International Standard

ISO 8504-5

First edition
2024-09

Preparation of steel substrates before application of paints and related products — Surface preparation methods —

Part 5: Water jet cleaning

Préparation des subjectiles d'acier avant application de peintures et de produits assimilés — Méthodes de préparation des subjectiles —

Partie 5: Nettoyage au jet

Reference number
ISO 8504-5:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 12, *Preparation of steel substrates before application of paints and related products*.

A list of all parts in the ISO 8504 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The performance of protective coatings of paint and related products applied to steel is significantly affected by the state of the steel surface immediately prior to painting. The principal factors that are known to influence this performance are:

— the presence of rust and mill scale,

— the presence of surface contaminants, including salts, dust, oils and greases, and

— the surface profile.

The ISO 8501 series, the ISO 8502 series and the ISO 8503 series provide methods for assessing these factors, while the ISO 8504 series provides requirements and guidance on the preparation methods that are available for cleaning steel substrates, indicating the capabilities of each in attaining specified levels of cleanliness.

The ISO 8504 series is applicable to new and corroded steel surfaces and to steel surfaces that are uncoated or have been previously coated with paints and related products.

The ISO 8501, ISO 8502, ISO 8503 and ISO 8504 series do not contain provisions for the protective coating system to be applied to the steel surface. They do not contain provisions for the surface quality requirements for specific situations, even though surface quality can have a direct influence on the choice of protective coating to be applied and on its performance. Such provisions can be found in other documents such as national standards and codes of practice. Users of the ISO 8501, ISO 8502, ISO 8503 and ISO 8504 series should ensure the qualities specified are:

— compatible and appropriate both for the environmental conditions to which the steel will be exposed and for the protective coating system to be used, and

— within the capability of the cleaning procedure specified.

The primary objective of surface preparation is to ensure the removal of deleterious matter and to obtain a surface that permits satisfactory adhesion of the priming paint to steel. It is also intended to assist in reducing the amounts of contaminants that initiate corrosion.

Water jetting is an effective method for removing coatings from previously painted surfaces, removing water-soluble contaminants, and producing partially removed coatings. While water jetting by itself can produce a granular profile in metals under some conditions, water jetting is considered a secondary surface preparation method and is not used to provide the primary anchor pattern on the metallic substrate known as “surface profile.” Water jetting is primarily used for surfaces where there is an adequate pre-existing surface profile or for Grade C and Grade D substrates. Water jetting can remove oil, grease, and corrosion-stimulating substances such as chlorides and sulphates. Water jetting is widely applicable because this method of surface preparation has several features listed below.

— The method allows a high production rate.

— Coatings and salts can be removed in one pass.

— Production rates can be similar to conventional abrasive blast cleaning.

— A work atmosphere is present without particulate dust pollution.

— Other trades can work nearby during the surface preparation.

— Surface preparation can generally be performed in unsafe explosive or flammable areas without interruption with suitable control measures, for example, earthing of equipment to prevent static discharges from water jetting guns, pumps, and hoses.

— The equipment can be stationary or mobile and is adaptable to the objects to be cleaned.

— The equipment can be remotely or manually controlled.

— The method is applicable to most types and forms of metal surfaces.

— Different surface preparation grades can be produced.

— It is possible to remove selectively partial failed coatings to leave sound coatings intact.

Representative photographic examples in ISO 8501-4:2020, Clause 8 can be used for assessing some new and previously coated steel surfaces. Owing to the many different situations that arise in the preparation of surfaces, these photographs are not always sufficient to describe specific instances. It is therefore recommended to produce specific photographs of a treated reference area that are acceptable to the interested parties for use as a basis for further surface preparation procedures.

Preparation of steel substrates before application of paints and related products — Surface preparation methods —

Part 5: Water jet cleaning

1 Scope

This document specifies water jet cleaning methods for the removal of the existing coatings and rust during surface preparation of steel surfaces before application of paints and related products. It provides information on the effectiveness of the individual methods and their fields of application. It also describes the equipment and the procedures to follow.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4628-3, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting*

ISO 8501-4:2020, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 4: Initial surface conditions, preparation grades and flash rust grades in connection with water jetting*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
field test
cleaning of selected surfaces, carried out before the start of work, intended to achieve the specified preparation grades

Note 1 to entry: ISO 8501-4:2020, Clause 5 defines the preparation grades that should be obtained through the field test.

