provided to the coating applicator with or without asphaltic or zinc coating and other various revisions, all revisions noted in bold.

If you have any questions, please contact Michael Domion, Support Branch Head, Capital Projects Division, at (808) 748-5740 or mdomion@hbws.org.

Attachments

cc: Kauai, Maui, Hawaii Water Departments

MD:em

cc: Design Br.
M/E Br.
Const. Br.
Supp. Br.

Table 3. Corrosion Control Requirements (REVISED 8/2022)

MATERIAL	CORROSION CATEGORY A (MODERATELY TO SEVERELY CORROSIVE)	CORROSION CATEGORY B (NEGLIGIBLY TO MILDLY CORROSIVE)
Ductile Iron Pipe (DIP)	<ol style="list-style-type: none"> 1. Use Class 53 pipe 2. Bonded dielectric coating (99 to 100% solids polyurethane or epoxy) 3. Galvanic CP (GACP) or impressed current CP (ICCP) design by a Registered Professional Corrosion Engineer or NACE CP4 ^a 	<ol style="list-style-type: none"> 1. Use Class 53 pipe 2. Bonded dielectric coating (99 to 100% solids polyurethane or epoxy) 3. Galvanic CP
Metallic Valves and Fittings (when electrically continuous with Metallic Pipe)	<ol style="list-style-type: none"> 1. Ductile iron with factory-applied coating 2. Petrolatum wax tape 3. Bonding wires to DIP that has CP system 	<ol style="list-style-type: none"> 1. Ductile iron with factory-applied coating 2. Petrolatum wax tape 3. Bonding wires to DIP that has CP system
Metallic Valves and Fittings (associated with Non-metallic Pipe)	<ol style="list-style-type: none"> 1. Ductile iron with factory applied coating 2. Petrolatum wax tape 3. Galvanic CP 	<ol style="list-style-type: none"> 1. Ductile iron with factory-applied coating 2. Petrolatum wax tape
Tapping Saddles and Repair Clamps	<ol style="list-style-type: none"> 1. 316 stainless steel or ductile iron with factory-applied coating 2. Wrap in petrolatum wax tape 	<ol style="list-style-type: none"> 1. 316 stainless steel or ductile iron with factory-applied coating 2. Wrap in petrolatum wax tape
Bolts, Nuts, and Washers	<ol style="list-style-type: none"> 1. 316 stainless steel or coated steel 2. Wrap in petrolatum wax tape 	<ol style="list-style-type: none"> 1. 316 stainless steel or coated steel 2. Wrap in petrolatum wax tape
Copper Pipe	<ol style="list-style-type: none"> 1. Insulate from dissimilar metals (such as ferrous pipe) 2. Type K copper 3. Galvanic CP only when soil resistivity is less than 500 ohm-cm 	<ol style="list-style-type: none"> 1. Insulate from dissimilar metals (such as ferrous pipe) 2. Type K copper

a – GACP is preferred over ICCP. ICCP systems may be used in cases that GACP cannot provide enough current to adequately protect the pipeline and must be approved by the Manager. ICCP systems must employ measures to mitigate DC stray current interference effects on nearby utilities and coordinate with nearby utilities to balance ICCP systems.

PART 4. BONDED DIELECTRIC COATING

SECTION 1. GENERAL

1.1 Overview

- 1.1.1 The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the exterior 100% solids polyurethane or epoxy shop coating application on new ductile iron water transmission pipeline to be buried in soil. This specification also requires field touchups on damaged coatings. This work shall include all precleaning, surface preparation, coating application on ferrous surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, in accordance with the requirements of the Contract Documents.
- 1.1.2 The ductile iron pipe shall be provided to the coating applicator **with or without** an asphaltic **or zinc** coating.
- 1.1.3 All coatings, solvents, equipment, and procedures necessary to complete the work specified in the Contract Documents shall be suitable for potable water and soil exposure.
- 1.1.4 The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

1.2 Definitions

- 1.2.1 Contractor shall be defined as the coating applicator in the shop and **as** the field applicator for touch ups **at the job site installation location**.
- 1.2.2 Inspector shall be defined as a Quality Assurance/Quality Control person knowledgeable with **AMPP**, **SSPC** and **NACE** standards and general coating industry standards. This person may be retained by **BWS**, a shop applicator, or by the pipe installer.
- 1.2.3 Touchup shall be defined as a repair made by the shop applicator or field installer. The criteria for repairs are as defined in paragraphs 3.11 and 3.12.

