



International Standard

ISO 8501-3

**Third edition
2025-08**

Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness —

Part 3:

Preparation grades of welds, edges and other areas with surface imperfections

*Préparation des subjectiles d'acier avant application de peintures
et de produits assimilés — Évaluation visuelle de la propreté de
surface —*

*Partie 3: Degrés de préparation des soudures, arêtes et autres
zones représentant des imperfections du subjectile*



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Contents		Page
Foreword		iv
Introduction		v
1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	General considerations	2
4.1	General.....	2
4.2	Recommended workflow.....	2
5	Types of imperfections	2
6	Preparation grades	2
Annex A (informative) Preparation grade converted into weld quality levels based on ISO 5817:2023		10
Bibliography		13

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).

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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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 8501-3:2006), which has been technically revised. The main changes compared to the previous edition are as follows:

- the illustrations of types of imperfections in [Table 1](#) have been revised;
- [Clause 2](#) and the Bibliography have been updated.;
- the introduction has been expanded.

A list of all parts in the ISO 8501 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. This document provides requirements for steel building organizations to avoid unnecessary production costs for steel structures that will be painted.

The principal factors that are known to influence the performance of protective coatings of paints and related products applied to steel are:

- a) the presence of rust and mill scale
- b) the presence of surface contaminants, including salts, dust, oils and greases
- c) the surface profile.

ISO 8501, ISO 8502 and ISO 8503 series have been prepared to provide methods of assessing these factors, while ISO 8504 series provide methods that are available for cleaning steel substrates, indicating the capabilities of each in attaining specified levels of cleanliness.

The ISO 8501, ISO 8502, ISO 8503, and ISO 8504 series do not cover the protective coating system to be applied to the steel surface. Nor do they cover 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 its performance. This subject matter is covered in other documents such as national standards and codes of practice.

Imperfections at welds, edges and other areas of steel substrates are generally starting points for corrosion. Such areas are also difficult to protect by application of paints and related products. To assist in achieving efficient corrosion protection, this document describes certain imperfections and defines preparation grades for such areas.

Steel imperfections can be generated in the manufacturing process or during handling, shipping, building and erection of a steel structure and can affect the durability of a protective coating system if they are not remedied.

The required preparation grade (P1 to P3) for a specific steel structure should be based on the required longevity of the coating system and the corrosivity of the environment that the coated steel structure will be exposed to.

The specified surface preparation grade should be compatible with other steel structures requirements, e.g. those specified in the ISO 8501 series, ISO 5817, the EN 10025 series and the EN 10163 series.

Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness —

Part 3:

Preparation grades of welds, edges and other areas with surface imperfections

1 Scope

This document provides requirements to identify visible imperfections and defines three preparation grades for welds, edges and surfaces of steel to assist in achieving efficient corrosion protection. Such imperfections can be visible before or can become visible after an abrasive blast cleaning process.

NOTE Although this document has been developed specifically for preparation of steel, the defined preparation grades will generally be appropriate for use when preparing other metal surfaces e.g. aluminium, castings, if agreed.

2 Normative references

The following documents are referred to in the text in such a way that some or all 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 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

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 as welded

condition of a weld, with or without imperfections, without any *dressing* (3.2)

3.2 dressing

grinding the surface of a weld to remove either *visible* (3.3) pores, lumps, welding spatter, excess metal and sharp edges, or correcting undercut or weld toe imperfections

3.3 visible

capable of being seen without tools in normal environmental conditions

4 General considerations

4.1 General

Protective coatings are applied to a substrate in liquid form. During either the drying or curing process, the liquid film forms a solid, continuous coating. This process is called film formation and is of crucial importance for the quality of the resulting coatings. The imperfections described in this document create additional stresses in the coating system during either drying or curing and cause weak points in the corrosion protection system after the coating is fully either dried or cured. The preparation grades given in this document have been selected to make steel with imperfections suitable for corrosion protection by paints and related products. The surface preparation levels P1 to P3 should be selected based on corrosivity and the desired durability of the coating system.

