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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

[Revision of first edition (ISO 15787:2001)]

ICS 01.100.20; 05.200

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

ISO 15787 was prepared by Technical Committee ISO/TC 10, *Technical Product Documentation*, Subcommittee SC 6, *Mechnical Engineer Documentation*.

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

Introduction

Technical drawings of workpieces are the most important documents for the construction, for the development and for the production, for the assembling and last but not least also for the use of the final products. Generally, the drawing informs about a workpiece, the shape and the design, the material, the dimensions, the surface behavior, permissed abbreviations, inspection datas and others.

Workpieces, made from steel and iron, have to withstand the working conditions like strength, wear or corrosion. To arrive the required properties, the workpieces have to be heat treated in the most applications. The drawing is a very important document to inform also the heat treater about the parameters, he must know for a successful heat treatment. For that he should know the used material, the required heat treatment, the required hardness and hardness depth, the expected or permissed microstructure, the required testing method and the measurement points for testing the heat treated workpiece.

In the time of global production it is essential to dispose of an international standard for the technical product documentation, especially for presentation and indication of heat treated parts. Therefore the ISO 15787:2001 has been revised by some experts and they expect this work may help to improve the quality of heat treated workpieces.

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

1 Scope

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

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 128-24:1999, *Technical drawings — General principles of presentation — Part 24: Lines on mechanical engineering drawings*

ISO 2639, *Steels — Determination and verification of the depth of carburized and hardened cases*

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

3 Terms, definitions and abbreviations

For the purposes of this International Standard, the terms and definitions given in ISO 4885 and the following abbreviations/symbols apply.

CHD **C**ase hardening **h**ardness **d**epth

CD **C**arburization **d**epth

CLT **C**ompound **l**ayer **t**hickness

NHD **N**itriding **h**ardness **d**epth

SHD **S**urface hardening **h**ardness **d**epth

HTO **H**eat-**t**reatment **o**rder

HTS **H**eat-**t**reatment **s**pecification

IOD **I**nternal **o**xidation **d**epth

OLT **O**xide **l**ayer **t**hickness

4 Indications in drawings

4.1 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 after heat-treatment giving relevant information on the condition prior to subsequent machining, suitable indications[1)] shall be used to illustrate to which condition the respective information in the drawing relates.

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

In some applications it could be necessary, to keep special data of the heat-treatment process strongly, to make sure, that the required properties after the heat-treatment would be arrived. In this case a Heat-Treatment Order (HTO) should be used. If there a HTO exists, in the drawing a reference must be given by wording “see HTO number …”. See Figures 11, 12, 28 and 41.

NOTE 1) This can be done, for example, by indicating the premachining dimensions (in brackets [ ]), by an additional representation, or by adding the words "before grinding" or "after grinding".

4.2 Material data

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

4.3 Heat-treatment condition

The condition after heat-treatment shall be specified in words indicating the required condition, for example, quench-hardened”, “quench-hardened and tempered” or “nitrided”.

Where more than one heat-treatment is required, they 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 6 for particular, 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, HTS) where this is of importance for the heat-treatment condition.

4.4 Hardness data

4.4.1 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-treatment condition are to have surface areas with different hardness (see clause 5).

In case of case-hardened, surface-hardened, nitrided or nitrocarburized parts, the hardness is decreasing from the surface up to the core. The measurement of the hardness in a cross section of a part from the surface until the core shows a hardness profile, which is used in accordance for instance to 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 will be indicated for case hardened or surface hardened parts, the test load shall be adjusted according to the hardness depth and the required surface hardness, see Tables A.1 to A.3.

The hardness profile and the surface hardness of nitrided or nitrocarburized parts is determined mainly of the kind of steel and the condition of the microstructure in the nitrided case. There is no correlation between the surface

hardness and nitriding hardness depth or compound layer thickness. Therefore it is expedient to think about, if the testing of the surface hardness would be necessary or not. In case of using alloyed steels a careful adaption of the test load to the expected surface hardness and the required nitriding hardness depth NHD shall be observed. Selection of the test load shall be in accordance with Table A.1.

Testing of the surface hardness of borided parts is not useable. So the specification for the hardness test and the indication of the surface hardness shall be adjusted in accordance with the designing engineer and the heat treatment shop.

4.4.2 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 Vickers hardness in accordance with ISO 6507-1, Brinell hardness in accordance with ISO 6506-1 or Rockwell hardness in accordance with ISO 6508-1.