1.3 Reference Specification, Codes, and Standards

ASTM International

D2240	Standard Test Method for Rubber Property – Durometer Hardness
D4285	Standard Test Method for Indicating Oil or Water in Compressed Air
D4414	Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gauges
D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
D5402	Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
D7393	Standard Practice for Indicating Oil in Abrasives

G95 Standard Test Method for Cathodic Disbondment Test for Pipeline Coatings

Code of Federal Regulations Title 40, Environmental Protection Agency
40CFR Part 59 Table 1 – VOC Content Limits for Industrial Coatings

National Association of Corrosion Engineers (NACE) International

- SP0188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
- SP0287 Field Measurements of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape

National Association of Pipe Fitters

- 500-03 Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings

SSPC - Steel Structures Painting Council, the Society for Protective Coatings

- PA1 Shop, Field, and Maintenance Painting of Steel
- PA2 Procedure for Determining Conformance to Dry Coating Thickness Requirements
- SP1 Solvent Cleaning
- SP2 Hand Tool Cleaning
- SP3 Power Tool Cleaning
- SP7 Brush Off Blast Cleaning
- SP11 Power Tool Cleaning to Bare Metal
- Vol. 1 Good Painting Practice

1.4 Contractor Submittals

1.4.1 Qualifications of the Shop Applicator

- 1.4.1.1 Letter identifying the person responsible for Quality Assurance/Quality Control (QA/QC) at the shop coating facility. This person shall have a minimum of 10 years of experience in the surface preparation of metals and application of the specified coatings. This person shall have an **AMPP**, **SSPC** or **NACE** training certification and shall be familiar with the industry standards. This person will be responsible for submitting QA/QC documentation to the Owner.
- 1.4.1.2 A copy of a typical QA/QC inspection report containing inspection items listed in Paragraph 3.10 of this Specification.
- 1.4.1.3 Three references which verify that the shop painting facility has demonstrated successful application of the specified coating systems in the past 5 years. Provide the structure name and size (area of coating), time of completion, the owner's name, address, and telephone number for each installation referenced.
- 1.4.1.4 The manufacturer shall provide written certification that the shop painting facility's supervisor and each applicator performing Work on the project have been trained and approved by the manufacturer to apply the selected coating system.

- 1.4.1.5 A written certification from the shop painting facility stating that it is qualified and experienced in the application of the specified coating systems.
- 1.4.1.6 The Contractor shall provide a letter states the type of mixing, spraying, heating, and environmental control equipment for the specified coating products.
- 1.4.2 Complete data on each type and kind of paint, and materials shall be submitted for review. Acceptance shall be received from BWS before the paint is applied. This procedure must be followed whether or not the paint that the Contractor proposes to use is named in the Contract Documents. Submitted data shall show where and for what uses each paint product is proposed with cross-reference made to sections of these Specifications. Paint material submittals shall include the following:
 - 1.4.2.1 Safety data sheets for all products used at the jobsite, including paints, thinners, solvents, and cleaners.
 - 1.4.2.2 Product Data Sheets for all coating products with the following information:
 - 1.4.2.2.1 Surface preparation requirements for immersion service or **severely corrosive** environments
 - 1.4.2.2.2 Minimum and maximum wet and dry film thickness per coat
 - 1.4.2.2.3 Minimum and maximum cure, induction, and pot lifetimes
 - 1.4.2.2.4 Temperature and humidity requirements during and after application
 - 1.4.2.2.5 Proper storage and shelf life at various temperatures
 - 1.4.2.2.6 EPA Method 24 results to verify compliance with 40 CFR 59 for VOC's
 - 1.4.2.2.7 Tensile, elongation, moisture vapor transmission rate, **adhesion, chemical, cathodic disbondment per ASTM G95**, and abrasion testing results.
- 1.4.3 Manufacturer's product data sheet for each abrasive material to be used with the following:
 - 1.4.3.1 Technical data sheet for each product used, including statements on the suitability of the material for the intended use.
 - 1.4.3.2 State and country of origin.
 - 1.4.3.3 Safety data sheet for each product, if applicable.
 - 1.4.3.4 Size/mesh and percentage by weight of each component
- 1.4.4 Paint Manufacturer's Information: For each paint system to be used, the Contractor shall submit the following listed data at least 30 days prior to coating:

- 1.4.4.1 Paint manufacturer's technical application instructions for application, heating materials, mixing, spray tip sizes, and hose pressures.
- 1.4.4.2 The manufacturer shall provide written certification that the coating Contractor's supervisor and each applicator performing Work on the project have been trained and approved by the manufacturer to apply the selected coating system. The manufacturer shall state whether or not it has verified that the Contractor is going to use the proper mixing, coating application, heating, and environmental control equipment for the specified coating products.
- 1.4.4.3 Drawing details for field repairs or coating terminations at joints, fittings, or special pipe sections (where applicable).

1.5 Safety and Health Requirements

- 1.5.1 Head and face protection and respiratory devices shall include protective helmets conforming to the requirements of ANSI Z 89.1, which shall be worn by all persons at all times while in the vicinity of the work. In addition, workers engaged in or near the work during abrasive blasting shall wear eye and face protection devices meeting the requirements of ANSI Z 87.1 and a respirator with **the** appropriate filter.
- 1.5.2 Where ventilation is used to control potential exposures to workers, as set forth in Section 1910.94 of the OSHA Regulations for Construction, ventilation shall be adequate to reduce the concentration of the air contaminant to the degree that a hazard to the worker does not exist. Methods of ventilation shall meet the requirements set forth in ANSI Z9.2.

SECTION 2. PRODUCTS

2.1 General

- 2.1.1 Definitions: The term "paint," "coatings," or "finishes," as used herein, shall include surface treatments, paints, and all other protective coatings, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- 2.1.2 General: Coating materials shall be sealed in new containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.
- 2.1.3 The Contractor shall use coating materials suitable for the intended use and recommended by their manufacturer for buried and groundwater environments. Materials shall be delivered unopened to the applicator in their original containers bearing the manufacturer's label, completely identifying the contents, date of manufacture, volatile organic compounds (VOCs), and listing directions for their proper use. No products shall be allowed on site that do not conform with 40 CFR Part 59.
- 2.1.4 Compatibility: In any coating system, only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of all applied coats.

- 2.1.5 Protective Coating Materials: Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide BWS with the names of not less than 5 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirements.
- 2.1.6 Substitute or "Or-Equal" Submittals: Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or-equal" material that said material meets the specified requirements and is equivalent or better than the listed materials in the following properties:
 - 2.1.6.1 Minimum and maximum cure times before immersion
 - 2.1.6.2 Moisture vapor transmission rate per **ASTM E96** or ASTM D1653 Method B at 40 mils minimum
 - 2.1.6.3 Abrasion resistance per ASTM D4060 using a CS17 wheel
 - 2.1.6.4 Adhesion per ASTM D4541 at 40 mils minimum**
 - 2.1.6.5 Minimum and maximum recoat times
 - 2.1.6.6 Ability to recoat in future
 - 2.1.6.7 Solids content by volume
 - 2.1.6.8 Dry film thickness per coat
 - 2.1.6.9 Compatibility with other coatings
 - 2.1.6.10 Suitability for the intended service
 - 2.1.6.11 Resistance to chemical attack
 - 2.1.6.12 Temperature limitations in service and during application
 - 2.1.6.13 Ease of application
 - 2.1.6.14 Ease of repairing damaged areas
- 2.1.7 The cost of all testing and analysis of the proposed substitute materials that may be required by BWS shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 Industrial Coating System Substitute Materials

2.2.1 Material Sources: Each of the following manufacturers is capable of supplying many of the industrial coating materials specified herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials must be shown to satisfy the material descriptions and to equal or exceed the properties of the listed materials as required in the paragraph entitled "Substitute or 'Or-Equal' Submittals" herein.

