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Technical product documentation — Heat-treated ferrous parts — Presentation and indications

Documentation technique de produits — Produits ferreux traités thermiquement — Présentation et indications

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Foreword

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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. www.iso.org/directives

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is Technical Committee ISO/TC 10 *Technical product documentation*, Subcommittee SC 6, *Mechanical engineering documentation*.

This second edition of ISO 15787 cancels and replaces the first edition (ISO 15787:2001), which has been technically revised.

In addition to a number of editorial revisions, the following main changes have been made with respect to the previous edition:

— addition of an indication of both states of the part: 1) after the heat treatment (before final machining); and 2) after the final machining (Figure 16 and Figure 30);

— addition of examples representing the hardness values and their limiting deviations (Table 1);

— addition of line types for the indication of local areas and their applications (Table 2);

— addition of line type 07.2 (dotted wide line) for carburized, carbonitrided, nitrided or nitrocarburized workpieces to indicate areas where heat treatment is not allowed;

— replacement of the representation of hardness values, hardness depths, layer thicknesses and limiting deviations by their values and limiting deviations (Tables 1, 3, 4 and 5);

— addition of marking of slip zones (5.5.2), key for the allocation test point and nominal value (5.6), indication of local areas (5.7), oxide layer thickness (OLT) (5.11), heat-treatment order (HTO)(5.14), heat-treatment document (HTD)(5.15);

— replacement of the title of "Drawings providing specific indication of heat treatment" by "Heat-treatment sketch" (6.4);

— deletion of the former 6.4 *surface fusion hardening* in the 2001 edition;

— deletion of the Annex A tables present in the 2001 edition;

— addition of graphical symbols (Annex A).

Introduction

Technical drawings of workpieces are the most important documents

— for construction, development and production,

— for the assembling, and

— for the use of the final products.

Generally, a drawing provides information about the workpiece, its shape and design, the material used, the dimensions, surface behaviour, permitted abbreviations, inspection data, and more.

Workpieces made from steel and iron often have to withstand severe conditions to resist wear and corrosion.

To attain the required properties, the workpieces are heat-treated in most applications. A drawing is a very important document as it also informs the heat-treater about the parameters to be aware of for a successful heat-treatment. For that, he should know the material used, the required heat-treatment, the required hardness and hardness depth, the expected or permitted microstructure, the required testing method and the test points for testing the heat-treated workpiece.

In this time of global production, it is essential to dispose of an International Standard for technical product documentation, especially for the presentation and indication of heat-treated parts. Therefore, ISO 15787:2001 was revised to help to improve the quality of heat-treated workpieces.

Technical product documentation — Heat-treated ferrous parts — Presentation and indications

1 Scope

This document specifies the manner of presenting and indicating the final condition of heat-treated ferrous parts in technical drawings.

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 128-24:2014, *Technical drawings — General principles of presentation — Part 24: Lines on mechanical engineering drawings*

ISO 4885, *Ferrous products — Heat-treatments — Vocabulary*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO/TS 8062-2, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 2: Rules*

ISO 81714-1, *Design of graphical symbols for use in the technical documentation of products — Part 1: Basic rules*

3 Terms, definitions

For the purposes of this document, the terms and definitions given in ISO 4885 apply.

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

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

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

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CHD	Case-hardening hardness depth
CD	Carburizing depth
CLT	Compound layer thickness
NHD	Nitriding hardness depth
SHD	Surface-hardening hardness depth
HTO	Heat-treatment order
HTD	Heat-treatment document
IOD	Internal oxidation depth
OLT	Oxide layer thickness

5 Indications in drawings

5.1 General

Indications in drawings concerning the heat-treatment condition can relate to the assembly or final condition as well as to the condition directly after heat-treatment. This difference has to be observed implicitly, as heat-treated parts are often subsequently machined (e.g. by grinding). By this, the hardness depth is reduced, especially with case-hardened, surface-hardened and nitrided parts, as is the compound layer thickness of nitrided and nitrocarburized parts. The machining allowance shall therefore be taken into account appropriately during heat-treatment. If no separate drawing is made for the condition of the heat-treated part before the subsequent machining or finishing, it is necessary to give information about the machining allowance. For this, indications should be made for both states of the part: 1) after the heat-treatment (before final machining); and 2) after the final machining.

NOTE This can be done, for example, by indicating the heat-treated state and the finished state in accordance with ISO/TS 8062-2, by an additional representation, or by adding the words “before grinding” or “after grinding” (see Figures 16 and 30).

The words indicating the heat-treated condition, the hardness and the hardness depth data shall be placed near the title block of the drawing.

For some applications, it might be necessary to keep special data on the heat-treatment process to make sure that the required properties after the heat treatment are attained.