4.2 Recommended workflow

This document provides requirements for steel building organizations to avoid unnecessary production costs for steel structures that will be painted. Involved parties include the steel structures designer, steel purchaser, internal logistics manager, quality manager, welder and welding inspector.

Involved parties should be informed of the requirements in this document prior to starting any design, purchasing, shipping or welding work.

Ideally, all welds should be checked against the requirements in this document prior to welding approval. If additional grinding to meet the requirements of this document is needed after welding approval, the responsible welding quality manager shall be notified. Welds that are dressed after welding approval shall not be dressed in such a way that either the resulting weld violate any form requirements or tolerances specified by the steel structures designer or welding quality manager.

The steel imperfections described in this document may be visible as built or as welded. Imperfections can in addition become visible after a cleaning process, e.g. those described in the ISO 8504 series.

An assessment of the pre-treatment grade (P1 to P3) should therefore include inspections both before cleaning pretreatment (as built or as welded) and inspections after each cleaning step described in the ISO 8504 series.

5 Types of imperfections

The various types of imperfections are described in [Table 1](#).

6 Preparation grades

The required appearance after pretreatment is defined by the text in [Table 1](#). Informative illustrations are shown under the corresponding pretreatment grade P1, P2 and P3 as examples. The preparation grades are as follows:

- P1 Minimal requirement: minimum preparation shall be carried out.
- P2 Medium requirement: most imperfections are remedied.
- P3 High requirement: all significant imperfections are remedied.

NOTE 1 It is possible that different imperfections on a structure require different preparation grades. For example, undercut ([Table 1](#), 1.6) can require P3 preparation while all other imperfections can require P2 preparation.

NOTE 2 The preparation methods used to achieve preparation grades P1-P3 are expected to not jeopardize the integrity of the steel surface or welded areas.

NOTE 3 The requirements to fulfil preparation grade P3 can be higher than the requirements e.g. on weld imperfections in ISO 5817:2023 and delivery requirements of steel products, e. g. pipes, hot-rolled steel plates, wide flats and sections.

ISO 8501-3:2025(en)

NOTE 4 Preparation grade P3 is not always achievable on steel with rust grade D according to ISO 8501-1.

NOTE 5 Welds can have a sufficiently smooth weld profile as welded, e.g. on machine welded components. In such cases dressing the weld is not required

NOTE 6 Welds and thermally cut edges can be harder than bulk steel. To achieve a sufficient blasting profile on thermally hardened steel, it can be important to dress the welds and edges surfaces by grinding, or to use blasting media that is harder than the thermally hardened steel surface.

NOTE 7 [Annex A](#) shows the correspondence between the requirements for the preparation grades and the weld quality requirements defined in ISO 5817:2023.

Table 1 — Illustrative representations of imperfections and preparation grade requirements

Type of imperfection		Preparation grades		
Description	Illustration	P1	P2	P3
1 Welds				
1.1 Welding spatter		Surface shall be free of all loose welding spatter (a). 	Surface shall be free of all loose and lightly adhering welding spatter (a and b). 	Surface shall be free of all welding spatter.
1.2 Welding slag		Surface shall be free from welding slag. 	Surface shall be free from welding slag. 	Surface shall be free from welding slag.
1.3 Discontinuous welds		Discontinuous welds may be used. 	Welds shall be continuous. 	Welds shall be continuous.
1.4 Weld porosity		Surface pores shall be sufficiently open to allow penetration of paint and blasting abrasives or dressed out. 	Surface pores shall be sufficiently open to allow penetration of paint and blasting abrasives or dressed out. 	Surface shall be free from visible pores.