2.2.1.1 Induron

2.2.1.2 International Protective Coatings

2.2.1.3 Raven Lining Systems

2.2.1.4 Sherwin Williams

2.2.1.5 Tnemec

2.3 Coating Systems

2.3.1 E100: A **99% to 100%** solids epoxy to be used to coat the exterior surfaces of pipe exposed to corrosive soil conditions. The epoxy shall have a moisture vapor transmission rate less than 3 grams per square meter per 24 hours ($\text{g}/\text{m}^2/24 \text{ hr}$) as measured per ASTM D1653 Method B **or ASTM E96** at a **minimum** thickness of **40** mils. Approved products include the following:

2.3.1.1 Finish Coat (DFT 40 mils): Carboline Plasite 4500, Induron Ceramawrap Epoxy, Tnemec Series FC22 Epoxoline, **Sherwin Williams Dura Plate UHS**, or approved equal.

2.3.1.2 Total System DFT: 40 mils.

2.3.2 P100: A 100% solids polyurethane to be used to coat the exterior surfaces of pipe exposed to corrosive soil conditions. The polyurethane shall have a moisture vapor transmission rate less than 6 grams per square meter per 24 hours ($\text{g}/\text{m}^2/24 \text{ hr}$) as measured per ASTM D1653 Method B **or ASTM E96** at a **minimum** thickness of 40 mils. Abrasion resistance shall be less than 55 mg loss per ASTM D4060 using a CS17 1,000 g wheel. Approved products include the following:

2.3.2.1 Finish Coat (DFT 40 mils): Carboline Polyclad 777, Lifelast Durashield 210, or ITW Polyspec/Futura Coatings Protec II, Sherwin Williams Polycote 110, or approved equal.

2.3.2.2 Total System DFT: 40 mils.

SECTION 3. EXECUTION

3.1 Storage, Mixing, and Thinning of Materials

- 3.1.1 **Plural Component Application Products:** After each component of the coating system has been thoroughly heated, the Contractor shall perform a paint pump ratio test on the first day of spraying and at least once a week thereafter in the presence of the Inspector. The Contractor shall set up two see-through containers with preprinted volumetric marks on a flat surface. The hose valve for each component shall be opened simultaneously and each component flow rate shall be allowed to stabilize by pouring the discharging materials into separate disposable containers. After the flow is stabilized, the hoses shall be transferred to the pre-printed volumetric containers and the valves shall be shut off after one of the containers has been filled to 32 or 48 fluid ounces, depending on the mixing ratio recommended by the manufacturer. If the volumetric quantity of coating in the containers does not match the manufacturer's recommendation, the Contractor shall reduce or increase the pressure and temperature until it meets the specified mixing ratio. No spraying shall be performed until the ratio test result has been accepted by the Inspector.
- 3.1.2 **Manufacturer's Recommendations:** Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed. The Contractor shall supply BWS with copies of each manufacturer's instructions.
- 3.1.3 **Thinning of paint** shall be in accordance with the manufacturer's published instructions, especially as to the amount and kind of thinner used.
- 3.1.4 **All protective coating materials** shall be used within the manufacturer's recommended shelf life. Materials exceeding the storage life recommended by the manufacturer shall be removed from the jobsite.
- 3.1.5 **Storage and Mixing:** Coating materials shall be protected from exposure to temperatures greater than or less than the manufacturer's recommendations and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together. Flammable materials shall be stored in accordance with state and local codes.

3.2 Preparation for Coating

- 3.2.1 **All surfaces to receive protective coatings** shall be cleaned as specified herein prior to application of said coatings. The Contractor shall examine all surfaces to be coated and shall correct all surface defects before application of any coating material. All slivers, sharp edges, gouges, sharp peaks, or burrs shall be grinded down.
- 3.2.2 **Surface preparation** shall be approved by the Inspector prior to application of coating.
- 3.2.3 **The Contractor** shall remove and dispose of all debris from abrasive blasting and other surface preparation prior to coating.
- 3.2.4 **Protection of Surfaces Not to Be Coated:** Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

- 3.2.5 Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- 3.2.6 Protection of Painted Surfaces: Cleaning and coating shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.3 Environmental Requirements

- 3.3.1 No coating work shall be performed under the following conditions:
 - 3.3.1.1 Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.
 - 3.3.1.2 Dust or smoke laden atmosphere.
 - 3.3.1.3 Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.
 - 3.3.1.4 Substrate and ambient temperatures are less than 5°F above the dewpoint and are decreasing. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.
 - 3.3.1.5 Ambient temperature that is expected to drop below 50°F or less than 5°F above the dewpoint within 8 hours after application of coating.

