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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

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 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15787 was prepared by Technical Committee ISO/TC 10, *Technical product documentation*, Subcommittee SC 6, *Mechanical engineering documentation*.

Annex A of this International Standard is for information only.

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 normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 2639—[1], *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 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

3 Terms, definitions and abbreviations

For the purposes of this International Standard, the terms and definitions given in ISO 4855 and the following abbreviations/symbols apply.

CHD Case hardening depth

CD Carburization depth

CLT Compound layer thickness

FHD Fusion hardness depth

1) To be published. (Revision of ISO 2639:1982)

NHD Nitriding hardness depth

SHD Surface hardening depth

FTS Fusion treatment specification

HTO Heat-treatment order

HTS Heat-treatment specification

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, surface fusion hardened and nitrided parts, as is the compound layer thickness of nitrocarburized parts. The machining allowance must 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[2)] shall be used to illustrate to which condition the respective information in the drawing relates.

4.2 Material data

Regardless of the heat-treatment method, generally the drawing shall identify the material used for the heat-treated 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 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 Vickers hardness in accordance with ISO 6507-1, as Brinell hardness in accordance with ISO 6506-1 or as Rockwell hardness in accordance with ISO 6508-1. Additional hardness values shall be given in instances where the parts in the heat-treatment condition are to have surface areas of varying hardnesses (see clause 5).

See Tables A.1 to A.3 for specification of surface hardness. See Table A.4 for its relationship to limiting hardness.

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2) 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”.

4.4.2 Core hardness

The core hardness shall be indicated in the drawing where necessary and a specification 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 (methods B and C) in accordance with ISO 6508-1:1999.

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 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, a). The symbol shall be directly combined with an identification number for the measuring point according to Figure 1, b), and its precise position shall be replaced (see, for example, Figures 2, 3 and 5).

a) General dimensioning of a measuring point b) Dimensioning of measuring point 2

Figure 1

4.6 Hardness depth

The hardness depth shall be given as surface hardening depth (SHD), case hardening depth (CHD), fusion hardness depth (FHD) or nitriding hardness depth (NHD) according to the heat-treatment method. For recommended grading of values, see Tables A.5, A.6, A.7 and A.8.

Hardness depth values shall be toleranced. The deviations should be as large as functionally possible. For recommended values for the upper limit deviations, see Tables A.5, A.6, A.7 and A.8.

The core hardness shall be indicated in the drawing where necessary and a specification given that it is to be tested. The core hardness is given as Vickers hardness in accordance with ISO 6507-1, Brinell hardness in accordance with ISO 6506-1 or Rockwell hardness (methods B and C) in accordance with ISO 6508-1:1999.

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.

4.7 Carburization depth (CD)

This is usually determined from the carbon content profile with the carbon content, expressed as percentage by mass as a limiting characteristic (cf. 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 $CD_{0,35}$

For recommended grading of values, see Table A.9. The core hardness shall be entered in the drawing where it is necessary and specified that it shall be tested. The core hardness is given as Vickers hardness in accordance with ISO 6507-1, Brinell hardness in accordance with ISO 6506-1 or Rockwell hardness (methods B and C) in accordance with ISO 6508-1:1999.

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 carborization depth shall be toleranced. For the purposes of this International Standard, the lower limit deviation shall be zero; for recommended values for the upper limit, see Table A.9.

Tolerances should be as large as functionality permits.

4.8 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. For recommended grading of values, see Table A.10.

The CLT thickness shall be enclosed in allowed deviations. The deviations should be as large as functionally possible. For the purposes of this International Standard, the lower limit deviation shall be zero. For recommended values for the upper limit deviations, see Table A.10.

4.9 Strength data

Strength values, where used, shall be toleranced. If samples of the workpiece are required for testing, they are heat-treated at the same time as the workpiece; the location from which they are to be taken shall be indicated.

Indication of the core hardness is unnecessary in such instances. The strength values are to be enclosed in allowed deviations. The deviations should be as large as functionally possible. For the purposes of this International Standard, the lower limit deviation shall be zero.

Strength values should be indicated only where necessary.

4.10 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 residual austenite portion.

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.

5 Graphical representation

5.1 General

Graphical representation of heat-treatment requirements shall be as shown in Figures 2 to 39.

5.2 Heat-treatment of the entire part

5.2.1 Uniform requirements

The heat-treatment condition shall be specified in words indicating the required condition. For examples, see Figures 2 to 6, 20 to 25 and 34 to 37.