Table 1 (continued)

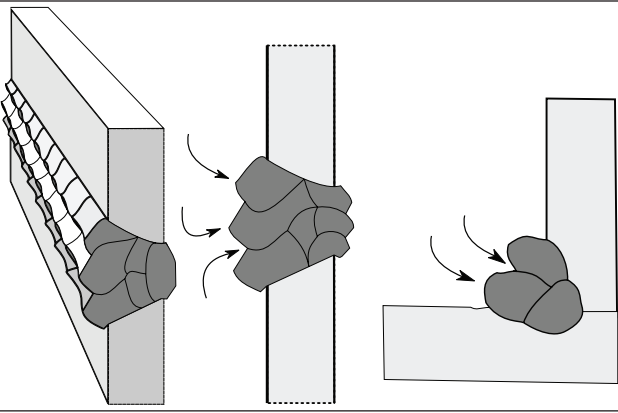
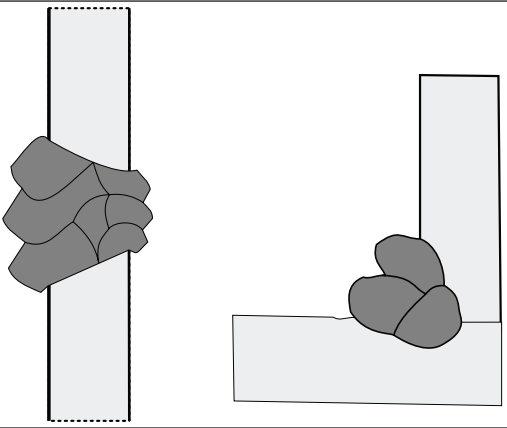
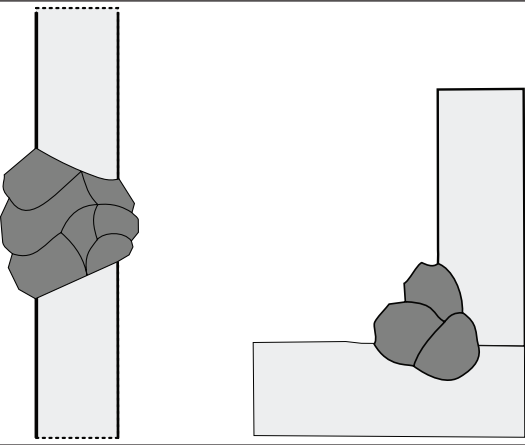
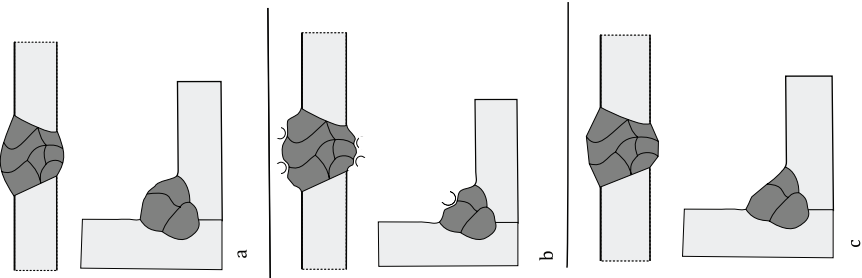
1.5 Weld profile/ weld ripple		No preparation. 	The weld shall be dressed to remove sharp-edged profiles. 	The topography of the weld bead shall be smooth, see a). Rounded profiles and three pass chamfered welds are also allowed, see b) and c). 
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Table 1 (continued)

