International Standard 7788

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Steel — Surface finish of hot-rolled plates and wide flats — Delivery requirements

Acier — État de surface des tôles et larges-plats laminés à chaud — Conditions de livraison

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Descriptors : steel products, hot-rolled products, metal plates, delivery condition, surface condition.

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7788 was prepared by Technical Committee ISO/TC 17, *Steel*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Steel — Surface finish of hot-rolled plates and wide flats — Delivery requirements

0 Introduction

Responsibility for the required surface finish rests with the material producer, who has to take the necessary precautions.

However, rolling or heat-treatment scale may conceal surface discontinuities. In these conditions, the producer can only take account of discontinuities which are visible to the naked eye.

If, during the subsequent descaling or working operations by the user, the material is found to be defective because of faulty rolling or processing by the producer, the producer shall be allowed to have the product repaired, provided that this is not in conflict with the appropriate quality standard.

The repair conditions laid down in the quality standard shall always prevail. If the user requires a surface free of defects according to 4.3, he must order descaled plates or wide flats, which shall be delivered free of defects visible to the naked eye.

1 Scope and field of application[1)]

This International Standard specifies delivery requirements which apply to the surface finish of hot-rolled plates and wide flats rolled on reversing mills, with nominal thicknesses equal to or less than 150 mm.

For plates with a thickness greater than 150 mm and for special applications for which a different surface condition is required, special agreements shall be made at the time of enquiry and order.

2 References

ISO 6929, *Definition of steel products by shape and dimensions.*[2)]

ISO 7452, *Hot-rolled structural steel plates — Tolerances on dimensions and form.*

3 Definitions

The definitions of products and discontinuities referred to in this International Standard are given in annex A.

4 Requirements

4.1 General

4.1.1 For plates and wide flats for boilers and pressure vessels, the remaining thickness of the affected area under the discontinuities shall not be less than the minimum permissible thickness as specified in the appropriate standards covering tolerances. This provision may also be applied for other applications as agreed at the time of enquiry and order.

4.1.2 In cases of dispute, measurement of depth of discontinuities shall be carried out from the surface of the product, descaled in the vicinity of the discontinuity.

4.1.3 Areas affected by surface discontinuities shall be determined as follows:

a) for isolated spotlike discontinuities [figure 1 a)], the affected area is obtained by surrounding the discontinuity with a circle having a radius which is 50 mm greater than the radius of the circumscribing circle of the discontinuity;

b) in the case of discontinuities appearing in a cluster or line [figure 1 b) and 1 c)], the affected area is obtained by drawing a rectangle or a square the sides of which are 50 mm from the rectangle or square circumscribing the cluster or line.

4.1.4 Depending on the steel grade and manufacturing process, plates and wide flats may have surface discontinuities, which may be divided into five categories depending on their nature, depth and number as defined in 4.2 and 4.3.

1) See 4.1.1.

2) At present at the stage of draft.

4.2 Imperfections (see annex B, figure 1 and table 1)

4.2.1 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 ISO 7452 is permissible with a maximum of 15 % of the area of the inspected surface (this does not apply to the applications mentioned in 4.1.1).

4.2.2 Discontinuities with depth exceeding the limits of table 1 but not exceeding the limit of table 2 and of which the sum of the affected areas does not exceed 5 % of the inspected surface, may be left unrepaired.

A surface area with a remaining thickness under the discontinuities less than the minimum thickness as specified in ISO 7452 is permissible with a maximum of 2 % of the area of the inspected surface (this does not apply to the applications mentioned in 4.1.1).

4.3 Defects (see annex B, figure 2 and table 1)

4.3.1 Discontinuities with depth not exceeding the limits of table 2, but with an affected surface area of more than 5 % of the inspected surface shall be repaired.

4.3.2 Discontinuities with depth exceeding the limits of table 2 shall be repaired irrespective of their number.

4.3.3 Discontinuities like cracks, shell and seams which are in general deep and sharp, and therefore impair the use of the product, shall always be repaired irrespective of their depth and number.

