

NAPF 500-03

SURFACE PREPARATION STANDARD FOR DUCTILE IRON PIPE AND FITTINGS IN EXPOSED LOCATIONS RECEIVING SPECIAL EXTERNAL COATINGS AND/OR SPECIAL INTERNAL LININGS

As approved by the
NAPF Board of Directors

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STANDARD

National Association of Pipe Fabricators

This document is a standard and as such constitutes a model developed to establish acceptable standards for the water and wastewater industry. The standard describes basic criteria and minimum requirements and contains several options, which must be evaluated by the user. It does not contain information normally included in a specification and therefore should not be considered one. The NAPF does not endorse any material or application method nor does it test, approve or certify their use. The standard has been developed under pressures by the NAPF Standards Council and may be revised or withdrawn at any time. Notice of such action will be posted in THE PIPELINE, the official newsletter of the association, and will become effective the first day of the month following publication.

NAPF 500-03
Surface Preparation Standard for Ductile Iron Pipe and Cast Ductile
Iron Fittings In Exposed Locations Receiving Special
External Coatings And/Or Special Internal Linings

Effective March 1, 2000
Revised 2/14/2006

FOREWARD

Introduction

Ductile iron has been used in the manufacture of pipe and fittings and is recognized as the industry standard for water and wastewater systems due to its strength, durability and reliability for the transportation of raw and potable water, sewage, slurries and process chemicals.

Generally, ductile iron pipe and fittings are furnished from the manufacturer with an external asphaltic coating and internal cement lining. This coating and lining is well suited for most underground distribution service requirements.

For external corrosion protection the ductile iron pipe industry recommends polyethylene encasement to protect buried ductile iron pipe and fittings in the vast majority of installations where aggressive soil conditions are a concern. This method of external corrosion protection, which has been extensively researched and used to successfully protect millions of feet of iron pipe since 1951, has proven effective in a broad range of soil conditions.

In some cases, however, either due to installation factors or to the environment to which the pipeline may be exposed, special bonded external coatings or internal linings may be required or specified in lieu of these two standard methods of protection. Appropriate surface preparation for these external coatings or internal linings must be observed.

This standard is not intended for use as the basis for surface preparation scenarios for bonded coatings for buried pipe applications. The conditions of exposure are substantially different. Moreover, no research was conducted by NAPF or others engaged in the standards publication to support any such use.

Inapplicable Surface Preparation Standards Currently In Use

Several publications and standards exist for surface preparation of steel surfaces. They include, but are not limited to Steel Structures Painting Council (SSPC), National Association of Corrosion Engineers (NACE) Standards, and Swedish Surface Preparation Standards. Although ductile iron and carbon steel are both ferrous metals, there are inherent metallurgical, manufacturing and processing differences between the two metals that preclude certain parts of the SSPC, NACE and other surface preparation standards, written specifically for steel surfaces, from being applied to ductile iron pipe and fittings.

Attempts to apply steel surface preparation specifications to ductile iron is inappropriate and may actually result in damage to the pipe surface with subsequent reduced coating effectiveness and life expectancy.

Steel versus Ductile Iron Surfaces

Inherent manufacturing differences between ductile iron pipe and carbon steel necessitate differences in surface preparation requirements. Examples of some of these differences are as follows:

- Rolled steel in "mill condition" will normally require (1) blast removal of mill scale, rust or other surface contaminants, and (2) the establishment of an anchor pattern to the normally smooth surface of steel through abrasive blasting. Generally, ductile iron pipe will not require the same degree of blast to achieve equivalent surface cleanliness. Also, ductile iron pipe has a higher anchor profile as cast than can be achieved with steel by abrasive blasting.
 - The chemistry and metallurgy of ductile iron pipe and fittings versus that of carbon steel result in a surface that has a different texture and color from that of steel. Additionally, the texture and color of ductile iron pipe and fittings also may vary due to the differences in manufacturing processes.
1. Ductile iron pipe manufactured using the deLavaud centrifugally cast process with dry spray on peen pattern metal molds will have an annealing oxide on the exterior surface. This annealing oxide is different than mill scales typically found on steel surfaces. It is significantly more tenacious, adherent and more difficult to remove by abrasive blasting than mill scale on steel surfaces. Testing by pipe manufacturers, the Ductile Iron Pipe Research Association (DIPRA) and established coating manufacturers have determined that tightly adherent annealing oxide on ductile iron pipe acts as a very corrosion resistant protective layer on the surface of the ductile iron.
 2. For these reasons, narrative visual descriptions and/or visual standards prepared for steel surfaces are not applicable for ductile iron surfaces (i.e.: terms such as white metal abrasive blast and near white metal abrasive blast do not apply). To illustrate, SSPC standards describe the visual appearance changes to steel as abrasive blasting is applied. The surface changes from a dull black/gray (SP 7) to gray (SP 6) to near white (SP 10) to bright white (SP 5). However, ductile iron pipe changes from the "as cast" medium gray to a bluish gray color when abrasive blasting (not recommended by these standards) eventually may produce an uneven black to a mottled dull gray/white surface color. However this activity frequently results in damage to some ductile iron surfaces.

Footnote: Test results are proprietary and available from the ductile iron pipe manufacturers.

- Unlike steel surfaces, it is possible to "overblast" the external surface of ductile iron pipe. High nozzle velocities and/or excessive blast times can cause "blistering" and "slivering" of some external deLavaud pipe surfaces resulting in a surface which is unsuitable for coating with any material. This overblasting normally occurs when attempts are made to remove the tenacious, tightly adherent annealing oxide from the external surface of deLavaud dry spray pipe with a peen pattern surface. Damage to the pipe surface due to overblasting normally does not occur on internal surfaces.

Manufacturing Variability of Ductile Iron Surfaces

Not only are ductile iron pipe surfaces different from steel surfaces, but they may also vary significantly with respect to each other depending on such variables as the pipe manufacturer, the manufacturing process, pipe size, pipe thickness, iron chemistry, iron cooling/solidifying rates and whether the surface to be coated is internal or external. For example, some types of external ductile iron surfaces with totally different appearances and coating characteristics include 1) small peen pattern dry spray deLavaud process pipe, 2) large peen pattern dry spray deLavaud process pipe, 3) chill free dual spray process large diameter pipe and 4) sand cast fitting surfaces.

In general, 1) large diameter, thicker pipe which solidify slower will have a rougher interior surface than thinner, small diameter pipe; 2) higher carbon content pipe will have a rougher internal surface than lower carbon content pipe. Cast Fitting surfaces will be smoother than centrifugally cast ductile iron pipe surfaces. Also, dual spray process large diameter pipe do not have annealing oxides as do dry spray process deLavaud pipe, but rather will have a residue layer of diatomaceous silica mold coating on the exterior surface.

Previously Painted Surfaces

1. Ductile Iron Pipe - The standard internal and external coating furnished by the manufacturer is an asphaltic cutback paint. The NAPF does not recommend the application of special coatings over asphaltic pipe coatings due to the incompatibility of most such coatings and asphalt. Asphaltic coatings are difficult to remove from centrifugally cast ductile iron pipe surfaces. **Therefore, uncoated pipe is recommended when special coatings are required, unless otherwise recommended by the coating manufacturer.**

2. Cast Ductile Iron Fittings - Some cast ductile iron fittings may be furnished by the manufacturer with an asphaltic cutback paint. The NAPF does not recommend the application of special coatings over asphaltic coatings due to the incompatibility of special coatings over asphaltic coatings due to the incompatibility of most such coatings and asphalt. However, unlike centrifugally cast ductile iron pipe surfaces, static cast ductile iron fitting surfaces are smoother, thus affording a greater opportunity for the removal of the previously applied asphaltic coatings. Although the NAPF recommends uncoated fittings when special coatings are required, it may be necessary to remove existing asphaltic paint through the use of more arduous methods. Therefore, this standard provides definitive procedures for both uncoated and previously coated cast ductile iron fittings.

