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

**Part 2:
Abrasive blast-cleaning**

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

Partie 2: Décapage par projection d'abrasif



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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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*.

This third edition cancels and replaces the second edition (ISO 8504-2:2000), which has been technically revised. The main changes compared to the previous edition are as follows:

- update of [Clause 2](#), normative references;
- editorial revision.

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.

These International Standards 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 are found in other documents such as national standards and codes of practice. Users of these International Standards 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.

Abrasive blast-cleaning is a most effective method for mechanical surface preparation. It is widely applicable because this method of surface preparation has a number of versatile features listed below.

- The method allows a high production rate.
- The equipment can be stationary or mobile and is adaptable to the objects to be cleaned.
- The method is applicable to most types and forms of steel surface.
- Many different surface states can be produced, for example different preparation grades and surface profiles.
- Effects such as cleaning, peening, roughening, levelling and lapping can be produced.
- It is possible to remove selectively partly failed coatings, leaving sound coatings intact.
- Abrasive ricochet (rebound) enables the cleaning of otherwise inaccessible areas.

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

Part 2: Abrasive blast-cleaning

1 Scope

This document specifies abrasive blast-cleaning methods for the preparation of steel surfaces before coating with paints and related products. It provides information on the effectiveness of the individual methods and their fields of application. It describes the equipment to use and the procedure to follow.

NOTE These methods are essentially intended for hot-rolled steel to remove mill scale, rust, etc. but could also be used for cold-rolled steel of sufficient thickness to withstand the deformation caused by the impact of abrasive.

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 (all parts), *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness*

ISO 8502 (all parts), *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness*

ISO 8503 (all parts), *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates*

ISO 11124 (all parts), *Preparation of steel substrates before application of paints and related products — Specifications for metallic blast-cleaning abrasives*

ISO 11126 (all parts), *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives*

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

abrasive blast-cleaning

impingement of a high-kinetic-energy stream of abrasive onto the surface to be prepared

3.2

blast-cleaning abrasive

solid material intended to be used for *abrasive blast-cleaning* ([3.1](#))

3.3

shot

particle that is predominantly round, that has a length of less than twice the maximum particle width and that does not have edges, broken faces or other sharp surface defects

3.4

grit

particle that is predominantly angular, that has fractured faces and sharp edges and that is less than half-round in shape

3.5

cylindrical

particle that is sharp-edged, that has a diameter-to-length ratio of 1:1 and that is cut so that its faces are approximately at right angles to their centreline

4 Abrasives

4.1 Materials and types

4.1.1 A wide variety of natural and synthetic solid materials are used for abrasive blast-cleaning. Solid materials commonly in use for the preparation of steel surfaces before coating are given in [Table 1](#). Each material provides a characteristic performance and surface finish.

When selecting a blast-cleaning abrasive, the following factors relating to its initial condition shall be taken into account:

- sub-group and type (see [Table 1](#));
- indication of chemical composition;
- range of particle size (see [4.1.2](#));
- particle hardness (for example Vickers, Rockwell or Mohs, or as measured by another appropriate method).

NOTE The ISO 11124 series, the ISO 11125 series, the ISO 11126 series and the ISO 11127 series are International Standards on metallic and non-metallic blast-cleaning abrasives.

4.1.2 The size and shape of the particles of an abrasive might change during use or re-use and this change can affect the resultant surface texture of the blast-cleaned steel.

Table 1 — Commonly used blast-cleaning abrasives for steel substrate preparation

Type			Abbreviation	Initial particle shape (see Table 2)	Comparator ^a	Remarks
Metallic (M) blast-cleaning abrasives ^c	Cast iron	Chilled	M/CI	G	G	Mainly for compressed-air blast-cleaning
	Cast steel	High-carbon	M/HCS	S or G	S ^b or G	Mainly for centrifugal blast-cleaning
		Low-carbon	M/LCS	S	S	
	Cut steel wire	—	M/CW	C	S ^b	
Non-metallic (N) blast-cleaning abrasives ^c	Natural	Olivine	N/OL	G	G	Mainly for compressed-air blast-cleaning
		Staurolite	N/ST	S	G	
		Almandite garnet	N/GA	G	G	
	Synthetic	Iron slag (Calcium silicate)	N/FE1	G	G	Mainly for compressed-air blast-cleaning
		Steel slag (Calcium silicate)	N/FE2	G/S		
		Copper refinery slag (Iron silicate)	N/CU	G/S		
		Nickel slag (Iron silicate)	N/Ni1	G		
		Ferronickel slag (Magnesium silicate)	N/Ni2	G/S		
		Coal furnace slag (Aluminium silicate)	N/CS	G		
		Fused aluminium oxide	N/FA	G	G	—

Key

M: Metallic blast-cleaning abrasives

N: Non-metallic blast-cleaning abrasives

^a Comparator to be used when assessing the resultant surface profile. The method for evaluating the surface profile by comparator is described in ISO 8503-2.