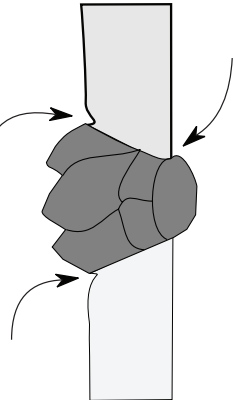
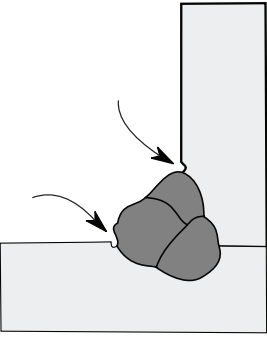
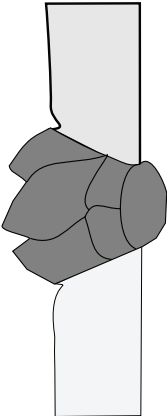
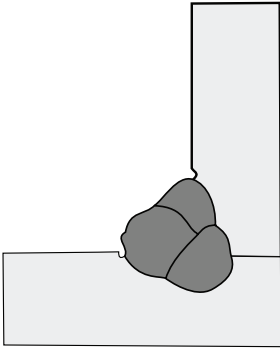
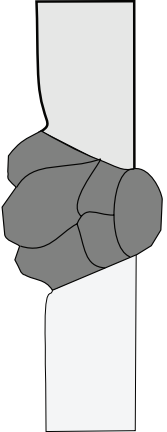
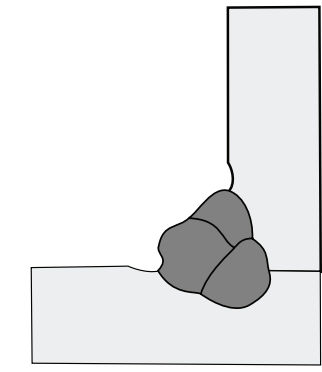
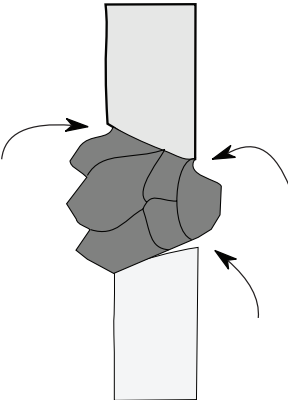
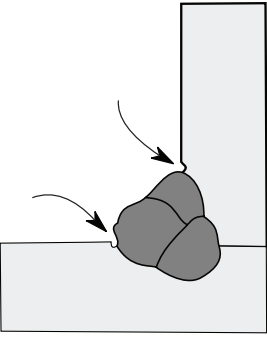
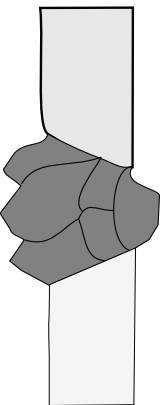
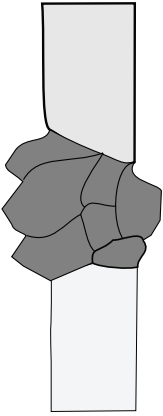
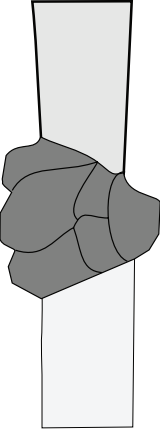
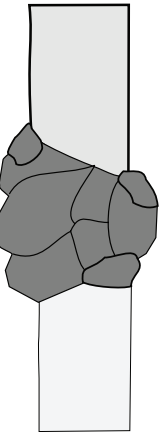
1.6 Undercut/ weld toe appearance			No preparation.			The transition between weld and base material shall be sufficiently open to allow penetration of paint and blasting abrasives.			The weld shall have a smooth transition between weld and base material.
1.7 Lack of fusion and shrinkage grooves			Lack of fusion is not acceptable.			Surface shall be free from sharp edges. Shrinkage grooves shall be sufficiently open to allow penetration of abrasives and paint. Lack of fusion is not acceptable.			Surface shall be free from sharp edges; shrinkage groove shall have a smooth transition. Lack of fusion is not acceptable.

Table 1 (continued)