Table 1

Values in millimetres

Nominal thickness of the product e	Maximum permissible depth of discontinuities
$3 \leqslant e < 8$	0,2
$8 \leqslant e < 25$	0,3
$25 \leqslant e < 40$	0,4
$40 \leqslant e < 80$	0,5
$80 \leqslant e \leqslant 150$	0,6

Table 2

Values in millimetres

Nominal thickness of the product e	Maximum permissible depth of discontinuities
$3 \leqslant e < 8$	0,4
$8 \leqslant e < 25$	0,5
$25 \leqslant e < 40$	0,6
$40 \leqslant e < 80$	0,8
$80 \leqslant e \leqslant 150$	0,9

5 Repair procedures

5.1 Grinding

In the case of plates and wide flats for boilers and pressure vessels, the remaining thickness of the repaired ground area shall not be less than the minimum permissible thickness as specified in the appropriate standard covering tolerances.

This disposition may also be applied for other applications as agreed at the time of enquiry and order.

Grinding of defects may be carried out subject to the following and the conditions specified in 4.1.

5.1.1 The maximum permissible depth of ground areas is defined as follows:

a) for plates and wide flats less than 8 mm thick, repair by grinding is permitted to a remaining thickness of 0,3 mm below the minimum thickness as specified in ISO 7452 (this does not apply to the applications mentioned in 5.1);

b) for plates and wide flats of 8 mm up to and including 15 mm thick, repair by grinding is permitted to a remaining thickness of 0,4 mm below the minimum thickness as specified in ISO 7452 (this does not apply to the applications mentioned in 5.1);

c) for plates and wide flats over 15 mm thick, repair by grinding is permitted to a remaining thickness of 7 % below the nominal thickness. The remaining thickness shall in no case be less than 3 mm below the nominal thickness.

5.1.2 For ground areas with a thickness under the minimum permissible thickness, as specified in the tolerance standards, the size of a single ground area shall not exceed 1/4 m^2 and the sum of all areas of one side of the product shall not exceed 2 % of the surface under consideration for plates having a surface area greater than or equal to 12 m^2, and 5 % for plates having a surface area less than 12 m^2. The size of the ground area refers only to the size of that area with a remaining metal thickness less than the specified minimum permissible thickness. The distance between two ground areas shall not be less than their average width.

5.1.3 The requirements of 5.1.1 apply to the remaining thickness between two opposite ground areas on either face of the product.

5.1.4 The defects shall be ground completely. The ground areas shall have a smooth transition to the surrounding surface of the product. Complete elimination of the defect may be demonstrated by magnetic particle or dye penetrant test procedures.

5.1.5 The producer is allowed to repair the whole surface by grinding to a thickness not less than the minimum permissible thickness of the product as specified in the appropriate tolerance standards. All the requirements of 5.1.1, 5.1.2 and 5.1.3 are also applicable.

5.2 Welding

The following notes are for guidance only.

For details of permissible welding repair, reference shall be made to the appropriate quality standard.

Defects which cannot be repaired by grinding as stated in 5.1 may be repaired by chipping and/or grinding, followed by welding. Unless otherwise agreed at the time of enquiry and order, repair shall be carried out with the agreement of the purchaser and/or inspecting authority under the following conditions:

5.2.1 The sum of all repaired areas by welding shall not exceed 2 % of the surface under consideration for plates having a surface area greater or equal to 6 m^2, 5 % for plates having a surface area less than 6 m^2.

The distance between two welded areas shall not be less than their average width.

5.2.2 The defects shall be completely eliminated before any filler metal is applied.

This procedure shall not reduce the thickness of the product below 80 % of the nominal thickness.

For occasional defects having depths exceeding the above-mentioned limits special consideration will be necessary.

5.2.3 The repair shall be carried out by competent welders using a procedure appropriate to the grade of steel and acceptable to the purchaser.

5.2.4 All welds shall have a reasonable length and shall consist of at least three parallel welding beads. The weld shall be free of any lack of fusion, undercutting, cracks and other defects, which could impair the workability or use of the product in question.

The deposited weld material shall have an excess of at least 2 mm which subsequently has to be ground smooth and level with the product surface.

5.2.5 After repair, a post-weld treatment may be considered, if necessary.

5.2.6 Proper repair may be verified by ultrasonic, radiographic, magnetic particle or dye penetrant inspection.

5.2.7 For every welding repair, the producer shall file on request at the time of enquiry and order reports containing a sketch, showing dimensions and location of the defect and full details of the repair procedure, including the welding consumables, eventual post-weld heat treatment and non-destructive testing.

Annex A

Definitions

(This annex forms an integral part of the Standard.)