3.4 Specials, Fittings, and Connections

- 3.4.1 Coating and lining application for special sections, connections, and fittings for steel or ductile iron pipe shall conform to coating system and application requirements as specified in this section.
- 3.4.2 Specials, fittings, and connections shall be defined as any pipe section with turnouts for blow offs, interconnects, any valve or other appurtenances, tees, crosses, wyes, laterals, mitered angles or elbows, and pipes which require special fabrication that prevents mechanical production application of the specified system from end to end of pipe joint.
- 3.4.3 Hand-applied tape coatings applied at the shop will not be permitted on any specials, fittings, connections, and elbow fittings unless it has been previously approved by BWS.
- 3.4.4 Special, fittings, and connections shall be shop coated with the E100 or P100 coating system.

3.5 Metal Surface Preparation

- 3.5.1 The Shop Painting Facility shall remove all water, grease, dust, and other contaminants from the surfaces prior to centrifugal or manual abrasive blast cleaning. All oil, grease, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 prior to blast cleaning.

- 3.5.2 All sharp edges shall be rounded or chamfered, and all slivers and surface defects shall be ground smooth prior to blast cleaning. Rust, scale, welding slag, and spatter shall be removed, and the surface prepared by SSPC SP2, Hand Tool Cleaning, and SSPC SP3, Power Tool Cleaning.
- 3.5.3 The QA person shall test for the presence of oil in the compressed air line used for abrasive blasting in accordance with ASTM D4285.**
- 3.5.4 The pipe surfaces shall be abrasive blast cleaned per NAPF 500-03-04 with the following exceptions stated in this specification. The Contractor shall use **abrasive media** material to remove all rust staining, and to achieve a minimum of a 3-mil surface profile. The surface shall be free of all visible dust, loose annealing oxide, loose mold coating, or other foreign matter. The abrasive shall be tested in accordance with ASTM D7393 and shall not contain any oil or emulsion on the surface. The abrasive shall not be reused if oil is present in the jar test.
- 3.5.5 Cast ductile iron fittings shall be abrasive blast cleaned per NAPF 500-03-05 Blast Clean #1 with the following exceptions stated in this specification. The Contractor shall use **abrasive media** material to remove all rust staining, and to achieve a minimum of a 3-mil surface profile. The surface shall be free of all visible dust, loose annealing oxide, loose mold coating, or other foreign matter. The abrasive shall not be reused unless otherwise approved by the Inspector.
- 3.5.6 If the ductile iron pipe **arrives to the shop or job site with** an asphaltic **or zinc** coating, it shall be removed at no additional cost to BWS **and replaced with the specified coating.**
- 3.5.7 Blast cleaned metal surfaces shall be painted before any rusting or other contamination of the surface occurs.
- 3.5.8 During abrasive blasting, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other NACE SP0287 approved equal, on 30% of the pipe sections. A minimum of three tests shall be conducted at the beginning, middle, and end of the work shift. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, three replica tape tests shall be performed along the length of the pipe section. For each pipe section, the three replica tape thickness values shall be recorded and the average of the three tests must be within 10% of the coating manufacturer's recommended profile. If the average is below the recommended profile, additional abrasive blasting shall be performed to meet the recommended profile.
- 3.5.9 Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil/moisture separators that remove at least 95% of the contaminants. The Inspector shall conduct a blotter test to confirm the cleanliness of the air stream per ASTM D4285.
- 3.5.10 Surfaces shall be cleaned of all dust and residual particles from the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting. The quantity and size of dust shall be tested in accordance with ISO 8502-3 and shall be Class 2 to Class 0 before proceeding.