5.2.2 Areas with varying requirements

If a workpiece is to have varying values in different areas, this shall be represented as follows.

The respective areas shall each be given a specific identity to indicate the treatment required and the extent of its application. The characteristic numbers shall be repeated below the information, in words and according to 4.3, together with the required values (see Figures 7, 14, 16, 17, 21, 26, 27 and 30). If appropriate, specified measuring points shall be marked according to 4.5.

5.3 Local heat-treatment

5.3.1 General

It should be considered in each instance whether it is practical to locally limit the heat-treatment, as this can mean additional expenditure compared with the treatment of the entire part.

The size of the transition between heat-treated and non-heat-treated areas depends on the method of heat-treatment, and the material and shape of the part to be treated. It is therefore appropriate to specify the dimensions and tolerances for the size and position of the areas to be heat-treated in agreement with the hardening shop.

Areas where heat-treatment is not required should be left unmarked.

5.3.2 Areas requiring heat-treatment

Those areas of a part that are to be heat-treated shall be marked in the graphical representation by a type 04.2.1 long-dashed dotted wide line, in accordance with ISO 128-24:1999, outside the body outlines of the part. For parts with rotational symmetry, it shall be sufficient to indicate one relevant surface line (the “generatrix”), if this is not misleading, for the purposes of simplification (e.g. Figure 10). If necessary, the size and position of these areas shall be specified by dimensions and tolerances.

The transition between heat-treated and non-heat-treated areas lies, in principle, outside the nominal size for the length of the heat-treated area.

5.3.3 Areas that may be heat-treated

Apart from those areas that must be heat-treated, information shall also be given on areas which may be heat-treated, as this can facilitate the execution of local heat-treatment and reduce distortion.

Areas which may be heat-treated shall be marked by a type 02.2.1 dashed wide line, in accordance with ISO 128-24:1999, outside the body outlines and, if necessary, shall be dimensioned. Indications of tolerance are generally not required for these areas (see Figures 9, 11 and 31).

5.3.4 Areas that may not be heat-treated

Areas where no heat-treatment is allowed, in the case of full-hardening or within the long-dashed dotted wide or dashed wide lines, shall be marked by a long-dashed double-dotted narrow line of type 05.1, in accordance with ISO 128-24:1999.

5.4 Drawings providing specific indication of heat-treatment

The instructions on heat-treatment may be made on a separate representation of a part. This representation may be incomplete and may be placed in any free area of the drawing. It shall be titled “Representation of heat-treatment”, (see Figure 17).

This is also applicable analogous to the surface layer fusion hardening drawing.

6 Practical examples

6.1 General

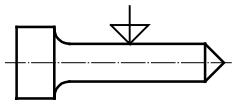
The figures and the associated instructions are practical examples. The suitability of the instruction to be given shall be determined on the basis of the technical details of the heat-treatment process.

Unless otherwise specified, all dimensions are in millimetres.

6.2 Quench hardening, quench hardening and tempering, austempering

6.2.1 Heat-treatment of the entire part — Allover uniform requirements

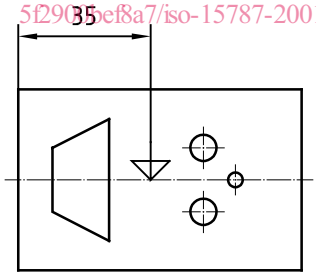
The quench hardened condition of the part illustrated by Figure 2 shall be designated by the wording "**quench hardened**" and by indicating the hardness value with the permissible deviation as well as by marking of the measuring point.



quench hardened
$\left(60^{+4}_{0}\right)$ HRC

Figure 2

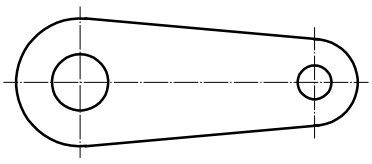
If tempering has to be carried out after hardening, "quench hardened" is not sufficient to designate the quench hardened *and* tempered condition unambiguously, and in such instances the full wording, "**quench hardened and tempered**", in accordance with 4.3 shall be given (see Figure 3).



quench hardened and tempered
$\left(59^{+4}_{0}\right)$ HRC

Figure 3

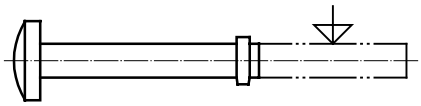
The part shown in Figure 4 is to be quench hardened and tempered. The designation shall read "**quench hardened and tempered**".