A.1 plate and wide flat: See ISO 6929.

A.2 imperfections: Discontinuities that may be left without repair.

Discontinuities that shall be repaired are regarded as defects.

A.3 Definitions of the most common discontinuities

A.3.1 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.3.2 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, *inter alia*, by protuberances on rolls or rollers.

A.3.3 scratches and grooves: Mechanical damages varying in width, depth and length at the surface. They are mostly parallel or at right angles to the rolling direction. They may be slightly rolled over and seldom contain scale.

These damages are caused by friction between the stock and parts of the equipment due to relative movements.

A.3.4 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 reductions. They are still connected — as minute particles of shell — to the base metal at certain points.

A.3.5 blisters: Blow holes of varying size and shape located closely beneath the surface and appearing during hot rolling.

A.3.6 hot tears: Variably orientated 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, roughed slabs and continuously cast slabs and are associated with the steel, with stresses in the initial material or with adverse forming conditions.

A.3.7 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.

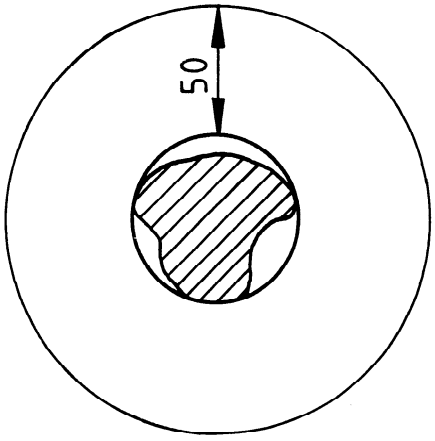
A.3.8 cracks: In the region of the surface, localized discontinuities of varying length parallel or at right angles to the direction of rolling and which may less frequently occur as crazing. Cracks are due mainly to material stresses which arise during the cooling of the rolled stock.

A.3.9 shell and seams: Overlapping material, the overlapping portions of the surface varying in shape and extent, being irregularly distributed over 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.

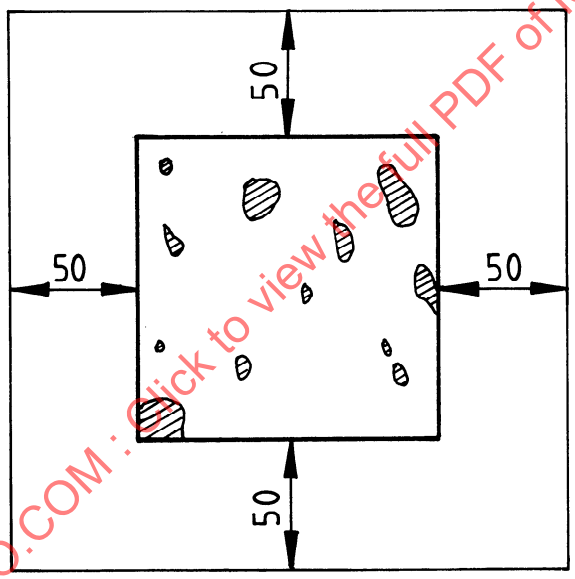
Shell can originate during casting or because of the shifting or sliding of layers of the material during hot rolling.

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

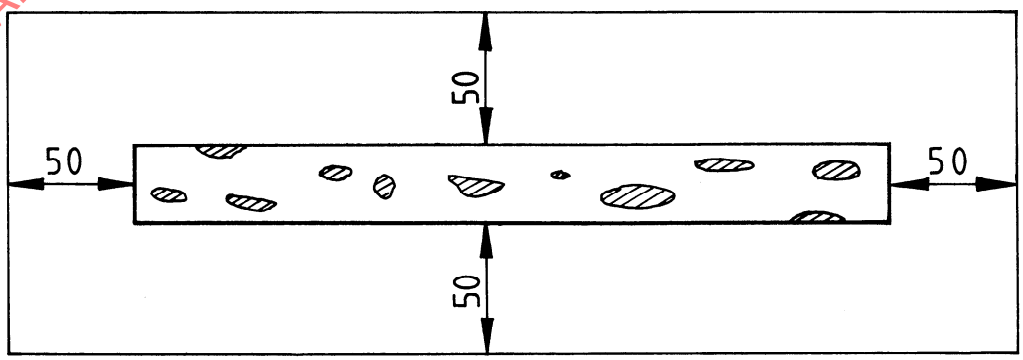
Dimensions in millimetres



a) Isolated spotlike discontinuity



b) Clustered discontinuities



c) Aligned discontinuities

Figure 1 — Determination of the areas affected by the surface discontinuities

Annex B

Action to undertake in function of the depth of discontinuities and nominal thickness of the products

(This annex forms an integral part of the Standard.)