Recommended Surface Preparation for Ductile Iron Pipe and Fittings

Most coating manufacturers require some type of surface preparation as a condition of warranty. Since their recommendation for surface preparation will vary depending on the type of coating and on the ultimate service environment, the coating/lining manufacturer's technical data sheet should be consulted each time a special coating/lining is used. Normally, recommendations given on coating/lining manufacturer's technical data sheets are for carbon steel and may not apply to ductile iron pipe and fittings. Therefore, the pipe or fitting manufacturer or NAPF pipe fabricator should also be consulted regarding the type of coating, method of application, and type of surface preparation to be used.

The standards given on the following pages for surface preparation of ductile iron pipe and fittings have been developed based on considerations discussed in the preceding paragraphs.

These standards are described as:

NAPF 500-03-01	Solvent Cleaning
NAPF 500-03-02	Hand Tool Cleaning
NAPF 500-03-03	Power Tool Cleaning
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings

NAPF 500-03-01

Surface Preparations Standard for "Solvent Cleaning"

1.0 Scope:

This standard covers the requirements for the solvent cleaning of previously uncoated ductile iron pipe and fitting surfaces.

2.0 Definition:

2.1

Solvent cleansing is a method which shall result in the surface being free of all oil, small deposits of asphalt paint, grease, soil, drawing and cutting compounds and other soluble contaminants from iron surfaces

2.2

It is intended that solvent cleaning, when necessary, be used prior to the application of special coating/lining and in conjunction with surface preparation methods specified for the removal of rust, annealing oxide, or mold coating

3.0 Surface Preparation Before and After Solvent Cleaning:

3.1

Prior to solvent cleaning, remove foreign matter (other than grease and oil) by one or a combination of the following: brush with stiff fiber or wire brushes, abrade, scrape or clean with solutions of appropriate cleaners provided such cleaners are followed by a fresh water rinse.

3.2

After solvent cleaning, remove dirt, dust and other contaminants from the surface prior to coating/lining application. Acceptable methods include brushing, blowing off with clean, dry air, or vacuum cleaning.

4.0 Methods of Solvent Cleaning:

4.1

Remove heavy oil or grease first by scraper. Then remove remaining oil or grease by any of the following methods:

4.1.1

Wipe or scrub the surface with rags or brushes wetted with solvent. Use clean solvent and clean rags or brushes for the final wiping.

4.1.2

Spray the surface with solvent. Use clean solvent for the final spraying.

4.1.3

Vapor degrease using stabilized chlorinated hydrocarbon solvents.

4.1.4

Immerse completely in a tank or tanks of solvent. For the last immersion, use solvent which contains no detrimental amounts of contaminant.

4.1.5

Emulsion of alkaline cleaners may be used in place of the methods described. After treatment, wash the surfaces with fresh water or steam to remove detrimental residues.

4.1.6

Steam clean, using detergents or cleaners and follow by steam or fresh wash to remove detrimental residues.

5.0 Inspection:

5.1

All work and materials supplied under this standard shall be subject to timely inspection by the purchaser or its authorized representative.

5.2

The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the standard.

6.0 Safety:

6.1

All safety requirements stated in this standard and its component parts apply in addition to any applicable federal, state and local rules and requirements and shall be in accordance with instructions and requirements of insurance underwriters.

NAPF 500-03-02

Surface Preparations Standard for "Hand Tool Cleaning"

1.0 Scope:

This standard covers the requirements for the hand tool cleaning of ductile iron pipe and fitting surfaces.

2.0 Definition:

2.1

Hand tool cleaning is a method of preparing iron surfaces by the use of non-power hand tools which shall result in the surface being free of all loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter. It is not intended that adherent annealing oxide, mold coating and rust be removed by this process. Annealing oxide, mold coating, and rust are considered adherent if they cannot be removed by lifting with a dull putty knife. All asphalt paint must be removed prior to hand tool cleaning.