- 3.5.11 Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

3.6 Workmanship

- 3.6.1 Each coat shall be subject to the inspection and approval of the Inspector before the next succeeding coat is applied. Defective work of any kind shall be deemed sufficient cause for completely stripping, preparing, and recoating the entire surface involved. Sufficient time shall be allowed between coats to assure proper drying for optimum bonding of the subsequent coats as recommended by the manufacturer for the existing ambient conditions. Excessive time beyond the manufacturer's recommended recoat window shall be avoided. When maximum recommended drying times are exceeded, surfaces shall be abraded for subsequent coats as recommended by the manufacturer.
- 3.6.2 All work shall be done in a professional manner with high quality workmanship leaving the finished surfaces free from runs, drops, ridges, waves, holidays, laps, brush marks, and variations in color, texture, and finish. No visual holes, bubbles, or blisters shall be allowed to be exposed to soil.
- 3.6.3 Skilled craftsmen and experienced supervision shall be used on all work.
- 3.6.4 Clean drop cloths shall be used to cover adjacent structures. All damage to surfaces resulting from the work hereunder shall be cleaned, repaired, and refinished to their original condition.
- 3.6.5 All coatings shall be applied under dry and dust-free conditions. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure that they have been thoroughly cleaned and that they receive an adequate thickness of coating material.

3.7 Surfaces Not to be Coated

- 3.7.1 The following surfaces shall not be protective coated hereunder unless shown or specified herein or elsewhere in the Contract Documents. The following exterior surfaces shall be masked off by the Contractor prior to coating work being performed on adjacent surfaces requiring coating:
 - 3.7.1.1 Push-on Joints, spigot end – Length of uncoated area shall vary with diameter of pipe. Do not coat surface covered by bell end of pipe or apply less than 10 mils DFT.
 - 3.7.1.2 Push-on Joints, bell end – flush with bell end
 - 3.7.1.3 Welded Flange Joint, spigot end – 3 inches minimum
 - 3.7.1.4 Welded Flange Joint, bell end – 4 inches minimum
- 3.7.2 Valve gaskets or seals, mating surfaces of flanges, bolt holes, drains, or manhole seats, which are not to be painted, shall be masked off prior to coating work.

3.8 Application of Spray-applied Coatings

- 3.8.1 Materials and supplies provided shall be the standard products of the manufacturer. Materials within a coating system shall be the products of a single manufacturer.
- 3.8.2 The application of protective coatings to metal substrates shall be in accordance with SSPC PA1, Shop, Field, and Maintenance Painting of Steel.
- 3.8.3 The Contractor shall perform the pump ratio check prior to spraying any coating material on the pipes. Procedures are given in Paragraph 3.1.A of this specification.
- 3.8.4 Before the start of the coating application each day, the Contractor shall set up polyethylene sheet or cardboard on the ground for the purpose of performing a test patch. The Contractor, in the presence of the Inspector, shall spray on the polyethylene sheet or cardboard and shall not have any discoloration, bubbles, or pinholes in the coating and the spray gun shall not clog. The spray gun shall produce an even fan spray and the coating shall be of a consistent color. After these performance characteristics are achieved, the coating application may proceed.
- 3.8.5 No coating shall be applied under conditions which, in the opinion of the Inspector, could jeopardize the appearance or quality of the finish in any way. It is necessary for the Contractor to provide a working area which meets the manufacturer's recommended environmental conditions. It is the Contractor's responsibility to maintain the proper ambient conditions required by the coating manufacturer.
- 3.8.6 Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The Contractor shall schedule such inspection with the Inspector in advance.
- 3.8.7 Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same work week unless environmental controls are implemented.
- 3.8.8 Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.
- 3.8.9 The Contractor shall verify the wet film thickness with a notched gauge in conformance with ASTM D4414. A minimum of one wet film thickness reading shall be recorded on 30% of the pipe segments.
- 3.8.10 Special attention shall be given to edges, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- 3.8.11 Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- 3.8.12 Finish coats, including touch-up and damage repair coats shall be overlapped 6 inches onto existing coatings and shall be applied in a manner that will present a uniform texture and color matched appearance.

- 3.8.13 The coating shall be smooth and free of sharp protrusions. It shall not exhibit any cracking, delamination, orange peeling, blisters, off-ratio discoloring, sticky areas, bubbles, craters, or pinholes. Sags and curtaining shall be less than 1% of total coated surface area for each pipe section. If any of the above defects exceed 1% of the total coated surface area of a pipe section, the pipe section shall be rejected.
- 3.8.14 Damaged shop coating that exposes the metal substrate greater than 1 inch in diameter or length shall be cleaned in accordance with SSPC SP11 using **a handheld scarifier such as MBX Bristleblaster, Desco Roto Peen**, or equivalent, and in accordance with the manufacturer's recommendations.

