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Structural steels — Surface condition of hot-rolled sections — Delivery requirements

Aciers de construction — Etat de surface des profilés laminés à chaud — Exigences de livraison

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Foreword

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ISO 20723 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes.*

Structural steels — Surface condition of hot-rolled sections — Delivery requirements

1 Scope

This International Standard specifies delivery requirements that apply to the surface condition of hot-rolled sections with nominal thickness between $\geqslant$ 3 mm and $\leqslant$ 160 mm.

It applies to all surfaces excluding edges.

2 Normative references

The following referenced documents are indispensable for the application 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 6929, *Steel products — Definitions and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6929 and the following apply.

3.1
imperfection
surface discontinuity with a depth and/or area equal to or less than a specified limiting value

3.2
defect
surface discontinuity with a depth and/or area greater than a specified limiting value

NOTE For most common surface discontinuities, see the descriptions in Annex A.

4 Measurement procedure

4.1 To differentiate the surface discontinuities in terms of imperfections and defects, the depth of representative surface discontinuities shall, when necessary, be measured. The measurement shall be carried out from the surface of the product. The depth of the discontinuities chosen as representative ones shall be determined after the discontinuity has been removed by grinding, or other methods such as machining.

4.2 Areas affected by surface discontinuities shall, when necessary, be determined as follows:

a) for isolated discontinuities (Figure 1), the affected area is obtained by drawing a continuous line that follows the circumference of the discontinuity at a distance of 20 mm;

b) for discontinuities appearing in a cluster (Figure 2), the affected area is obtained by drawing a continuous line which follows the circumference of the cluster at a distance of 20 mm;

c) for discontinuities appearing in a line (Figure 3), the affected area is obtained by drawing a continuous line which follows the discontinuities at 20 mm.

Aligned discontinuities shall be at least 10 times their biggest width. Single or multiple appearing discontinuities, whose edges are closer together than 40 mm, shall be considered as one discontinuity.

5 Requirements

5.1 Repair procedure

Imperfections may be left without repair.

Defects shall be repaired.

5.2 Types and classes

5.2.1 General

The surface requirements and repair conditions are subdivided into 2 types, 2 classes and each class is further subdivided into 3 subclasses.

5.2.1.1 Types

Type 1: The remaining thickness of the affected area under discontinuities and of repaired ground areas may be less than the minimum thickness as specified in the appropriate tolerance standard.

NOTE The appropriate standard for the tolerances on dimensions are the relevant International Standard (see Bibliography). In case there is no relevant International Standard, the standard or the tolerances to apply should be agreed at order.

Type 2: The remaining thickness of the affected area under discontinuities and of repaired ground areas shall not be less than the minimum thickness as specified in the appropriate tolerance standard.

5.2.1.2 Classes

Class C General applications

The surface condition shall comply with the requirements of 5.3.1 and Clause 6.

Class D Special applications

The surface condition shall comply with the requirements of 5.3.2 and Clause 6.

5.2.1.3 Subclasses

Subclass 1 Repair by grinding or other methods, such as machining followed by welding, is permitted in compliance with 6.2.2 and 6.2.3

Subclass 2 Repair by welding is only permitted if agreed at the time of enquiry and order and under agreed conditions (see 6.2.4)

Subclass 3 Repair by welding is not allowed (see 6.2.5)

5.2.1.4 Additional requirements

The required type, class and subclass shall be specified in the appropriate material or product standard. If this is not the case, the type, class and subclass shall be agreed upon at the time of the enquiry and order.

5.3 Classification of discontinuities

5.3.1 Class C

5.3.1.1 Imperfections

Discontinuities not exceeding the limits of Table 1 are regarded as being inherent of the manufacturing process and are permissible, irrespective of their number.

A surface area with a remaining thickness under the discontinuities less than the minimum thickness, as specified in documents specifying tolerances, is permissible with a maximum of 15 % of the inspected surface.

When Type 2 is required, the remaining thickness under the discontinuities shall not be less than the minimum thickness, as specified in documents specifying tolerances.

Table 1 — Maximum permissible depth of discontinuities for class C

Dimensions in millimetres

Nominal thickness of the product t	Maximum permissible depth of discontinuities
$3 \leqslant t < 6$	20 % of t
$6 \leqslant t < 20$	1,2
$20 \leqslant t < 40$	1,7
$40 \leqslant t < 80$	2,5
$80 \leqslant t < 160$	3,0

5.3.1.2 Defects

Discontinuities with a depth exceeding the limits of Table 1 shall be repaired irrespective of their number.

5.3.2 Class D

5.3.2.1 Imperfections

Discontinuities not exceeding the limits of Table 2 are regarded as being inherent of the manufacturing process and are permissible irrespective of their number.

A surface area with a remaining thickness under the discontinuities less than the minimum thickness, as specified in the applicable quality documents, is permissible with a maximum of 2 % of the inspected surface.