2.2

Visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

3.0 Surface Preparation Before and After Hand Tool Cleaning:

3.1

Before hand tool cleaning, remove oil, small deposits of asphalt paint, grease, soluble welding residues, and salts by the methods outlined in the Standard for Solvent Cleaning or other agreed upon methods. (See [NAPF 500-03-01](#)).

3.2

After hand tool cleaning and prior to coating, remove dirt, dust or similar contaminants from the surface. Acceptable methods include brushing, blowing off with clean, dry air, or vacuum cleaning.

4.0 Methods of Hand Tool Cleaning:

4.1

Use hand tools to remove stratified rust (rust scale).

4.2

Use hand tools to remove all weld slag.

4.3

Use hand wire brushing, hand abrading, hand scraping or other similar non-impact methods to remove all loose annealing oxide, and all loose or non-adherent rust.

5.0 Inspection:

5.1

All work and materials supplied under this standard shall be subject to timely inspection by the purchaser or its authorized representative.

5.2

The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the standard.

6.0 Safety:

6.1

All safety requirements stated in this standard and its component parts apply in addition to any applicable federal, state and local rules and requirements and shall be in accordance with instructions and requirements of insurance underwriters.

NAPF 500-03-03

Surface Preparations Standard for "Power Tool Cleaning"

1.0 Scope:

This standard covers the requirements for the power tool cleaning of ductile iron pipe and fitting surfaces.

2.0 Definition:

2.1

Power tool cleaning is a method of preparing iron surfaces by the use of power assisted hand tools which shall result in the surface being free of all loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter. It is not intended that adherent annealing oxide, mold coating and rust be removed by this process. Annealing oxide, mold coating, and rust are considered adherent if they cannot be removed by lifting with a dull putty knife. All asphalt paint must be removed prior to hand tool cleaning.

2.2

Visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

3.0 Surface Preparation Before and After Power Tool Cleaning:

3.1

Before power tool cleaning, remove oil, small deposits of asphalt paint, grease, soluble welding residues, and salts by the methods outlined in the Standard for Solvent Cleaning or other agreed upon methods. (See [NAPF 500-03-01](#)).

3.2

After power tool cleaning and prior to coating, remove dirt, dust or similar contaminants from the surface. Acceptable methods include brushing, blowing off with clean, dry air, or vacuum cleaning.

4.0 Methods of Power Tool Cleaning:

4.1

Use rotary or impact power tools to remove rust.

4.2

Use rotary or impact power tools to remove all weld slag.

4.3

Use power wire brushing, power abrading, power impact or other power rotary tools to remove all loose annealing oxide, and all loose or non-adherent rust. Do not burnish the surface.

4.4

Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts.

5.0 Inspection:

5.1

All work and materials supplied under this standard shall be subject to timely inspection by the purchaser or its authorized representative.

5.2

The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the standard.

6.0 Safety:

6.1

All safety requirements stated in this standard and its component parts apply in addition to any applicable federal, state and local rules and requirements and shall be in accordance with instructions and requirements of insurance underwriters.

NAPF 500-03-04

Surface Preparations Standard for "Abrasive Blast Cleaning of Ductile Iron Pipe"

1.0 Scope:

This standard covers the requirements for the abrasive blast cleaning of ductile iron pipe and fitting surfaces.

[CAUTION: Ductile iron pipe external surfaces, in some cases, can be damaged by excessive abrasive blast cleaning beyond this standard. (See Foreward)].

2.0 Definition:

2.1

Abrasive Blast Cleaning - External Pipe Surfaces is a method of preparing the exterior of ductile iron pipe surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of asphalt paint and grease shall have been removed by solvent cleaning (see NAPF 500-03-01). After the entire surface to be coated is struck by the blast media, tightly adherent annealing oxide, mold coating and rust staining may remain on the surface provided they cannot be removed by lifting with a dull putty knife.