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.

4.4.3 Hardness value

All hardness values shall be toleranced.

Tolerances should be as large as functionality permits.

4.5 Markings

4.5.1 Marking of measuring points

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

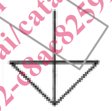

Figure 1 — Symbol for the measuring point

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

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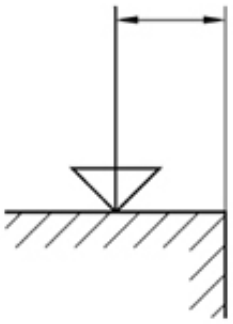

Figure 2 — General dimensioning of a measuring point

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

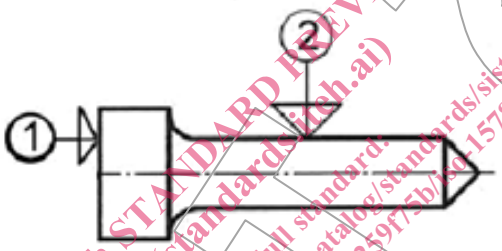

Figure 3 — Identification number for each measuring point

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, the section should be marked by a long- dashed double-dotted narrow line of type 05.1 in accordance with ISO 128-24:1999 (see Figure 4).

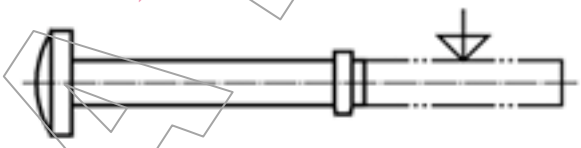

Figure 4 — Marking of a section where the heat-treated part is cut off

4.5.2 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 of the area where the surface-hardening operation was started.

It should be decided, where the slip zone could be placed without affect 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 5. The graphical symbol for the slip zone shall be drawn in accordance with B 4. The length of a slip zone has to be dimensioned as to seen in Figure 24.

4.6 Key for the allocation measuring point and nominal value

Preferable the complete symbol with its identification according to Figure 3 is to be used. If no confusion with other

information can be occur it is sufficient to use the circle with the allocated number for the measuring point in the key.

4.7 Indication of local areas

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

a) not heat treated areas of a quench hardened, carburized or nitrided part;
b) surface hardened areas of surface hardened parts;
c) areas of a part where heat treating may be allowed.
d) indication of expected or wished spread of a hardened area
e) indication of the section of a workpiece that will be cutted after heat-treatment.

Parts which will have the mentioned special conditions in 4.7 a), b) and c) shall be marked in accordance with Table 1.

Table 1 — Kinds of lines for the indication of local areas and their application

Line according to ISO 128-20		Application
No.	**Description and representation**	
04.2	Long-dashed dotted wide line	For surface-hardened workpieces: to indicate the areas that should be surface-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 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;
05.1	Long-dashed double-dotted narrow line	for heat-treated workpieces: to indicate the section that shall be cutted off after the heat-treatment for inspection purposes

4.8 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. The tolerance should be as large as functionally possible.

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.

4.9 Carburization depth (CD)

This 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.

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

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 carburization depth shall be toleranced. Tolerances should be as large as functionality permits.

It could be necessary to indicate the internal oxidation in accordance to their depth. For the depth of internal oxidation the abbreviation IOD should be used and shall be toleranced.

4.10 Compound layer thickness (CLT)

This 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 CLT thickness shall be toleranced. The tolerances should be as large as functionally possible.

The wording compound layer could be used also for the boride layer in case of borided workpieces.

4.11 Oxide layer thickness

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

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 CLT thickness shall be toleranced. The tolerances should be as large as functionally possible.

4.12 Strength data

Strength values are only indicated, if it is necessary and if the shape and dimension of a part respectively for such a case the heat-treated probe will allow the testing of the strength. If necessary, the place and its location from which the cutted section is to be taken shall be indicated. Indication of the core hardness is unnecessary in such instances.

The strength values are to be toleranced. The tolerances should be as large as functionally possible.

4.13 Microstructure

If necessary, information on hardness and hardness depth may be supplemented by information on the microstructure of the heat-treated parts, for example, the maximum amount of retained austenite, the quantity, size or layout of carbides, the length of the martensite needles or other important criterions.

NOTE For investigation of the microstructure, destruction of, or (at least) damage to, the workpiece is inevitable. It can be sufficient, however, to carry out investigation on a reference sample heat-treated together with the workpieces for this purpose.