Note 2 to entry: The field test can be referred to as the control specimen.

3.2
flash rust
rapid rusting of the surface prepared by water jet or water-abrasive blast cleaning, which occurs as the substrate is drying

Note 1 to entry: ISO 8501-4:2020, Clause 6 defines the flash rust grades.

Note 2 to entry: Flash rust in this document is more limited than the definition given in ISO 4618:2023, 3.120.

3.3
nozzle
device that modifies the stream of water as it discharges from the system

Note 1 to entry: Nozzle openings can be referred to as bits, tips, or orifices.

3.4
threshold pressure
minimum pressure required to penetrate the material

3.5
water jetting
continuous or discontinuous stream of water in air with defined geometry, velocity and, if discontinuous, frequency

[SOURCE: ISO/TS 19392-3:2018, 3.1]

4 Health and safety

4.1 General requirements

The procedures described in this document shall be carried out by either suitably trained or supervised personnel or both. The substances and procedures used in these methods can be injurious to health if adequate precautions are not taken. Attention is drawn in the text to certain specific hazards. This document refers only to the technical suitability of the methods and does not absolve the user from statutory obligations relating to health and safety.

WARNING — Equipment and materials used for surface preparation can be hazardous. It is important to ensure that adequate instructions are given and that all required precautions are exercised. Only trained or certified operatives or both should use the equipment.

5 Consideration of water jetting pressure and flow parameters

5.1 General

The contract documents describe the final condition of the substrate. Depending on the initial condition of the area and the materials intended to be cleaned, the method to achieve the preparation grades described in ISO 8501-4 can be low-pressure, high-pressure, or ultra high-pressure methods. The methods of water cleaning or water jetting are based on the capabilities of the equipment and its components. Dwell time, traverse rate, pressure, flow, stand-off distances, the number of nozzles, and rotational speed all interact in determining what material remains and what will be removed. Removal of loose material such as dirt, detritus, or bird faeces, which is an example of the preparation grade Wa 1, requires different equipment than the stripping of a coating system which is an example of the preparation grade Wa 2 1/2. Cleaning to a preparation grade of Wa 1 requires a different set of parameters than cleaning to a preparation grade of Wa 2 1/2. See ISO 8501-4:2020, Clause 5 for definitions of Wa preparation grades.

Pressurized water cleans by hydraulic shear (mass) at the lower pressures, and by implosion or cavitation at the upper pressures or both. The removal of material by mass or implosion is a continuum, not a discrete, abrupt change. This mix is discussed in greater depth in Annex B.

5.2 Methods

5.2.1 General

It is important to carefully consider the historic concept of linking the pressure and flow to material removal. The operating parameters specified in Table A.1 shall apply. Ultra high-pressure water jetting can accomplish all of these end results by changing the stand-off distance and traverse time, but it is not economical to use ultra high-pressure water jetting, for purposes such as removing loose dirt or achieving

the preparation grade Wa 1. Low-pressure water cleaning cannot deliver the energy density, expressed as kJ/mm^2, or threshold pressure to the surface to break the cohesion force of old rust or coating systems. Contractors use the pump and flow conditions which are most economical to achieve the desired result.

Pressurized water cleaning is accomplished when droplets of water impact the substrate. The droplets force their way into pits and crevices and hydraulically shear between the interface of the metal and the corrosion or paint layers. Water jetting (water jet cleaning or water jet stripping) uses cavitation or implosion to cut through the different layers of coating or corrosion.

5.2.2 Cleaning with low-pressure water (LP WC)

Low-pressure water cleaning is performed at pressures less than 34 MPa. The stream of water jetting shears the surface with the load parallel to the surface. The predominant energy characteristic is the mass.