When Type 2 is required, the remaining thickness under the discontinuities shall not be less than the minimum thickness, as specified in documents specifying tolerances.

Table 2 — Maximum permissible depth of discontinuities for class D

Dimensions in millimetres

Nominal thickness of the product t	Maximum permissible depth of discontinuities
$3 \leqslant t < 20$	0,5
$20 \leqslant t < 40$	0,7
$40 \leqslant t < 80$	1,0
$80 \leqslant t < 160$	1,5

5.3.2.2 Defects

Discontinuities with a depth exceeding the limits of Table 2 shall be repaired irrespective of their number.

6 Repair procedures

6.1 Grinding or other types of machining

If a discontinuity has to be repaired, it shall be removed completely by grinding to its full depth. The ground areas shall be smooth transition to the surrounding surface of the product. In case of dispute, complete elimination of the defect may be demonstrated by magnetic particle or by penetrant test techniques.

The maximum permitted grinding allowance below the minimum thickness, as specified in documents specifying tolerances, is given in Table 3.

NOTE The appropriate standard for the tolerances on dimensions will be the relevant International Standard. In case there is no relevant International Standard, the standard or the tolerances to apply is or are agreed at the time of ordering.

Furthermore, the following conditions apply:

for a ground area with a thickness under the minimum permissible thickness, as specified in documents specifying tolerances, the sum of all ground areas shall not exceed 15 % of the surface for class C and 2 % for class D.

When Type 2 is required, a remaining thickness of ground area shall not be less than the minimum thickness, as specified in documents specifying tolerances.

Table 3 — Maximum permissible values below the minimum thickness

Dimensions in millimetres

Nominal thickness of the product t	Maximum permissible values below the minimum thickness
$3 \leqslant t < 20$	0,4
$20 \leqslant t < 40$	0,6
$40 \leqslant t < 80$	1,2
$80 \leqslant t < 160$	2,0

6.2 Welding

6.2.1 General

The following conditions apply for the repair by welding of defects that cannot be repaired by grinding or other means of machining as stated in 6.1.

The defects of the steel section shall be repaired by welding, after their complete removal by means of an appropriate machining method, such as chipping or grinding. This procedure shall not reduce the thickness of the product to less than 70 % of its nominal thickness.

The welding shall be carried out by qualified operators and with qualified procedures.

The weld shall be free of any lack of fusion, undercutting, cracks and other defects that could impair the workability of use of the product in question, as specified by the purchaser.

The reinforcement of weld shall be at least 1,5 mm or over in height from the rolled surface and shall subsequently be ground smooth and levelled with the product surface. After grinding smooth, ordered product thickness tolerances apply to the ground surface.

After repair, a post-weld heat treatment may be agreed between the manufacturer and purchaser.

Proper repair shall be verified by ultrasonic, radiographic, magnetic particle or dye penetrant inspection. When the method has not been specified by the purchaser, the choice of the method is at the manufacturer's options.

If requested at the time of enquiry and order, for every welding repair the producer shall provide reports containing a sketch, showing the dimensions and location of the defect and full details of the repair procedure, including the welding consumables, eventual post-weld treatment and non-destructive testing.

Furthermore, the requirements in 6.2.2 to 6.2.5 shall apply.

6.2.2 Class C, subclass 1

The sum of the welded areas shall not exceed 15 % of the surface area under inspection.

6.2.3 Class D, subclass 1

The sum of the welded areas shall not exceed 2 % of the surface area under inspection.

When type 2 is specified, the sum of the welded area shall not exceed 2 % of the surface area under inspection.

6.2.4 Subclass 2

Repair by welding is only permitted if this was agreed at the time of enquiry and order, and in this case requirements different from 6.2.2 and 6.2.3 may be specified.

6.2.5 Subclass 3

Repair by welding is not permitted.