— In this case, a heat-treatment order (HTO) should be used. If an HTO exists, in the drawing, a reference shall be given by the wording “see HTO number …”. Examples are given in Figures 11, 12, 25, 29 and 42.

— To document the heat-treatment process carried-out in the heat-treatment workshop, a heat-treatment document (HTD) should be used.

5.2 Material data

Regardless of the heat-treatment method, generally the drawing shall identify the material used for the heat-treated part (name of the material, reference to the bill of materials, etc.).

5.3 Heat-treatment condition

The heat-treated condition shall be specified in words, such as “quench-hardened”, “quench-hardened and tempered”, “case-hardened”, “surface-hardened”, “nitrided”, etc.

If more than one heat-treatment is required, these treatments shall each be identified in words in the sequence of their execution, for example, “quench-hardened and tempered”. Indications by wording shall be chosen in accordance with ISO 4885. See Clause 7 for practical examples.

The heat-treatment condition can be achieved in different ways. As a result, the performance characteristics can differ. Particulars of the technical process shall be specified in supplementary documents (e.g. HTO, HTD) where this is of importance for the heat-treated condition.

5.4 Hardness data

5.4.1 Surface hardness

The surface hardness shall be indicated

— as Rockwell hardness in accordance with ISO 6508-1,

— as Vickers hardness in accordance with ISO 6507-1, or

— as Brinell hardness in accordance with ISO 6506-1.

Additional hardness values shall be given in instances where the parts in the heat-treated condition have areas with different hardnesses (see Clause 6).

For case-hardened, surface-hardened, nitrided or nitrocarburized parts, the hardness decreases downwards from the surface to the core. A test of the hardness in a cross section of a part from the surface until the core yields a hardness profile; this profile can be used, for instance, in accordance with ISO 2639 to specify the hardness depth. The surface hardness value depends on the hardness profile, the hardness depth and the test load. Therefore, if the surface hardness is indicated for case-hardened or surface-hardened parts, the test load shall be adjusted according to the hardness depth and the expected surface hardness.

5.4.2 Core hardness

The core hardness shall be indicated in the drawing where a specification is given that it is to be tested. The core hardness shall be given

— as Rockwell hardness in accordance with ISO 6508-1,

— as Vickers hardness in accordance with ISO 6507-1, or

— as Brinell hardness in accordance with ISO 6506-1.

5.4.3 Hardness value and limit deviations

All hardness values shall be toleranced. They can be written as shown in the examples in Table 1.

Table 1 — Examples of how to represent hardness values and their limiting deviations

Written mode	Lower and upper limit
(62 ±2) HRC	60 HRC up to 64 HRC
(64 0/-4) HRC	
(60 +4/0) HRC	
$\left(60\ {}^{+4}_{0}\right)$ HRC	
(61 +3/-1) HRC	
(750 ±75) HV10	675 HV10 up to 825 HV10
(825 0/-150) HV10	
(675 +150/0) HV10	
(700 +125/-25) HV10	
$\left(700\ {}^{+125}_{-25}\right)$ HV10	

Tolerances should be as large as functionality permits.

5.5 Markings

5.5.1 Marking of test points

If it is necessary to mark the test point in the drawing, the symbol for the test point shall be indicated according to Figure 1. The graphical symbol for the test point shall be drawn in accordance with A.2.

Figure 1 — Symbol for the test point

The precise position of the symbol shall be placed according to Figure 2.

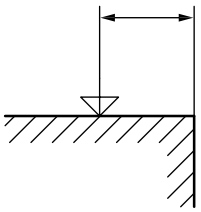

Figure 2 — General dimensioning of a test point

If there is more than one test point, the symbol shall be directly combined with an identification number for each test point according to Figure 3. The graphical symbol for the test point with its identification number shall be drawn in accordance with A.3.

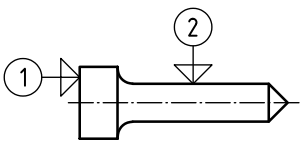

Figure 3 — Identification number for each test point

If a section of the heat-treated part is cut off in order to test the heat-treated state, marking shall be as shown in Figure 4. If there is a section of a piece that should be cut off after the heat-treatment, this section should be marked by a long-dashed double-dotted narrow line of type 05.1 in accordance with ISO 128-24 (see Figure 4).

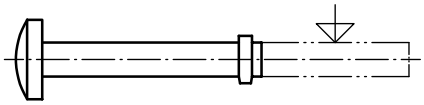

Figure 4 — Marking of a section where the heat-treated part is cut off

5.5.2 Marking of slip zones

A slip zone is a zone of a surface-hardened workpiece, where the surrounding surface-hardening operation has to be stopped to avoid the reheating the area where the surface-hardening operation began.