2.2

Abrasive Blast Cleaning - Internal Pipe Surfaces is a method of preparing the interior of ductile iron pipe surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of asphalt paint and grease shall have been removed by solvent cleaning (see NAPF 500-03-01). The entire surface to be coated shall be struck by the blast media. **Depending upon the type of service for which the lined pipe is intended, and upon the type of lining which is specified, different degrees of tightly adherent annealing oxide and rust staining removal may be required.** For some lining materials, extra internal grinding prior to abrasive blasting may be required. Internal pipe surface preparation requirements shall be specified by the pipe manufacturer or pipe fabricator as well as the lining manufacturer, and shall be based upon testing of a specific lining applied to ductile iron pipe exposed to a specific environment.

3.0 Appearance of Completed Surfaces:

3.1

The surface shall be roughened to a degree suitable for the specified coating system.

3.2

The entire surface shall be subjected to the abrasive blast. The remaining annealing oxide, rust staining or mold coating shall be tight and the surface sufficiently abraded to provide good adhesion and bonding of the specified coating system.

3.3

The appearance of the surface may be affected by the particular blasting abrasive used, the original surface condition and the pipe manufacturing process.

3.4

Visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

4.0 Surface Preparation Before and After Abrasive Blast Cleaning:

4.1

Before abrasive blast cleaning, deposits of oil or grease shall be removed by the methods outlined in the Standard for Solvent Cleaning or other agreed upon method.

4.2

After blast cleaning and prior to coating/lining, perform the following:

4.2.1

Remove deposits of oil, grease or other contaminants. (See NAPF 500-03-

01).

4.2.2

Remove dust and loose residues from dry abrasive blast cleaning. Acceptable methods include brushing, blowing off with clean, dry air, or vacuum cleaning. (When compressed air is used for blowing off, use and maintain moisture and oil separators and traps to provide a clean and dry air supply).

5.0 Blast Cleaning Methods and Operation:

5.1

Methods:

5.1.1

Dry abrasive blasting, using compressed air, blast nozzles and abrasive.

5.1.2

Dry abrasive blasting, using a closed cycle, recirculating abrasive system with compressed air, blast nozzle and abrasive, with or without vacuum for abrasive recovery.

5.1.3

Dry abrasive blasting, using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive.

5.2

Operation:

5.2.1

When compressed air is used for nozzle blasting, moisture and oil separators and traps shall be used and maintained to provide a clean dry air supply.

5.2.2

Blast cleaning operations shall be performed such that no damage is done to partially or entirely completed portions of the work.

6.0 Blast Cleaning Abrasives:

6.1

Abrasives shall conform to the following requirements:

6.1.1

The abrasive shall be free of corrosion producing contaminants and also free of oil, grease, or other deleterious contaminants.

6.1.2

Selection of abrasive size and type shall be based on the surface condition of the pipe to be cleaned and on the finished surface to be produced for the subsequent coating/lining system.

6.1.3

The cleanliness and sizing of the abrasive shall be maintained to ensure compliance.

7.0 Inspection:

7.1

All work and materials supplied under this standard shall be subject to timely inspection by the purchaser or its authorized representative.

7.2

The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the standard.

8.0 Safety:

8.1

All safety requirements stated in this standard and its component parts apply in addition to any applicable federal, state and local rules and requirements and shall be in accordance with instructions and requirements of insurance underwriters.

NAPF 500-03-05

Surface Preparations Standard for "Abrasive Blast Cleaning of Cast Ductile Iron Fittings"

1.0 Scope:

This standard covers the requirements for the abrasive blast cleaning of cast ductile iron fitting surfaces.