^b Certain types of abrasive rapidly change their shape when used, depending on hardness. As soon as this happens, the appearance of the surface profile changes and becomes closer to that of the "shot" comparator.

^c International Standards for the range of abrasives given here are the ISO 11124 series for metallic blast-cleaning abrasives, and the ISO 11126 series for non-metallic blast-cleaning abrasives.

Table 2 — Initial particle shape

Designation and initial particle shape	Abbreviation
Shot — round	S
Grit — angular, irregular	G
Cylindrical — sharp-edged	C

4.2 General requirements

4.2.1 Technical

Abrasives shall be dry (except when added to pressurized liquid or slurry blast-cleaning systems) and shall be free-flowing to permit consistent metering into the blast stream.

Abrasives shall meet the requirements specified in the ISO 11124 series and in the ISO 11126 series and shall be free from corrosive constituents and adhesion-impairing contaminants. Because of their deleterious effect on the blast-cleaned steel surface, permanently contaminated abrasives (for example those that cannot be cleaned before recycling and those produced from slag that has been granulated by the use of saline water, i.e. sea water, for cooling) are not permitted.

The abrasive is typically propelled either by centrifugal force or by a high-velocity stream of fluid such as air or water to remove rust, mill scale, existing coatings and other contaminants and expose the substrate. The cleaned surface has a characteristic secondary profile dependent on the blast-cleaning conditions, the properties of the abrasive, the initial condition of the surface and the properties of the steel being blast-cleaned. The initial surface roughness or primary profile can be altered by the abrasive blast-cleaning procedure. Surface profiles are assessed using the method described in ISO 8503-2. When selecting a surface preparation method, it is necessary to consider the preparation grade required to give a level of surface cleanliness and, if required, a surface profile (roughness), such as coarse, medium or fine (see ISO 8503-1 and ISO 8503-2), appropriate to the coating system to be applied to the steel surface. Since the cost of surface preparation is usually in proportion to the level of cleanliness, a preparation grade appropriate to the purpose and type of coating system or a coating system appropriate to the preparation grade which can be achieved should be chosen.

4.2.2 Health and safety

The procedures described in this document shall be carried out by suitably trained and/or supervised personnel. 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, materials and abrasives used for surface preparation can be hazardous. It is important to ensure that adequate instructions are given and that all required precautions are exercised.

4.3 Selection considerations

4.3.1 Selection of a suitable abrasive, together with an appropriate blast-cleaning method and operating conditions, is necessary to achieve the required standard of surface preparation.

The type of blast-cleaning abrasive — i.e. its particle size distribution, shape, hardness, density and impact behaviour (deformation or shatter characteristics) — is important in determining the standards of cleanliness, the cleaning rate and the resulting surface profile of the blast-cleaned surface.

The particle size distribution of abrasives should be determined using the methods specified in ISO 11125-2 and ISO 11127-2 respectively.

4.3.2 Preliminary blast-cleaning tests are recommended to determine the most effective abrasive, the resulting surface preparation grade and the resulting surface profile (see ISO 8501-1 or ISO 8501-2 and ISO 8503-2). If recycled abrasive is used for the surface preparation work, a preliminary test should be carried out with the same material, as new abrasive might give misleading results [see also [4.3.3 c](#)].

4.3.3 When selecting an abrasive, the following considerations should be taken into account:

- a) The influence of a particular particle size on the resulting surface profile is different for metallic abrasives and for non-metallic abrasives. This is because the shatter characteristics differ and because differences in density affect the kinetic energy of the abrasive particles.
- b) A balanced mixture of particle sizes will produce the optimum level of cleanliness, cleaning rate and surface profile.
- c) In blast-cleaning plants where the abrasive is recycled, it is necessary
 - to remove dust and contaminants before the abrasive is re-used, and
 - to make up for the abrasive which is lost by wear and adherence to the workpieces. This is done by controlled addition of new abrasive so that the abrasive mixture is maintained within the prescribed particle size limits or particle size distribution.