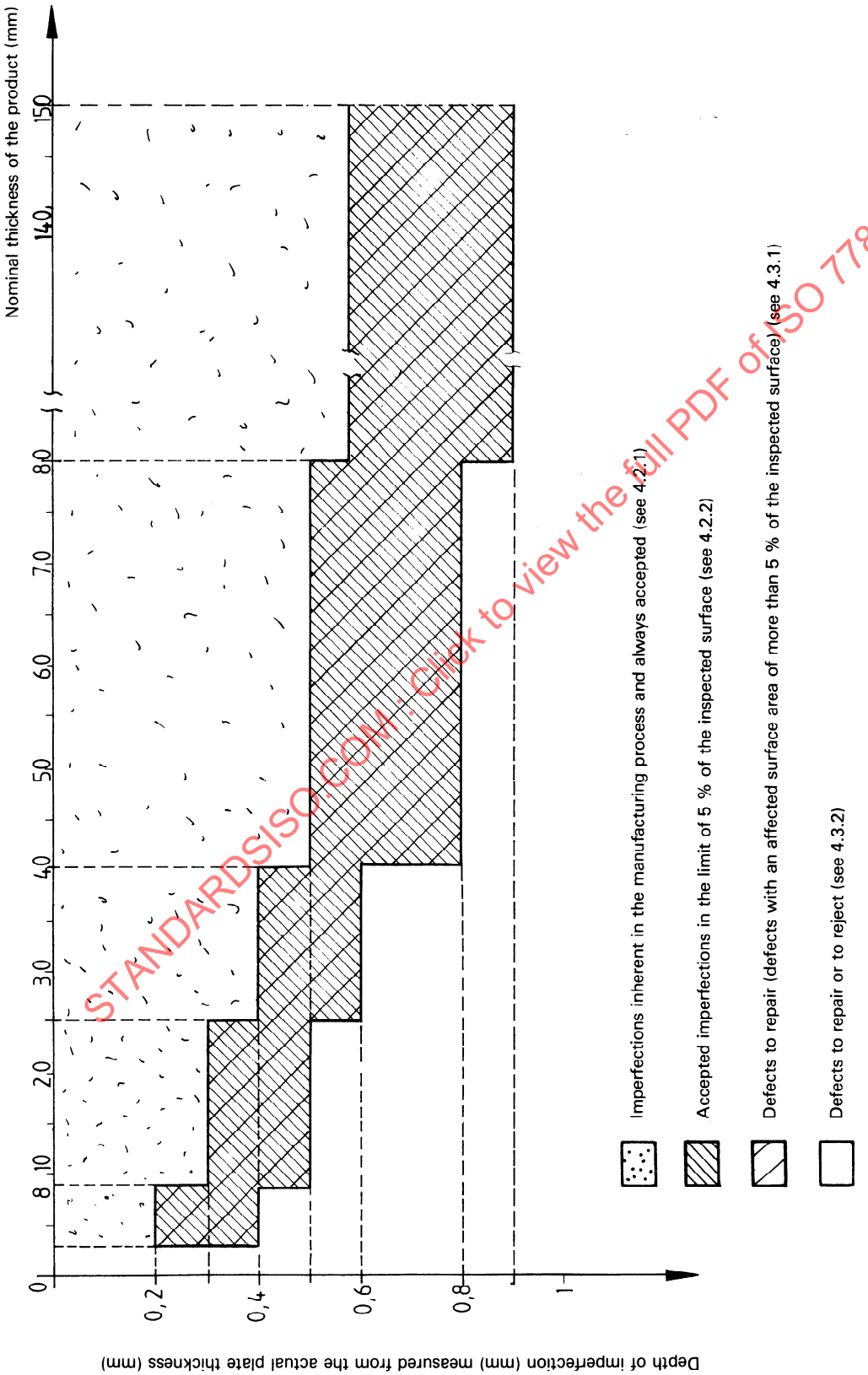


Figure 2 — Limits for discontinuities