3.9 Exterior Field Joint Coating

- 3.9.1 Pipe joints shall be field-coated after the pipe has been installed and before the surfaces have been contaminated with oil, grease, or soil.
- 3.9.2 All mechanical joint or push-on joint restraints, couplings, fittings, elbows, tees, crosses, interconnects, or valves with uncoated surfaces shall be protected with petrolatum tape as specified in the Cathodic Protection Specification.

3.10 Inspection and Testing During and After Application

- 3.10.1 The Inspector shall provide anchor profile measurements, ammeter reading indicating the electrical loading on the abrasive blasting wheel motor, type/percent mixture of the abrasive, and shall check the cleanliness of the abrasive blasting material.
- 3.10.2 The Inspector shall provide a written record of the quantity of coating material applied, the quantity of surface area covered, a pipe identification number, each coating product batch number, dew point temperature, surface temperature, ambient temperature, relative humidity, and names of applicators on a daily basis. The Inspector shall record the pressures and temperatures at which the coating material is being heated and delivered to the spray gun.
- 3.10.3 The Inspector shall provide wet film and dry film thickness readings, and results of the holiday testing, and shall note any discrepancies with the coating specifications.
- 3.10.4 Inspection Devices: The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition and calibrated for the detection of holidays and measurement of dry-film thicknesses of protective coatings. The Contractor shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- 3.10.5 Holiday Testing: The Contractor shall holiday test all coated ferrous surfaces exposed to soil and severe service environments in the presence of the Inspector. After the specified coating has set hard to the touch, the Contractor shall test the coated surfaces for visual pinholes and sparking holidays using a high-voltage spark tester according to NACE SP0188. Areas which contain visual pinholes and sparking holidays shall be marked, repaired or recoated, and retested in accordance with the coating manufacturer's printed instructions. The electrode movement over the coating surface shall be continuous and shall proceed in a systematic manner, which ensures 100% coverage of the coated surfaces.

3.10.5.1 Coatings with DFT Exceeding 20 Mils: Pulse-type holiday detector, such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal, shall be used. Holiday testing shall be conducted with a new 12-inch or 18-inch wide wire brush electrode attached to the unit.

3.10.5.2 Induron Ceramawrap Coating: Low voltage-capable pulse type holiday detector such as Tinker & Razor Model AP-W, Elcometer 236 DC, or equal, shall be used at a setting of 2,000 Volts. Holiday testing shall be conducted with a new or clean 12-inch or 18-inch wire brush electrode.

3.10.6 Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC PA2, Determining Profile Compliance, using an electromagnetic-type Type 2 dry film thickness gauge **and a Level 3 thickness restriction**. The instruments shall have the capability of measuring 50% over the specified coating thickness and shall produce an actual reading and shall not be estimated. No measurements shall be made until at least 8 hours after application of the coating. The following instruments are acceptable:

3.10.6.1 Ferrous and Non Ferrous Surfaces

3.10.6.1.1 Wet – Notched gauge per ASTM D4414 or approved equal.

3.10.6.1.2 Dry – Elcometer Model 456, PosiTector 6000, Fischer MMS DFT, or equal.

3.10.7 Surface Profile: 30% of the pipe sections shall have the surface profile tested. The surface profile shall be tested with the use of Press-o-Film as manufactured by Testex or other NACE SP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex or other ASTM D4417 Type C approved equal. For each test area, three replica tape tests shall be performed within a single test area 12 inches in diameter. For each test area, the three replica tape thickness values shall be recorded and must be within 10% of the coating manufacturer's recommended profile.

3.11 Handling, Transportation, and Storage

3.11.1 Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.

3.11.2 During coating application, storage, loading, transportation, unloading, laying and installation, the handler shall take precaution to not damage the coating. Padding shall be installed on surfaces of forklift equipment that comes in contact with the pipe.

3.11.3 When transporting multiple stacks of pipe, padded bolsters between each layer of pipe and heavy duty padding under the load tie-downs shall be installed. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide. All pipe contact locations shall be heavily padded with carpet, HDPE padding, or other durable material when shipping to the project location and from the shop coating application location to the job site.