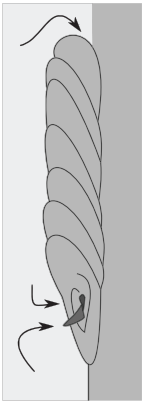
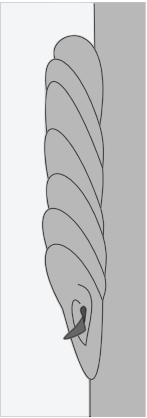
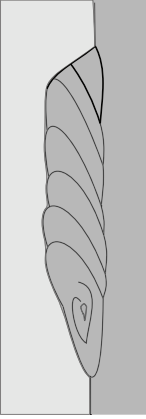
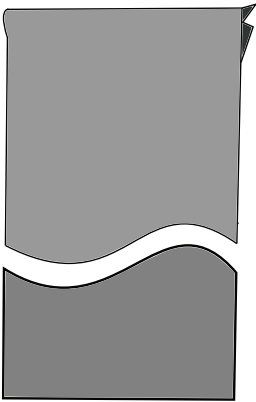
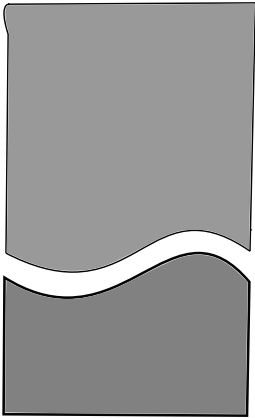
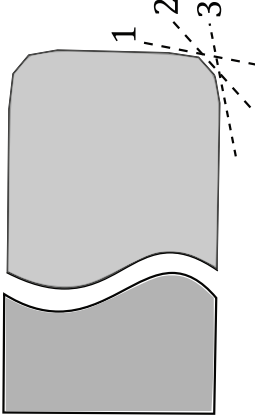
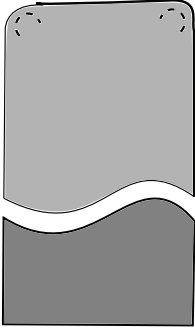
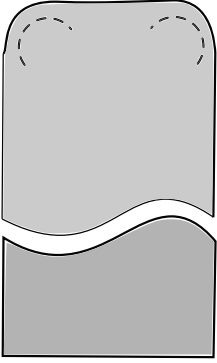
1.8 End Craters and weld start overhang		No preparation.		End craters shall be sufficiently open to allow penetration of paint and blasting abrasives or dressed out. Overhang at weld start shall be dressed away.		Surface shall be free from visible end craters. Overhang at weld start shall be dressed away.
2 Edges						
2.1 Sharp edges made by punching, shearing, sawing, drilling, rolled edges, etc.		Edges shall be deburred.		Edges shall be free from fins; no part of the edge shall be sharp. Edges shall be rounded or chamfered at least 1 mm from each side.		Edges shall be free from fins; no part of the edge shall be sharp. Edges shall be rounded with a radius of not less than 2 mm or by 3 passes chamfering (as illustrated in the following figure) at least 2 mm from each side.
						NOTE It is possible that P3 is not achievable on thin steel (<3 mm).

Table 1 (continued)