Low-pressure water cleaning depends upon the mass flow of the water stream to remove coatings by shearing between the substrate and the material to be removed. The achieved result is removal of loose dirt, grime, bird droppings, some of the soluble contaminants and possibly weathered paint or chalk. The stream flows parallel to the substrate, so it is possible that the water stream does not get into pits and crevices. A typical usage is to wash surfaces which are intended to be cleaned by abrasive blast or a hand or power tool before starting that method. LP WC is typically conducted with a fan jet or non-rotating multi-orifice nozzle. When a multiple orifice nozzle is rotated, it produces a flexure stressing by a repetitive loading and unloading of the coatings system as the stream passes over the surface. The rapid load and unloading reveals areas of low adherence and other nonvisible defects in the coating system.

5.2.3 Cleaning with high-pressure water (HP WC)

Water cleaning which is performed at pressures from 34 MPa to 70 MPa combines shear and implosion to remove unwanted material. The predominate energy characteristic is a combination of the mass and velocity.

High-pressure water cleaning depends upon a combination of the mass flow of the water stream and the impact energy to remove coatings by predominately shearing between the substrate and the material to be removed with subordinate impact and implosion. The result is the partial removal of adhered coatings, revelation of incipient blisters or areas of low adhesion, and partial removal of rust layers. Oxidized paint is removed from the adherent layer. The water stream can get into the pits and craters and crevices. In removal of old rust, the typical appearance is clean, shiny pits with adherent rust layers at the top surface. It is the opposite visual appearance of a dry abrasive blast method where the shiny top is cleaned, and the pits are filled with dark, detrital material.

5.2.4 Cleaning with high-pressure water jetting (HP WJ)

Water cleaning which is performed by pressurized water jetting between 70 MPa and 140 MPa is considered high-pressure water jetting by some industries.

At 70 MPa, the effect of the energy density starts to predominate over the shear forces of the mass flow as the velocity of the water stream increases through a smaller diameter tip.

High-pressure water cleaning depends upon a combination of the mass flow of the water stream and the energy density, in order to remove coatings by predominately impact and implosion and by subordinately shearing between the substrate and the material to be removed. The achieved result is the removal of adhered coatings with lower cohesion, removal of coatings over areas of low adhesion or incipient blisters, and partial to full removal of rust layers.

5.2.5 Cleaning with very high-pressure water jetting (VHP WJ)

Water cleaning which is performed by pressurized water jetting between 140 MPa and 210 MPa removes material predominately by implosion.

Systems operating greater than 140 MPa clean predominately by impact implosion perpendicular to the surface, resulting in the sharp cut where the jet impacts the surface. The predominant energy characteristic is velocity.

The cleaning mechanism is a combination of shear and energy density. The side shear (mass flow) becomes less predominant as the energy density increases, and the stand-off distance becomes more critical. The jetter requires more experience and training to maintain a narrow stand-off distance and guide the sharp cut-off edge. The use of >140 MPa is suitable to economically achieve preparation grades Wa 2 or Wa 2 1/2, depending on the coating and rust. See ISO 8501-4:2020 Clause 5 for descriptions of preparation grades.

NOTE VHP WJ is referred to as THP WJ (see Reference [3]).

5.2.6 Cleaning with ultra high-pressure water jetting (UHP WJ)

Water cleaning which is performed by pressurized water jetting greater than 210 MPa removes material predominately by implosion.

Ultra high-pressure water jetting is typically used to achieve preparation grades Wa 2 1/2 and Wa 3 to bare substrate. The cleaning action is caused by impact intensity, which is an implosion or cavitation of the individual droplets on the substrate. The cleaning is a straight cut through the material yielding a sharp edge. The pressured water is heated by the compression and rapidly vaporizes off the surface. The drying time is fast compared to de-energized water in low-pressure or high-pressure water systems. The stripping of coatings with none to light flash rusting can be achieved and held with a full recovery vacuum system. This recovery vacuum system prevents water mist from subsequent, near-by activities from settling on the previously prepared Wa substrates.