Complete renewal of abrasive charges in recycling machines requires a period of use before the mixture reaches a steady condition.

5 Abrasive blast-cleaning methods

5.1 Dry abrasive blast-cleaning

5.1.1 Centrifugal abrasive blast-cleaning

5.1.1.1 Principle

Centrifugal abrasive blast-cleaning is carried out on fixed installations or mobile units in which the abrasive is fed to rotating wheels or impellers positioned to throw the abrasive evenly and at high velocity on to the surface to be cleaned.

5.1.1.2 Field of application

The method is suitable for continuous operation on workpieces with accessible surfaces. It is also applicable to workpieces having different rust grades (see ISO 8501-1).

NOTE Most centrifugal abrasive blast-cleaning equipment is stationary and the abrasive is circulated in a closed system. The workpieces are either fed through or rotated within the equipment. In certain cases, the equipment might be mobile, and therefore useful for cleaning large uninterrupted surfaces, such as ships' hulls and oil storage tanks.

5.1.1.3 Effectiveness

This method can achieve preparation grade Sa 3 on steel of all rust grades defined in ISO 8501-1.

5.1.1.4 Limitations

Centrifugal abrasive blast-cleaning equipment has to be carefully set up for each application and so this method is generally limited to repetitive work associated with high-volume throughput or continuous production.

Generally, chemicals contaminating a steel surface cannot be totally removed by centrifugal blast-cleaning. Thus, additional treatment is required (see [6.3](#)) if complete removal is necessary.

5.1.2 Compressed-air abrasive blast-cleaning

5.1.2.1 Principle

Compressed-air abrasive blast-cleaning is carried out by feeding the abrasive into an air stream and directing the air/abrasive mixture at high velocity from a nozzle on to the surface to be cleaned.

The abrasive can be injected into the air stream from a pressurized container or can be drawn into the air stream by suction from an unpressurized container.

5.1.2.2 Field of application

The method is suitable for cleaning workpieces (including large structures) of all types. It is also applicable to workpieces having different rust grades (see ISO 8501-1). It may be used either continuously or intermittently and may be used when centrifugal abrasive blast-cleaning (5.1.1) is not suitable.

This system of cleaning can be used in factories, rooms or cabinets, or on site.

5.1.2.3 Effectiveness

This method is versatile and can achieve preparation grade Sa 3 on steel of all rust grades defined in ISO 8501-1.

5.1.2.4 Limitations

This method gives rise to evolution of free dust and its use might be restricted in applications where dust suppression or extraction facilities are unable to meet permissible environmental contamination levels.

Generally, chemicals contaminating a steel surface cannot be totally removed by compressed-air abrasive blast-cleaning. Thus, additional treatment is required (see 6.1 and 6.3) if complete removal is necessary.

5.1.3 Vacuum or suction-head abrasive blast-cleaning

5.1.3.1 Principle

This method is similar to compressed-air abrasive blast-cleaning (5.1.2) but with the blast nozzle enclosed in a suction head sealed to the steel surface, collecting the spent abrasive and contaminants. Alternatively, the air/abrasive stream might be sucked on to the surface by reduced pressure at the suction head.

5.1.3.2 Field of application

The method is particularly suitable for localized cleaning where the dust and debris resulting from other blast-cleaning techniques are unacceptable and where the technical requirements (for example tight sealing of the suction head to the surface) can be met.

5.1.3.3 Effectiveness

This method is clean, with little dust produced in the area, and can achieve preparation grade Sa 2½ as defined in ISO 8501-1. After an extended period of cleaning with this method, preparation grade Sa 3 might be obtained.

5.1.3.4 Limitations

This method is more time-consuming than other blast-cleaning methods. It is unsuitable for cleaning heavily corroded steel (of rust grade D as defined in ISO 8501-1) and not applicable to irregular shapes

due to the necessity to seal the suction head tightly to the surface and difficulties in handling the equipment.

Generally, chemicals contaminating a steel surface cannot be totally removed by vacuum or suction-head abrasive blast-cleaning. Thus, additional treatment is required (see [6.1](#) and [6.3](#)) if complete removal is necessary.