Dimensions in millimetres

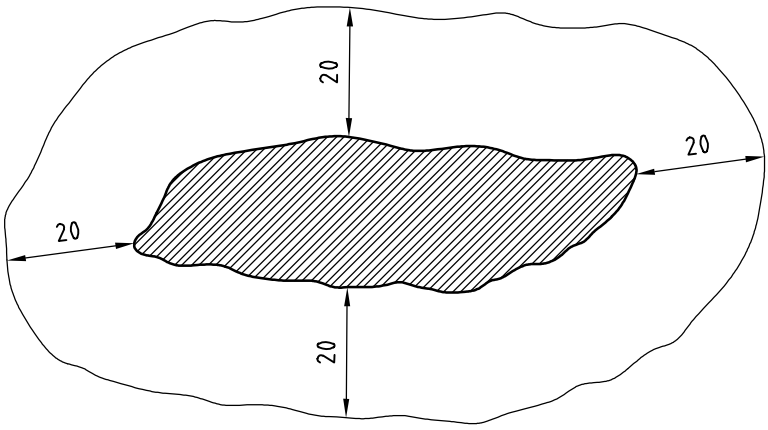

Figure 1 — Determination of the area affected by an isolated discontinuity

Dimensions in millimetres

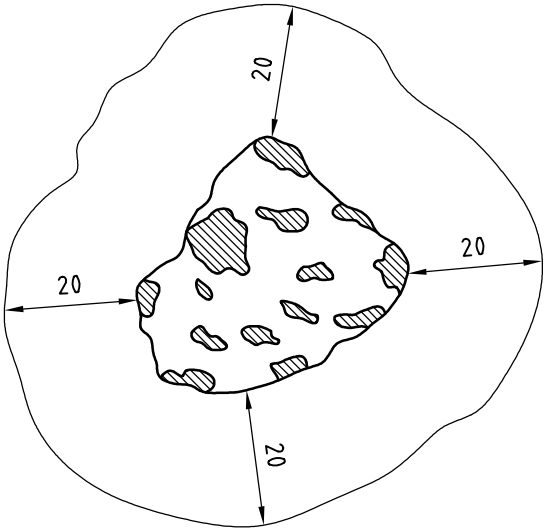

Figure 2 — Determination of the area affected by clustered discontinuities

Dimensions in millimetres

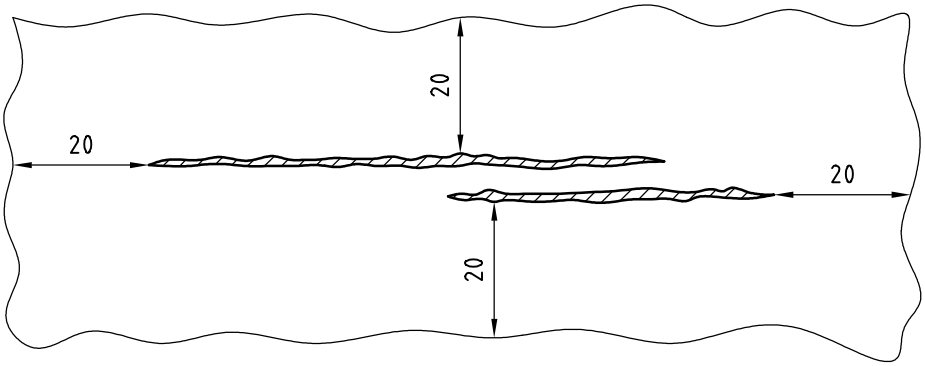

Figure 3 — Determination of the area affected by aligned single or multiple discontinuities

Annex A
(informative)

Description of the most common discontinuities

A.1 Rolled-in scale, pitting

Marks on the rolled surface varying in shape, thickness and frequency.

Rolled-in scale results from the unsatisfactory subsequent removal of scale from the stock before or during hot-rolling and processing.

A.2 Indentations and roll marks

Indentations (depressions) or roll marks (protuberances) can be distributed at definite distances apart, or irregularly throughout the length and width of the stock.

Roll marks appearing at periodic intervals are caused by damaged rolls or pinch rolls. Indentations can be caused by protuberances on rolls or rollers.

A.3 Scratches and grooves

Mechanical damage varying in width, depth and length at the surface. These scratches and grooves are mostly parallel or at right angles to the rolling direction. They may be slightly rolled over and seldom contain scale.

This damage is caused by friction between the stock and parts of the equipment due to relative movements.

A.4 Spills and slivers

Minute surface discontinuities of an irregular and flake-like nature.

Spills are elongated in the direction of rolling, their extent depending on the degree of reduction. They are still connected (as minute particles of shell) to the base metal at certain points.

A.5 Blisters

Blow holes of varying size and shape located just beneath the surface and appearing during hot-rolling.

A.6 Hot tears

Variably oriented material discontinuities in the surface region. They may vary in length, width and depth and may occur in preferred directions and/or be distributed over a limited area.

Hot tears arise in the processing of slab ingots, rough slabs and continuously cast slabs, and are associated with the steel stresses in the initial material or with adverse forming conditions.

A.7 Sand patches

Non-metallic inclusions in the surface that vary in size and shape. They are elongated in the direction of rolling, randomly localized, and they are distinctly coloured, standing out from their background.

A.8 Cracks

In the region of the surface, localized discontinuities of varying length parallel or at right angles to the direction of rolling, and which may less frequently occur as crazing. Cracks are due mainly to material stresses which arise during cooling of the rolled stock.

A.9 Shell and seams

Overlapping material, the overlapping portions of the surface varying in shape and extent, being irregularly distributed over certain areas of the rolled product, and being only partially connected with the base material. There is a preponderance of non-metallic inclusions and/or scale among the shell.

Shell can originate during casting or because of the shifting or sliding of layers of the material during hot rolling.

Seams are caused mainly when defects in the semi-product parallel to the rolling direction, for instance flame-cutting burrs, are overlapped during rolling.

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[10] ISO 657-21, *Hot-rolled steel sections — Part 21: T-sections with equal depth and flange width — Dimensions*

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