The threshold pressure of the target substrate is crucial when the objective is to remove existing coatings or corrosion and to not significantly change the texture or profile.

6 Components

6.1 General

A wide variety of pumps and delivery systems are used for water jetting. The basic components are inflow water, pump, hose, by-pass valve or shut-off mechanism, gun and nozzles.

Water pressure, water volume, nozzle design, stand-off distance and traverse rate are factors which affect the efficiency of removing contaminants such as water-soluble matter, rust, and paint coatings.

When selecting a water jetting system, the following factors are taken into account:

— water exit velocity at the nozzle (pressure);

— water volume (flow rate);

— manual or remote-controlled;

— power output expressed as kW;

— complexity of the site and structure;

— space limitations;

— types of coatings or rust to be removed;

— the degree of cleanliness to be obtained;

— a balance between pressure, flow, standoff, and traverse rate to achieve the desired result;

— availability and quality of water;

— economics of a single pass system (open system) with some clean-up of the effluent versus recycling of the effluent water (closed system).

6.2 Pump

The pump is selected based on the required horsepower and type of power generation (e.g. diesel or electrical motors), the capacity to feed remotely controlled nozzles or multiple jetters, ease of transport, handling, and site installation.

Intensifier pumps operating on the principle of hydraulic jacks are used primarily in stationary manufacturing operations. Direct driven piston pumps are used in field or mobile operations. For further information on safety, see Reference [4].

6.3 Hose and fittings

The hose and fittings shall be appropriate for the pressures that they will carry. The largest diameter hose which is rated for the pressure is used from the pump to just before the gun, with a short, more flexible hose (a whip hose) attached to the gun itself. Hoses and fittings are certified to the pressure range.

6.4 Water path

The number of connections and fittings are minimized to reduce pressure loss between the pump and the nozzle. The water stream has a return flow path when it is not passing through the nozzle. The system will either shut down the pump, idle the pump, bypass the flow, or reduce the discharge pressure to a low level when the water is not passing through the nozzle.

6.5 Vacuum recovery

The gun or nozzle head can be fitted with a vacuum system to remove de-energized water back to a holding area. Using a vacuum to collect the water reduces the water containment and collection system.

6.6 Water quality

Most often the inlet water is of mains or potable quality with some filtering.

Surface preparation water (SP water) is of sufficient purity and quality that it does not prevent the object being cleaned from achieving the specified degree of surface cleanliness nor nonvisible contamination criteria. Surface preparation water does not contain sediments or other impurities that are destructive to the proper functional of the cleaning equipment. For further information, see References [5], [6], [7], [8].

NOTE Lower quality water can be acceptable during low-pressure water cleaning. See 5.2.1

6.7 Manual guns

The guns shall have appropriate safety controls. The water flow is dumped at the gun, or the water is shunted through another by-pass mechanism. The barrel of the gun is long enough so that it is hard for the jetter to hit his or her extremities, such as a foot.

6.8 Remote gun or wall-deck cleaning heads

Remote guns or wall-deck heads have multiple tips and are not limited to the back thrust of manual operations. The tips generally rotate at high speeds. Vacuum recovery is available. Multiple equipment variations are available. The nozzle is controlled by an operator who is isolated from the immediate vicinity. The nozzle assembly can be at the end of a robotic arm or held to the surface with magnetics or vacuum.

Remote-controlled or automated equipment is widely available in industrial cleaning operations from tight spaces to large outdoor surfaces but is not as widely used in surface preparation. Remote-controlled or

automated units provide consistent results, reduced worker fatigue, and the use of higher horsepower for tough coatings or corrosion layers. The important factor in choosing manually or automated systems is the financial cost. Examples of remote-controlled devices are “deck cleaners”’ which can range in width from 5 cm to 90 cm, and three axis robots with focused cleaning nozzles that can be used, for example, on angles or inside I or U beams.

6.9 Nozzle

The nozzle can hold multiple tips or a single zero degree or fan opening. The nozzle or the gun barrel can rotate. Materials for the tip orifice (the opening through which the water exits) are selected for the pressure and include drilled steel, drilled carbide, drilled sapphire or diamond jewels.

