
Steel forgings — Testing frequency, sampling conditions and test methods for mechanical tests

*Pièces forgées en acier — Fréquence des essais, conditions
d'échantillonnage et méthodes d'essai pour essais mécaniques*





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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.

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 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 10 *Steel for pressure purposes*.

This first edition of ISO 15461 is based on Technical Report ISO/TR 15461:1997, which has been withdrawn. The main changes are as follows:

- [Figures 3](#) a) and b) have been revised;
- [Table 3](#) has been revised;
- [Table 5](#) has been extended to steels for pressure purposes;
- the text of the document has been generally revised.

Steel forgings — Testing frequency, sampling conditions and test methods for mechanical tests

1 Scope

This document gives guidelines for the simplification and harmonization of the specifications for mechanical testing of open die and closed die forgings in International Standards and other technical delivery conditions for forgings of steel.

This document

- a) offers various options for
 - 1) the frequency of testing, and
 - 2) sampling conditions,
- b) introduces a designation system for the options, mentioned under (a), and
- c) specifies the test methods for
 - 1) room temperature tensile tests,
 - 2) elevated temperature tensile tests,
 - 3) impact tests, and
 - 4) uniformity checks by hardness tests.

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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 377:2017, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 404, *Steel and steel products — General technical delivery requirements*

ISO 3785, *Metallic materials — Designation of test specimen axes in relation to product texture*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6892-2, *Metallic materials — Tensile testing at elevated temperature — Part 2: Method of test at elevated temperature*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— IEC Electropedia: available at <https://www.electropedia.org/>

— ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1
specific inspection and testing

inspection and testing carried out before delivery, according to the technical requirements of the order, on the products to be supplied or on test units of which the product supplied is part, in order to verify whether these products comply with the requirements of the order

[SOURCE: ISO 404:2013, 3.4, modified — “and testing” has been added and the wording has been altered.]

3.2
test unit

number of pieces or the tonnage of products to be accepted or rejected together, on the basis of the tests to be carried out on sample products in accordance with the requirements of the product standard or order

[SOURCE: ISO 404:2013, 3.6, modified — the wording has been altered slightly and the notes to entry have been deleted.]

3.3
sample product

item (e.g. bar, sheet, coil) selected for inspection or testing

[SOURCE: ISO 377:2017, 3.2]

3.4
sample

sufficient quantity of material taken from the sample product for the purpose of producing one or more test pieces

Note 1 to entry: In certain cases, the sample can be the sample product.

[SOURCE: ISO 377:2017, 3.3, modified — a note to entry has been deleted.]

3.5
test piece

part of a sample, with specified dimensions, machined or unmachined, brought to a required condition for submission to a given test

[SOURCE: ISO 377:2017, 3.5, modified — the wording has been altered slightly and a note to entry has been deleted.]

Note 1 to entry: In certain cases the test piece can be the sample.

3.6
ruling section

section for which the mechanical properties are specified

4 General

Unless otherwise specified in this document, the general conditions given in ISO 377 for the marking and preparation of samples and test pieces apply.

Where the conditions specified in this document differ from the conditions specified in the product standard or order, then the conditions of the product standard or order apply.

5 Testing frequency

5.1 For the testing frequency of room temperature tensile tests and of impact tests, the requirements given in 5.1.1 to 5.1.3 apply.

5.1.1 The product standard or order shall specify, by reference to the appropriate symbol(s) in [Table 1](#), column 1, the following:

- a) the composition of the test unit as defined in [Table 1](#), columns 2 to 8;
- b) whether uniformity checks by hardness tests in accordance with [Table 1](#), column 9 are required and, if so, the percentage of products to be subjected to the hardness tests;
- c) the number of sample products to be taken from the test unit. (See the explanations in [Table 1](#), footnote ^a, for replacing the letter “n” of the symbol by the mass of the test unit up to which the taking of one sample product is sufficient.)

NOTE Less stringent requirements for the composition of the test unit can be compensated by more stringent requirements for the number of sample products to be tested. Therefore, for example, a test unit characterized by the symbol CH5 can be regarded as equivalent to a test unit characterized by the symbol CHD10 or CFHD15 and the test unit CU100 can be regarded as equivalent with CFH DU10. Consequently, it seems possible and reasonable to specify in the product standards or orders not only one distinct test unit, but to leave various equivalent test units to the choice of the manufacturer or to an agreement at the time of enquiry and order, as shown in the example in [Table A.1](#), column 5.