5.2 Wet abrasive blast-cleaning

5.2.1 General

The water used for wet abrasive blast-cleaning shall have a low salt content to avoid contamination of the surface being prepared.

5.2.2 Moisture-injection abrasive blast-cleaning (compressed-air moisture-injection abrasive blast-cleaning)

5.2.2.1 Principle

This method is similar to compressed-air abrasive blast-cleaning ([5.1.2](#)) but with the addition, upstream of the nozzle, of a very small amount of liquid (usually clean, fresh water) to the air/abrasive stream, resulting in a blast-cleaning procedure which is dust-free in the suspended-particle size range of less than 50 µm. The consumption of water can be controlled and is usually 15 l/h to 25 l/h.

A suitable rust inhibitor may be added to the water (see, however, [5.2.2.4](#)).

5.2.2.2 Field of application

This method is suitable for cleaning workpieces (including large structures) of all types. It is also applicable to workpieces having different rust grades (see ISO 8501-1) as the addition of liquid can be controlled to match the intensity of the dust produced. It can be used in the majority of cases where high dust levels and large amounts of water shall be avoided.

The addition of liquid, which binds the dust, is controlled in such a way that normally no liquid drips out of the nozzle. This means that the individual abrasive particles are enveloped with an extremely thin liquid film that, when the particles burst, prevents the formation of dust around the surface being treated.

5.2.2.3 Effectiveness

This method is versatile and can achieve preparation grade Sa 3 on steel of all rust grades defined in ISO 8501-1.

5.2.2.4 Limitations

The surface preparation quality achieved by this method differs from that obtained by compressed-air abrasive blast-cleaning ([5.1.2](#)) only by the fact that the prepared surface is initially moist. The moisture disappears within a few minutes, the time depending on the ambient conditions, and might cause a light, negligible rust trace on the roughened surface. In cases where "flash rusting" occurs, suitable coating systems are necessary.

When a rust inhibitor is used, it shall be compatible with the subsequent coating.

NOTE The use of a rust inhibitor in the water might require that special waste disposal procedures be taken to comply with local environmental regulations.

5.2.3 Compressed-air wet abrasive blast-cleaning

5.2.3.1 Principle

This method is similar to compressed-air abrasive blast-cleaning (5.1.2) but with the addition of liquid (generally clean, fresh water) downstream of the nozzle to produce a stream of air, water and abrasive.

A suitable rust inhibitor may be added to the water (see, however, 5.2.3.4).

5.2.3.2 Field of application

This method is suitable for cleaning workpieces (including large structures) of all types. It is also applicable to workpieces having different rust grades (see ISO 8501-1) and particularly for pitted and chemically contaminated steel, provided the presence of water is permitted. It may be used in both continuous and intermittent operations, particularly where cleaned surfaces are required to have low levels of residual soluble salts.

For surface preparation during maintenance, it is possible to partially or selectively remove existing coatings by adjusting the pressure and the proportions of air, water and abrasive in the mixture.

5.2.3.3 Effectiveness

This method can achieve preparation grade Sa 3 as defined in ISO 8501-1. The method is particularly suitable for reducing the amount of water-soluble contaminants and minimizing dust generation during cleaning. Since the water is added downstream of the nozzle, the chemical cleaning action is less effective.

5.2.3.4 Limitations

The blast-cleaned surface is usually covered with a slurry that impairs visual examination by the operator. This slurry must therefore be removed by a dry blast or water jet. The substrate might need to dry before application of paint, and "flash rusting" might occur as the substrate is drying. This thin iron oxide film will need to be removed if considered detrimental to the subsequent coating.

Wet blast-cleaning shall not be used where the presence of water can be harmful.

The abrasives used are generally restricted to expendable non-ferrous materials.

When a rust inhibitor or surface conditioner is used, it shall be compatible with the subsequent coating.

NOTE 1 The use of a rust inhibitor or surface conditioner in the water might require that special waste disposal procedures have to be taken to comply with local environmental regulations.

NOTE 2 See to ISO 8501-4 for pictorial representation of flash rust grades.

5.2.4 Slurry blast-cleaning

5.2.4.1 Principle

A dispersion of fine abrasive in water or another liquid is directed, with pumps or compressed air, on to the surface to be cleaned.

A suitable rust inhibitor may be added (see, however, 5.2.3.4).

5.2.4.2 Field of application

This method is suitable for producing a fine surface profile on surfaces requiring little or no secondary profile, often needed for small workpieces.