6.10 Containment (management of water)

Water runoff and mist is contained by cloths or waterproof liners that direct the mist into a holding area at the ground to collect the water. The discharge of the effluent water and the paint residues are typically not allowed to enter the environment.

Equipment is available to remove the solids and dissolved chemicals, and return the water to be recycled at the pump. The use of systems to recycle the effluent is based on the specifics of the site, sustainability, and the financial costs of sending the effluent water to a waste facility compared to cleaning the water for reuse.

7 Systems

7.1 Continuous system

The continuous water jetting systems have accessories for specific coating and cleaning applications. The direct piston or intensifier pump system provides a continuous flow of water. The cleaning is accomplished by disruption of the stream by rotating heads or manual movement to maximize the initial impact pressure. The change in the water droplet streamlines provides a loading-unloading effect on the target in comparison to a static head.

7.2 Pulsed (disrupted) system

The concept of the force pulse system is to produce individual drops or slugs of water. As an example, the force pulse or electrical discharge systems is described. The flow of the water is pulsed or disrupted by an electrical discharge or piezoelectric ceramic, which is an auxiliary unit placed between a pump, generally in the 20,7 MPa range, and the nozzle. The packets of water act differently from a continuous water jet stream, in that the impact dynamics rapidly change. When a drop or slug of water strikes the surface, the initial impact pressure (water hammer pressure) is much higher than the stagnation pressure. The short impact time amplifies the pressure on the surface. The breakdown of the material depends on the impact pressure and time. The force pulse or electrical discharge systems amplifies a 34,5 MPa system to an impact of 400 MPa. Pulsed water jetting systems have a significant difference in cleaning performance compared to continuous water jets.

8 System operation

8.1 General

It is necessary to select an equipment system in consideration of the appropriate pressure and flow operating conditions, to achieve the required level of surface preparation.

Removal of degraded coating is coupled with thorough stressing of the retained coating. Jet energy (expressed in joules) is performed when the jet stream vertically impacts the coating surface to stress the cohesion. Shear stress is developed against the vertical pit walls and larger fractures are created on the eroded coating surface. In gross terms, this is considered as a hydraulic load which stresses the adhesion force between the coating (rust) and the metal substrate.

Flexure stressing is induced by repetitive loading and unloading of the coatings by the jet streams as they pass over the surface. Rapid loading and unloading is vital to find areas of low adherence and non-visible adherence defects in the coating system.

The classification between the pressurized water system with respect to pressure and flow has no abrupt distinction. The classification of low, high, very high, and ultra high originates from the manufacturers of the systems and the specific industries. For further information, see Clause 5, Annex A and Annex B.

The effect of rotating nozzles on the removal rate compared to non-rotating nozzles is profound. The contractor should be aware of the effect of a pressure pulse, or loading and unloading, as compared to a static head. For example, a hydraulic lift is a static pressure head which has high-pressure but no motion. This static head does not clean the surface. However, when even low-pressure water is allowed to rotate so that the target experiences an on-off load cycle, that target will begin to erode.

A typical method to select pressure and flow is: the contractor determines the threshold pressure to remove the material. Then the contractor increases the pressure gradually to about two times the threshold pressure.

For further information on general water jet parameters, see Annex B.

8.2 Interactive parameters for productivity

The following parameters all interact to change the effectiveness of the cleaning productivity:

— stand-off distance;

— rotation speed;

— traverse speed;

— flow (mass);

— pressure (velocity);

— output power;

— shear between materials compared to implosion (cavitation);

— temperature.

8.3 Additives

The removal efficiency can depend on whether additives are being used in the cleaning process. The additives can consist of a variety of chemicals, such as, detergents, emulsifiers, acidic, basic, neutral, molecular, or ionic in nature. Unless not recommended by the additive manufacturer, if an additive is used then rinsing afterwards with surface preparation water is advisable.