quench hardened and tempered
$\left(350^{+50}_{0}\right)$ HBW 2,5/187,5

Figure 4

If a section of the heat-treated part is cut off in order to test the quench hardened and tempered state, marking shall be as shown in Figure 5.



quench hardened and tempered
$R_m = 1100^{+100}_{0}$ N/mm^2
$R_{p0,2} \geqslant 900$ N/mm^2
$A_5 \geqslant 9$ %

Figure 5

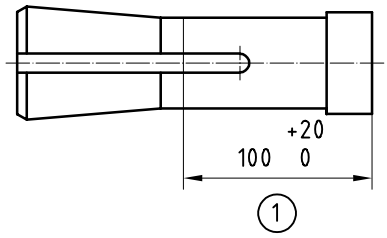
The part shown in Figure 6 is to be austempered. The designation shall read "**austempered**".

austempered
according to HTO
$\left(59^{+2}_{0}\right)$ HRC

Figure 6

6.2.2 Heat-treatment of the entire part — Areas with varying data

If a part is to have different hardness values for individual areas and heat-treatment is to be carried out in accordance with a heat-treatment order (HTO), the areas of different hardness shall be marked and, if necessary, dimensioned. In addition, reference shall be made to the HTO (see Figure 7).



quench hardened and tempered
according to HTO
$\left(58^{+4}_{0}\right)$ HRC
① $\left(40^{+5}_{0}\right)$ HRC

Figure 7

6.2.3 Local heat-treatment

The part shown in Figure 8 is to be locally heat-treated. The heat-treated area shall be marked by a type 04.2.1 long-dashed dotted wide line, in accordance with ISO 128-24:1999, and with dimensional data according to 5.3. The test point shall be marked in accordance with 4.5.

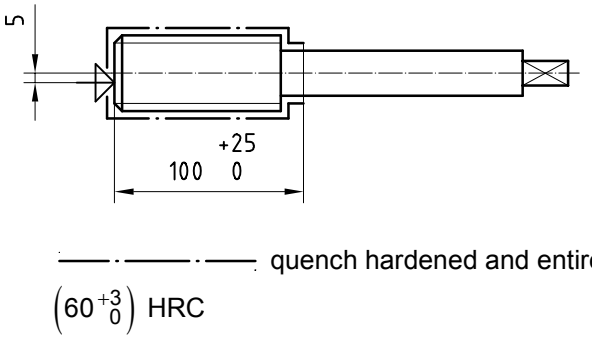


Figure 8

When heat-treating a workpiece, for reasons of processing it might be more convenient to harden a larger area than required. If this is done, the additionally quench hardened area shall be marked by a type 02.2.1 dashed wide line, in accordance with ISO 128-24:1999, and with dimensional data indicating the position of the heat-treated area (see Figure 9).

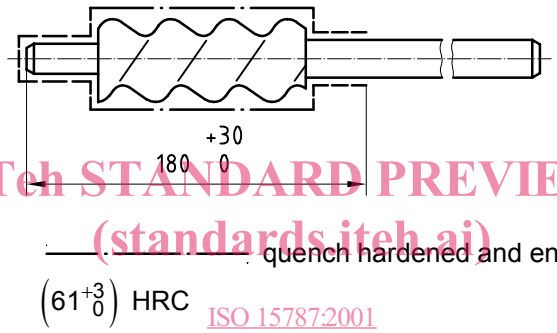


Figure 9

6.3 Surface hardening

6.3.1 General

Surface hardening is almost locally limited. Consequently, the requirements given in 5.3 shall be applicable.

6.3.2 Specification of surface hardness

When specifying the surface hardness of surface-hardened parts, a careful adaptation of the test load to SHD shall be observed. Selection of the test load shall be in accordance with Tables A.1 to A.3.

6.3.3 Specification of surface hardening depth (SHD)

To the symbol for the depth of hardening SHD shall be appended the numerical value for the limiting hardness, usually measured as Vickers hardness HV1. The limiting hardness is usually 80 % of the prescribed minimum surface hardness calculated in HV and can be taken from Table A.4, which also contains the limiting hardness for instances where the surface hardness is given in HRC, HRA or HRN.

The depth of hardening is given as a nominal dimension in millimetres. For recommended grading of SHD values and reference values for allocated minimum values, see Table A.5.