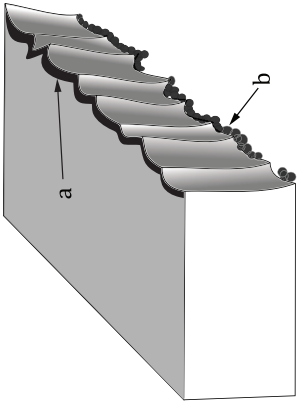
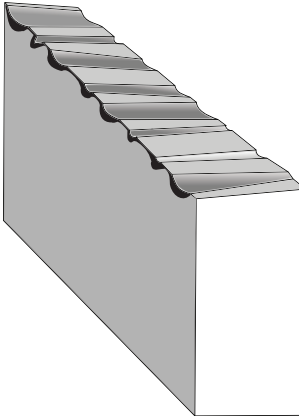
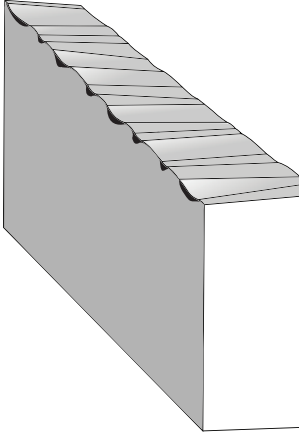
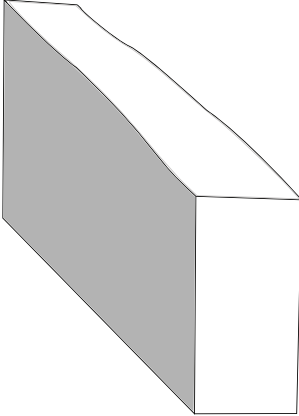
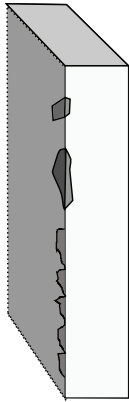
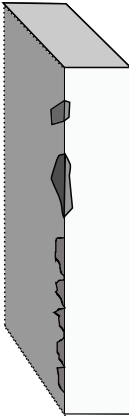
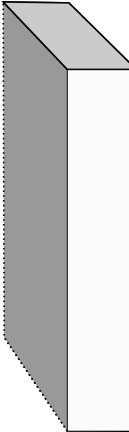
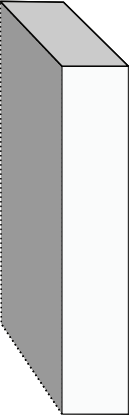
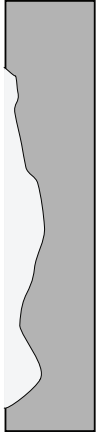
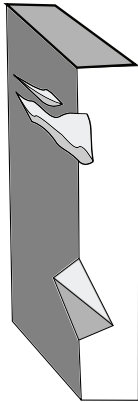
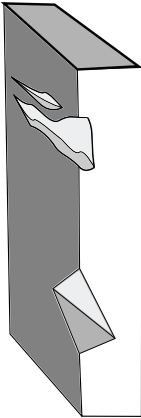
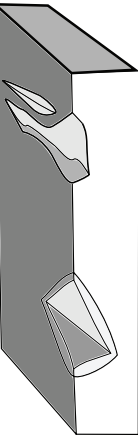
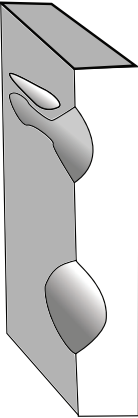
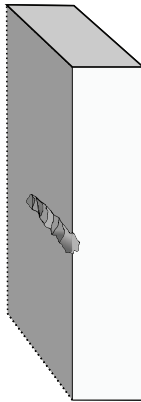
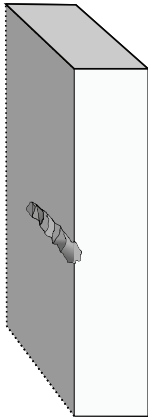
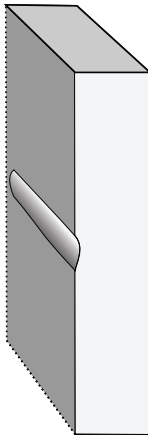
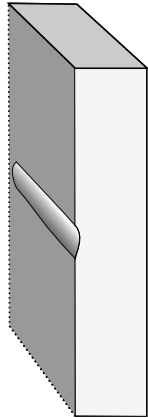
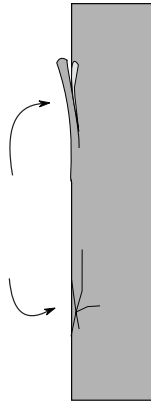
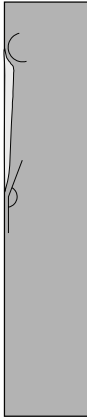
2.2 Thermally cut surfaces	 a) heat affected zone b) slag	Surface shall be free of slag and loose scale. Sharp edges on the cut face shall be broken.		Surface shall be free of slag and loose scale. No part of the cut surface shall be sharp. The surface may be uneven, but transitions shall be smooth.		Surface shall be free of slag and loose scale. No part of the cut surface shall be sharp. The surface shall be smooth and essentially flat.	
3 Surfaces							
3.1 Rolled-in scale and extraneous matter		No preparation.		Surface shall be free from rolled-in scale and extraneous matter.		Surface shall be free from rolled-in scale and extraneous matter.	
3.2 Pits and craters		Pits and crater shall be free from overhang.		Pits and craters shall meet the nominal criteria or shall be free from overhang.		Pits and craters shall meet the nominal criteria or shall be within the nominal tolerances specified for the original product and shall be sufficiently open to allow penetration of paint. If pits and craters do not meet the specified nominal criteria or are not within the specified nominal tolerances, sharp edges of pits and craters shall be dressed.	