Further information on the compatibility of the additives with the coatings can be obtained from the coatings' supplier. Further information on compatibility and interaction with water jetting equipment can be obtained from the additive or pump supplier.

There is a broad range of additives for water jetting available in the market with different properties. Some common properties are:

— degreasing of the surface;

— protection against flash rust;

— creating a passivation layer for a better corrosion resistance and paint adhesion;

— pickling the surface with an acidic, neutral, or alkaline solution;

— a combination of the abovenamed properties.

8.4 Maintenance coating work

When water jetting is used in maintenance coating work, specific instructions are provided on the extent of the surface to be partially or spot cleaned. The surface cleanliness is achieved across the entire area specified.

8.5 Maintenance of pump

Daily maintenance of pumps and accessories is critical along with inspection check lists to avoid unexpected breakdowns.

8.6 Pressure drop in the hydraulic system

Pressure losses occur throughout the system at each connection, the flow through the supply lines, the diameter of the lines, and change in elevation. This pressure loss can be significant and is complicated to calculate. Most of this pressure is lost in the lines and connections, and is not available at the nozzle or exit point. Digital applications free to the public are available to aid in optimum parameter selection such as: pressure loss, jet reaction force, jet impact, flow through orifice, orifice size, and the flow to achieve a certain horsepower.

8.7 Positioning of the gun

The angle of attack of the water jet on the substrate, as well as the optimal nozzle head distance from the surface (stand-off distance) and the traverse speed are determined by in situ testing and vary according to the nature of the coating to be removed.

The gun shall be perpendicular to the surface for stripping of coatings.

The effective stand-off distance from the surface is generally 100 to 200 times the tip (orifice) diameter. Thus, the stand-off distance decreases as the water jet method goes up in pressure because the orifice diameter becomes smaller.

9 Procedure

9.1 Preparation before water jetting

Check for the presence of oil, grease, salts or similar contaminants. Deposits of heavy grease can be removed using a degreasing (emulsifier) procedure. After the washing, assess whether oil or grease contaminants are still present with methods such as water break or fluorescence or UV light test.

The contractor establishes an exclusion work zone to protect other workers.

Suitable methods for removal of contaminants are described in ISO 12944-4.

A field test is used to determine if the selected water jetting method removes surface deposits of grease, oil and dirt, or achieves the specified preparation grade or both. The project documents provide recommendations regarding the preliminary treatment of welds, the removal of weld spatter and the removal of burrs and other sharp edges as described in ISO 8501-3.

Assess the rust grade(s) and the degree of rusting of the workpiece, using the surface conditions described in ISO 8501-4:2020, Clause 4 or ISO 4628-3, or both, within the limits of a contract or specification, if any.

9.2 During water jetting

9.2.1 Selection of initial condition

Select an initial starting condition from ISO 8501-4:2020, Clause 4 and a water jetting method.

9.2.2 Selection of preparation grade

Determine the minimum preparation grade required in accordance with the preparation grades defined in ISO 8501-4:2020, Clause 5. The required surface profile should be determined according to the ISO 8503 series. The exposed profile will reflect the previous existing profile under the coating or material to be removed.

9.2.3 Selection of water jetting method

Select the appropriate water jetting method which will produce the specified preparation grade. Be aware that the energy density of the water jet can create a fine profile within the retained coating.

9.2.4 Selection of water jetting system

Select the appropriate water jetting-system that fits the properties of the workplace and the productivity requirement.

9.3 After water jetting and before applying coatings

The method of testing for soluble contaminants and the acceptable limit is agreed between all parties involved. If the amount of residual soluble impurities is reduced further, the user can wash with a steam jet, hot fresh water, solvent or other suitable cleaner (followed by rinsing with clean fresh water) and dry. For testing methods, see the ISO 8502 series and ISO 12944-6.

Before the application of paints and related products, a cleaned surface shall dry; as the substrate is drying, "flash rusting" can occur. Newly formed "flash rust" resulting from the drying of the substrate is reduced to a level agreed between all parties involved.

NOTE For further information on salt levels, see Reference ISO/TR 15235.

For further information on flash rust levels, see Annex C.