2.0 Definition:

2.1

Abrasive Blast Cleaning - Cast Ductile Iron Fittings. Internal and External Surfaces is a method of preparing the interior and exterior of cast ductile iron fittings surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of asphalt paint and grease shall have been removed by solvent cleaning (see NAPF 500-03-01). Four degrees of abrasive blast cleaning for fittings are available, depending on the type of service for which the fitting is intended and upon the type of coating/lining specified.

2.1.1

Ductile Iron Fitting Blast Clean #1 - No staining may remain on the surface after abrasive blast cleaning. This is the only method recommended for fittings previously coated with asphaltic paint.

2.1.2

Ductile Iron Fitting Blast Clean #2 - In addition to the above general description, no more than 5% staining may remain on the surface after abrasive blast cleaning. Staining may consist of light shadows, rust stains, oxide stains or stains from previously applied coatings (provided the coating is not asphaltic).

2.1.3

Ductile Iron Fitting Blast Clean #3 - In addition to the above general description, no more than 33% staining may remain on the surface after abrasive blast cleaning. Staining may consist of light shadows, rust stains, oxide stains or stains from previously applied coatings (provided the coating is not asphaltic).

2.1.4

Ductile Iron Fitting Blast Clean #4 - In addition to the above general description, no limit is placed on the staining which may remain on the surface after abrasive blast cleaning provided it is tightly adherent. Staining may consist of light shadows, rust stains, oxide stains or stains from previously applied coatings (provided the coating is not asphaltic).

3.0 Appearance of Completed Surfaces:

3.1

The surface shall be roughened to a degree suitable for the specified coating system.

3.2

The entire surface shall be subjected to the abrasive blast. The remaining annealing oxide, rust staining or mold coating shall be tight and the surface sufficiently abraded to provide good adhesion and bonding of the specified coating system.

3.3

The appearance of the surface may be affected by the particular blasting abrasive used, the original surface condition and the pipe manufacturing process.

3.4

Visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

4.0 Surface Preparation Before and After Abrasive Blast Cleaning:

4.1

Before abrasive blast cleaning, deposits of oil or grease shall be removed by the methods outlined in the Standard for Solvent Cleaning or other agreed upon method.

4.2

After blast cleaning and prior to coating/lining, perform the following:

4.2.1

Remove deposits of oil, grease or other contaminants. (See NAPF 500-03-

01).

4.2.2

Remove dust and loose residues from dry abrasive blast cleaning. Acceptable methods include brushing, blowing off with clean, dry air, or vacuum cleaning. (When compressed air is used for blowing off, use and maintain moisture and oil separators and traps to provide a clean and dry air supply).

5.0 Blast Cleaning Methods and Operation:

5.1

Methods:

5.1.1

Dry abrasive blasting, using compressed air, blast nozzles and abrasive.

5.1.2

Dry abrasive blasting, using a closed cycle, recirculating abrasive system with compressed air, blast nozzle and abrasive, with or without vacuum for abrasive recovery.

5.1.3

Dry abrasive blasting, using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive.

5.2

Operation:

5.2.1

When compressed air is used for nozzle blasting, moisture and oil separators and traps shall be used and maintained to provide a clean dry air supply.

5.2.2

Blast cleaning operations shall be performed such that no damage is done to partially or entirely completed portions of the work.

6.0 Blast Cleaning Abrasives:

6.1

Abrasives shall conform to the following requirements:

6.1.1

The abrasive shall be free of corrosion producing contaminants and also free of oil, grease, or other deleterious contaminants.

6.1.2

Selection of abrasive size and type shall be based on the surface condition of the pipe to be cleaned and on the finished surface to be produced for the subsequent coating/lining system.

6.1.3

The cleanliness and sizing of the abrasive shall be maintained to ensure compliance.

7.0 Inspection:

7.1

All work and materials supplied under this standard shall be subject to timely inspection by the purchaser or its authorized representative.

7.2

The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the standard.

8.0 Safety:

8.1

All safety requirements stated in this standard and its component parts apply in addition to any applicable federal, state and local rules and requirements and shall be in accordance with instructions and requirements of insurance underwriters.