Table 1 (continued)

3.3 Indentations and roll marks			No preparation.	Indentations and roll marks shall meet the nominal criteria or shall be within the nominal tolerances specified for the original product and shall be sufficiently open to allow penetration of paint. If indentations and roll-marks do not meet the specified nominal criteria or are not within the specified nominal tolerances, sharp edges of indentations and roll-marks shall be dressed.		Indentations and roll marks shall meet the nominal criteria or shall be within the nominal tolerances specified for the original product and shall be sufficiently open to allow penetration of paint. If indentations and roll-marks do not meet the specified nominal criteria or are not within the specified nominal tolerances, sharp edges of indentations and roll-marks shall be dressed/welded and rounded smooth.	
3.4 Scratches and grooves			No preparation.	The radius of grooves and gouges shall comply with the nominal properties specified for the original product and shall be sufficiently open to allow penetration of paint. If scratches and grooves are non-compliant with nominal specified properties, sharp edges of scratches and grooves shall be dressed.		The radius of grooves and gouges shall comply with the nominal properties specified for the original product and shall be sufficiently open to allow penetration of paint. If scratches and grooves are non-compliant with nominal specified properties, sharp edges of scratches and grooves shall be dressed/ welded and rounded smooth.	
3.5 Cracks, shell and seams			Cracks and any lifted material shall be removed.	Cracks, shell and seams shall be removed, any resulting crater shall comply with the nominal properties specified for the original product and shall be sufficiently open to allow penetration of paint.		Cracks, shell and seams shall be removed, any resulting crater shall comply with the nominal properties specified for the original product and shall be sufficiently open to allow penetration of paint.	
3.6 Rust grade			Any rust grade of the used steel material may be used.	Rust grade of used steel material shall conform to rust grade A to C in accordance with ISO 8501-1. For grade D, the paint manufacturer should be consulted for recommendations and its use should be agreed between interested parties.		Rust grade of used steel material shall conform to rust grade A to C in accordance with ISO 8501-1. For grade D, the paint manufacturer should be consulted for recommendations and its use should be agreed between interested parties.	

Annex A (informative)

Preparation grade converted into weld quality levels based on ISO 5817:2023

A.1 Preparation grade P3

A.1.1 General

Preparation grade P3 based on ISO 5817:2023 can be achieved as specified in [A.1.2](#) to [A.1.4](#).

A.1.2 Quality level B

Preparation grade P3 can be achieved according to quality level B as specified in ISO 5817:2023 Table 1, except for the imperfection types listed hereafter:

- ISO 5817:2023, Table 1, 1.12 – Incorrect weld toe – Butt weld: the angle α may be reduced to $\geq 130^\circ$;
- ISO 5817:2023, Table 1, 1.12 – Incorrect weld toe – Fillet weld: the angle α may be reduced so it meets quality level C;
- ISO 5817:2023, Table 1, 1.23 – Spatter: weld spatter is not permitted;
- ISO 5817:2023, Table 1, 1.24 – Temper colours: there are no supplementary requirements unless otherwise agreed at time of the order;
- The topography of the weld bead shall meet the requirements given for P3 in [Table 1](#), 1.5 of this document.

A.1.3 Quality level C

Preparation grade P3 can be achieved according to quality level C as specified in ISO 5817:2023, except for the imperfection types listed hereafter:

- ISO 5817:2023, Table 1, 1.3 – Surface pore: as for quality level B;
- ISO 5817:2023, Table 1, 1.4 – End crater pipe: as for quality level B;
- ISO 5817:2023, Table 1, 1.12 – Incorrect weld toe – Butt weld: the angle α shall as a minimum be $\geq 130^\circ$;
- ISO 5817:2023, Table 1, 1.23 – Spatter: weld spatter is not permitted;
- ISO 5817:2023, Table 1, 1.24 – Temper colours: there are no supplementary requirements unless otherwise agreed at time of the order.