It should be decided where the slip zone can be placed without affecting the functional properties of the workpiece. If it is necessary to mark the slip zone in the drawing, the symbol for the slip zone shall be indicated according to Figure 24. The graphical symbol for the slip zone shall be drawn in accordance with A.4. The length of the slip zone and its position shall be dimensioned as shown in Figure 25.

5.6 Key for the allocation test point and nominal value

If more than one test point is allocated, the number of the measuring point should be written together with the nominal values of the hardness or of the hardness depth. See the example in Figure 12.

5.7 Indication of local areas

In some cases, it is necessary to indicate local areas of a part which have the following special conditions:

a) surface-hardened areas of surface-hardened parts;

b) areas of a part where heat-treating may be allowed;

c) not heat-treated areas of a quench-hardened, carburized, carbonitrided, nitrided or nitrocarburized part;

d) indication of expected or wished spread of a hardened area.

Parts which will have the mentioned special conditions in 5.7 a), b) and c) shall be marked in accordance with Table 2.

Table 2 — Line types for the indication of local areas and their applications

Line according to ISO 128-24		Application
No.	Description and representation	
04.2	Long-dashed dotted wide line —— · —— · —— · ——	For surface-hardened or case-hardened workpieces: to indicate the areas that should be surface-hardened or case-hardened
02.2	Dashed wide line – — — — — — — — –	For surface-hardened or case-hardened workpieces: to indicate the areas that may be surface-hardened or case-hardened
07.2	Dotted wide line	For carburized, carbonitrided, nitrided or nitrocarburized workpieces: to indicate the areas where the heat-treatment is not allowed
04.1	Long-dashed dotted narrow line —·—·—·—·—·—·—	For surface-hardened workpieces: to indicate the expected or wished spread of the surface-hardened areas

5.8 Hardness depth

The hardness depth shall be given as surface-hardening hardness depth (SHD), case-hardening hardness depth (CHD) or nitriding hardness depth (NHD) according to the heat-treatment method.

Hardness depth values shall be toleranced and should be written as shown in the examples in Table 3. The tolerance should be as large as functionality permits.

Table 3 — Examples of how to represent hardness depths and their limiting deviations

Written mode	Lower and upper limit
1,0 ±0,3	0,7 mm up to 1,3 mm
1,3 0/-0,6	
0,7 +0,6/0	
$0,7\ ^{+0,6}_{0}$	
0,9 +0,4/-0,2	

5.9 Carburizing depth (CD)

The CD is determined from the carbon content profile with the carbon content, expressed as percentage by mass as a limiting characteristic (see ISO 4885). The carbon content limit shall then be added as a suffix (subscript) to the symbol.

EXAMPLE A carbon content limit of 0,35 of carbon percentage by mass is indicated by "$CD_{0,35}$".

The carburizing depth shall be toleranced and should be written as shown in the examples in Table 4. Tolerances should be as large as functionality permits.

Table 4 — Examples of how to represent carburizing depths and their limiting deviations

Written mode	Lower and upper limit
2,0 ±0,5	1,5 mm up to 2,5 mm
2,5 0/-1,0	
1,5 +1,0/0	
$1,5\ ^{+1,0}_{0}$	
1,8 +0,7/-0,3	

In the case of carburizing or case-hardening, it might be necessary to indicate the internal oxidation in accordance with its depth. For the depth of internal oxidation, the abbreviation IOD should be used. This depth shall be toleranced and should be written like the examples in Table 5, with the dimension micrometre.

5.10 Compound layer thickness (CLT)

The CLT is the thickness of the outer area of the nitrided layer (see also ISO 4885). It is usually determined by light-microscopy. The abbreviation of compound layer thickness is CLT.

NOTE Destruction of, or damage to, a workpiece is inevitable when testing. If necessary, testing can be carried out on a reference sample heat-treated together with the workpieces for this purpose.

The compound layer thickness shall be toleranced and should be written like the examples in Table 5. The tolerances should be as large as functionality permits.

Table 5 — Examples for representation the CLT and their limiting deviations

Written mode	Lower and upper limit
(15 ±5) µm	10 µm up to 20 µm
(20 0/-10) µm	
(10 +10/0) µm	
$\left(10\ ^{+10}_{0}\right)$ µm	
(12 +8/-2) µm	

The wording “compound layer” can also be used for the boride layer of borided workpieces.

5.11 Oxide layer thickness (OLT)

The OLT is the thickness of the oxide layer after nitrocarburizing to optimize the corrosion resistance. It is usually determined by light microscopy. The abbreviation of oxide layer thickness is OLT.

The oxide layer thickness shall be toleranced and can be written as shown in the examples in Table 5. The tolerances should be as large as functionality permits.