5.1.2 In general one sample is to be taken per sample product. The product standard or order may, however, by reference to the symbols in [Table 2](#), specify that in the case of products with a length and/or mass greater than a certain limiting value two samples per sample product shall be taken.

5.1.3 If room temperature tensile tests are to be carried out, one tensile test piece shall be taken per sample. If impact tests are to be carried out, three impact test pieces shall be taken per sample.

5.2 If elevated temperature tensile tests are to be carried out, the product standard or order shall specify the number of test pieces to be taken for this test in relation to the number of test pieces to be taken for the room temperature tensile test (see example in [Table A.1](#), column 9).

5.3 For simplifying comparisons the data for the frequency of testing should preferably be specified in the form of a table. (See the example in [Table A.1](#).)

Table 1 — Options for the test units, the number of sample products to be taken per test unit and the percentage of products to be subjected to hardness tests for uniformity checks

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Test unit symbol	The test unit shall be composed of products							The test unit shall have been subjected to	Number of sample products to be taken from test units with an as heat-treated weight of					Notes	
	of the same forming			having been subjected to					x tonnes						
	of the same cast	process	cycle ^b	of the same shape and dimensions	of similar ^c shape and dimensions	the same type ^d of heat treatment	the same conditions ^e of heat treatment								
tu ^a	C ^a		F ^a	D ^a			H ^a	U _X ^a							
C _n	x	x	—	—	x	x	—	—	1	2	3	4	5	In general not for quenched and tempered products	
CH _n	x	x	—	—	x	x	x	—							
CHD _n	x	x	—	x	—	x	x	—	1	2	3	4	5	—	
CFHD _n	x	x	x	x	—	x	x	—							
C _U _X	x	x	—	—	x	x	—	an % uniformity check by hardness tests (see Clause 6)	Independent from the weight of the test unit, two sample products, namely the hardest and softest, shall be tested.					Only applicable where the test pieces for the mechanical tests can be taken from the products themselves (no prolongations)	
CH _U _X	x	x	—	—	x	x	x								
CHD _U _X	x	x	—	x	—	x	x								
CFHD _U _X	x	x	x	x	—	x	x								
C _n _U _X	x	x	—	—	x	x	—	Normally only applied where, for the tensile and impact tests, prolongations or integral surplus-material is provided. The product standard shall, in this case, include specifications for the maximum hardness range	1	2	3	4	5		
CH _n _U _X	x	x	—	—	x	x	x								
CHD _n _U _X	x	x	—	x	—	x	x								
CFD _n H	x	x	x	x	—	x	x								Not for small products
IND	The test unit sample product shall consist of the individual forging														

Table 1 (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Test unit symbol	The test unit shall be composed of products							The test unit shall have been subjected to	Number of sample products to be taken from test units with an as heat-treated weight of						Notes
	of the same forming			having been subjected to					x tonnes						
	of the same cast	process	cycle ^b	of the same shape and dimensions	of similar ^c shape and dimensions	the same type ^d of heat treatment	the same conditions ^e of heat treatment								
tu ^a	Ca		Fa	Da			Ha	Ux ^a	≤ n ^a	> n ≤ 2n	> 2n ≤ 4n	> 4n ≤ 8n	> 8n ≤ 16n		
a The symbols for the test unit in column 1 and in the headings of columns 2 to 10 have the following meaning: tu test unit; C products of the same cast; F same forming cycle; D same shape and dimensions; H same heat treatment conditions. n in the product standard or order; the letter n of the symbol for the test unit given in column 1 is to be replaced by the mass of the test unit in tonnes up to which, in accordance with the indications in column 10, the testing of one sample product is sufficient. (For n the values 5, 10, 20 and 40 is preferred.) Ux for checking the uniformity of the test unit, x % of the products and at least the number of products given in Table 3 are to be subjected to a hardness test. EXAMPLE The symbol CHD10 would, in accordance with the indications in columns 2 to 15, mean the following: The test unit covers products of the same cast and the same dimensions and has been subjected to the same heat treatment condition. If the weight of the test unit is 10 t one sample product is to be tested; if its weight is > 4 n but ≤ 8 n, (that means in this example > 40 t but ≤ 80 t) four samples are to be tested. b Forgings are regarded as being taken from the same forming cycle when they were, without any essential interruption, manufactured one after the other by the same forming process under the same conditions or, in other words, when they were produced in series.															