A.1.4 Quality level D

It is not recommended to use quality level D as specified in ISO 5817:2023 for preparation grade P3 unless the specific requirements have been agreed at time of the order.

A.2 Preparation grade P2

A.2.1 General

Preparation grade P2 based on ISO 5817:2023 can be achieved as specified in [A.2.2](#) to [A.2.4](#).

A.2.2 Quality level B

Preparation grade P2 can be achieved according to quality level B as specified in ISO 5817:2023, except for the imperfection types listed hereafter:

- ISO 5817:2023, Table 1, 1.12 – Incorrect weld toe – Butt weld: the angle α may be reduced so it meets quality level C;
- ISO 5817:2023, Table 1, 1.12 – Incorrect weld toe – Fillet weld: the angle α may be reduced so it meets quality level C;
- ISO 5817:2023, Table 1, 1.23 – Spatter: surface should be free from all loose and lightly adhering welding spatter;
- ISO 5817:2023, Table 1, 1.24 – Temper colours: there are no supplementary requirements unless otherwise agreed at time of the order.

A.2.3 Quality level C

Preparation grade P2 can be achieved according to quality level C as specified in ISO 5817:2023, except for the imperfection types listed hereafter:

- ISO 5817:2023, Table 1, 1.3 – Surface pore and 1.4 End crater pipe – $t > 3$ mm;

The following supplementary requirements apply:

- $d/h > 1$

NOTE d is diameter of the pore/crater, h is the depth of the imperfection, t is the wall or plate thickness (nominal size).

- allowable number of imperfections:
 - For welds > 500 mm: maximum 10 imperfections per any 5 000 mm of weld;
 - For welds < 500 mm: maximum 3 imperfections per weld.
- ISO 5817:2023, Table 1, 1.23 – Spatter: surface should be free from all loose and lightly adhering welding spatter.
- ISO 5817:2023, Table 1, 1.24 – Temper colours: there are no supplementary requirements unless otherwise agreed at time of the order.

A.2.4 Quality level D

Preparation grade P2 can be achieved according to quality level D as specified in ISO 5817:2023, except for the imperfection types listed hereafter:

- ISO 5817:2023, Table 1, 1.3 – Surface pore and 1.4 End crater pipe – $t > 3$ mm.

The following supplementary requirements apply:

- $d/h > 1$

NOTE d is diameter of the pore/crater, h is the depth of the imperfection, t is the wall or plate thickness (nominal size).

- allowable number of imperfections:
 - for welds > 500 mm: maximum 10 imperfections per any 5 000 mm of weld;
 - for welds < 500 mm: maximum 3 imperfections per weld;
- ISO 5817:2023, Table 1, 1.6 – Incomplete root penetration: as for quality level C;
- ISO 5817:2023, Table 1, 1.12 – Incorrect weld toe: as for quality level C;

ISO 8501-3:2025(en)

- ISO 5817:2023, Table 1, 1.13 – Overlap: as for quality level C;
- ISO 5817:2023, Table 1, 1.18 – Root porosity: as for quality level C;
- ISO 5817:2023, Table 1, 1.19 – Poor restart: as for quality level C;
- ISO 5817:2023, Table 1, 1.23 – Spatter: surface should be free from all loose and lightly adhering welding spatter;
- ISO 5817:2023, Table 1, 1.24 – Temper colours: there are no supplementary requirements unless otherwise agreed at the time of the order.

Bibliography

- [1] ISO 5817:2023, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*
- [2] ISO 6520-1, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding*
- [3] ISO 9013, *Thermal cutting — Classification of thermal cuts — Geometrical product specification and quality tolerances*
- [4] ISO 8504-1, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 1: General principles*
- [5] ISO 8504-2, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2: Abrasive blast-cleaning*
- [6] ISO 8504-3, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 3: Hand- and power-tool cleaning*
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- [10] EN 10025 (all parts), *Hot rolled products of structural steels*
- [11] EN 10163, *Delivery requirements for surface conditions of hot-rolled steel plates, wide flats and sections*



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