10 Assessment of the cleaned surface

10.1 Selection of preparation grade

All parties involved in the project shall agree on the preparation grade to be achieved, in explanation: Wa 1, Wa 2, Wa 2 1/2, and Wa 3, as described in ISO 8501-4:2020, Clause 5.

10.2 Field test

A field test or control specimen is recommended to determine the most effective operating parameters to achieve the resulting surface preparation grade and the resulting surface profile.

In all cases, all oil, grease, mud, concretions, and non-adherent scale are eliminated.

Except in the case of "clean to bare substrate", tightly adherent mill scale, thin rust, thin coatings, and other thin adherent foreign matter can be present.

After the water jetting, discoloration of the metal substrate can be present. If the metal substrate has not been attacked under the existing coating, the texture will appear as the original method, i.e. retention of grit or rounded abrasive profile, grinding marks from grinders, scratches from rotating pads or wire brushes, finely etched surface if chemically etched. The exposed substrate reflects activity which occurred under the coating. The revealed substrate under existing corrosion can be lightly pitted, or very uneven with an overall large variation in profile.

On steel surfaces with abundant rust, the exposed substrate has a rough appearance, due to the non-uniformity of the corrosion and the presence of corrosion craters.

The degree of visual cleanliness, e.g. thorough or very thorough, is checked after the jetting operation, perhaps even as the water is drying, and without the use of a magnifying glass.

The level of cleaning, and the amount of newly formed "flash rust" is visually checked again before new paint is applied to ensure conformance to the project specifications. See Annex C.

10.3 Organic contaminants

Check for the presence of oil, grease, or similar contaminants. Remove any deposits using a degreasing or washing procedure and check whether any other contaminants are still present.

NOTE Water break or fluorescence or UV light methods are suitable methods to assess the presence of oil and grease.

10.4 Visual

10.4.1 Visual assessment of preparation grade

Visual assessment shall be performed in accordance with ISO 8501-4. The preparation grade should be assessed when the surface is dried and before any flash rust occurs.

NOTE The initial assessment for remaining residual paint or rust can be made while the substrate is still wet. The surface appears darker if it is wet and darker than a dry abrasive blasted substrate.

10.4.2 Flash rust

Assess the flash rust after the substrate has dried but before the application of paint. If the amount of flash rust is greater than as agreed by all parties involved, the amount is reduced, generally by pressure wash or brushing or wiping.

NOTE For further information, see Annex C.

10.5 Non-visible inorganics contaminants

The surface should be assessed for non-visible ionic species as agreed by all parties involved. For further information on salt levels, see ISO 8502 series and ISO/TR 15235.

10.6 Third-party representation

Work performed under this document is subject to assessment by a representative of those responsible for establishing the requirements. Work areas are accessible to the assessor. The procedures and times of assessment are as agreed by all parties involved.

As agreed by all parties involved, the surfaces can additionally be assessed according to the ISO 8502 series and ISO 8503 series. For further information on test methods or surface texture, the ISO 8502 series and ISO 8503 series can also be consulted.

10.7 Conformity

Immediately prior to the coating application, the entire substrate shall conform with the degree of cleaning as agreed by all parties involved.

Annex A
(normative)

Pressure levels

Table A.1 — Pressure levels and descriptive terms

Pressure	Abbreviation	Minimum pressure (MPa)	Maximum pressure (MPa)	Description
Low-pressure water cleaning	(LP WC)	0,7	34	remove laitance, dirt, scale or light marine growth
High-pressure water cleaning	(HP WC)	34	70	remove weak concrete, marine growth, clean pipe, expose concrete aggregate
High-pressure water jetting	(HP WJ)	70	140	remove rust layers, loose paint, burned deposits, cut concrete
very high-pressure water jetting	(VHP WJ)	140	210	remove rust layers, loose paint, burned deposits, cut concrete
Ultra high-pressure water jetting	(UHP WJ)	210	> 210	Remove non-skid, heavy rust layers, paint, scour surfaces prior to dry abrasive blast cleaning