3.11.4 Dragging or skidding of pipe on grade or in trench will not be permitted.

- 3.11.5 The pipe shall not be laid on asphalt without suitable padding at all contact points.
- 3.11.6 Metal chains, wire cables, clam shell bucket, or excavator bucket in contact with the exterior of the pipe or appurtenances without padding shall not be used to lift or move the pipe.
- 3.11.7 The coated pipe shall be inspected by the Contractor at the job site for damage prior to laying down the pipe in the trench. Damage to the coating as defined in Section 3.12, shall be repaired in accordance with the manufacturer's recommendations to the satisfaction of BWS. If the damage is widespread and is more than 5% of the total surface area of the pipe section, the lining shall be removed by abrasive blasting and recoated.

3.12 Shop and Field Repairs

- 3.12.1 If an area is found to have bubbles, blisters, insufficient film thickness, visual or sparking holidays, or other deficiencies; then the Contractor shall abrade, clean, and topcoat the coated surface per the manufacturer's mixing recommendations and these Specifications. The abraded area and repair coating shall overlap the surrounding coated area by 3 to 6 inches, depending on the size of the defect or field repair. Work shall be free of bubbles, blisters, visual or sparking holidays, and discoloration.
- 3.12.2 Damaged shop coating that exposes the metal substrate greater than 1 inch in diameter or length shall be cleaned in accordance with SSPC SP11 using **a handheld scarifier such as MBX Bristleblaster, Desco Roto-Peen**, or equivalent, and in accordance with the manufacturer's recommendations.

3.13 Curing of Coatings

- 3.13.1 If the coating exhibits delamination, blisters, or tackiness after the manufacturer's recommended cure time, the Inspector shall conduct a Solvent Rub Test in accordance with ASTM D5402 **or using an amine blush test kit as manufactured by Elcometer or equal**. The test area shall be evaluated for appearance, hardness, or any color transfer to the cloth. If there is no change to the coating after the test, it will be considered cured. If there is color transfer to a cloth, the affected areas shall be removed and recoated at the Contractor's expense.
- 3.13.2 If the coating exhibits softness, blisters, or tackiness after the manufacturer's recommended cure time, the Inspector shall conduct Shore D Hardness Testing per ASTM D2240. In order to consider the coating cured and properly mixed, it must meet the manufacturer's recommended Shore D Durometer requirement for the specified product. If the hardness result does not meet the requirement, the affected areas shall be removed and recoated at the Contractor's expense.
- 3.13.3 The Contractor shall provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the highest requirement, prior to placing the completed coating system into service.
- 3.13.4 In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.14 Coating System Schedules for Ductile Iron Pipe

- 3.14.1 One of the following 100% solids polyurethanes, 100% solids epoxy, or approved equal, shall be used to coat the exterior surfaces of pipe exposed to soil and groundwater.
- 3.14.2 Any deviations to the following schedule shall be submitted 10 business days in advance and shall be approved by BWS prior its application. Unapproved materials applied prior to approval by BWS shall be removed at the sole expense of the Contractor.

Substrate	Surface Preparation	Coating System No.
Ductile Iron Pipe Exterior	NAPF-500-03-04 with a 3 mil surface profile minimum	P100 or E100
Ductile Iron and Cast Iron Fittings, Elbows, Tees, Crosses, Wyes and other metal appurtenances	NAPF-500-03-05 Blast Clean #1 with a 3 mil surface profile minimum	P100 or E100

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



July 28, 2021

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ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ELLEN E. KITAMURA, P.E.
Deputy Manager and Chief Engineer

TO: WHOM IT MAY CONCERN

FROM: ERNEST Y. W. LAU, P.E., MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY 

SUBJECT: 2021 UPDATE OF THE WATER SYSTEM EXTERNAL CORROSION CONTROL STANDARDS

Effective immediately Oahu Only, the Water System External Corrosion Control Standards, dated 1991 shall be replaced with the update Water System External Corrosion Control Standards, dated 2021. All construction plans received by the Board of Water Supply shall comply with the updated Standards.

An electronic copy of the updated Standards is available on our website at boardofwatersupply.com/wss.

If you have any questions, please contact Michael Domion, Support Branch Head, Capital Projects Division, at (808) 748-5740 or mdomion@hbws.org.

cc: Hawaii, Kauai and Maui Water Departments