BS EN 1559-2:2014

BSI Standards Publication

Founding — Technical conditions of delivery

Part 2: Additional requirements for steel castings

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National foreword

This British Standard is the UK implementation of EN 1559-2:2014. It supersedes BS EN 1559-2:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/111, Steel Castings and Forgings.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword

This document (EN 1559-2:2014) has been prepared by Technical Committee ECISS/TC 111 “Steel castings and forgings”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2015 and conflicting national standards shall be withdrawn at the latest by April 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1559-2:2000.

Within its programme of work, Technical Committee ECISS/TC 111 included the revision of the following standard:

EN 1559-2, *Founding - Technical conditions of delivery - Part 2: Additional requirements for steel castings*

Annex B provides details of significant technical changes between this European Standard and the previous edition.

This European Standard is one of a series of European Standards for technical delivery conditions for castings. The other standards in this series are:

— EN 1559-1, *Founding - Technical conditions of delivery - Part 1: General;*

— EN 1559-3, *Founding - Technical conditions of delivery - Part 3: Additional requirements for iron castings;*

— EN 1559-4, *Founding - Technical conditions of delivery - Part 4: Additional requirements for aluminium castings;*

— EN 1559-5, *Founding - Technical conditions of delivery - Part 5: Additional requirements for magnesium castings;*

— EN 1559-6, *Founding - Technical conditions of delivery - Part 6: Additional requirements for zinc castings.*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

In order to assist manufacturers and purchasers to prepare proper contractual arrangements and prevent misunderstanding, CEN/TC 190 approved the preparation of a series of standards covering technical delivery conditions. These have been prepared as separate parts.

This European Standard covers the additional technical delivery conditions for all the steel casting materials and has the same structure for clauses as EN 1559-1 "*Founding - Technical conditions of delivery – Part 1: General*".

This European Standard cannot be used alone for compiling a specification for ordering and supplying steel castings, but as a complement to EN 1559-1.

The structure of this European Standard is as follows:

— clauses and subclauses preceded by ■ indicate no additional conditions to EN 1559-1:2011;

— clauses and subclauses marked with a single dot • indicate that conditions shall be agreed at the time of enquiry and order;

— subclauses and paragraphs marked with two dots •• indicate that conditions can be agreed at the time of enquiry and order (optional);

— subclauses without dot marking are mandatory.

Annex A gives a checklist for quick information about different points that shall or may be agreed by the time of acceptance of the order. It relates to the applicable clauses or subclauses of EN 1559-1:2011 and EN 1559-2:2014.

1 Scope

This part of EN 1559 specifies the additional technical delivery conditions for steel castings unless other conditions have been agreed at the time of enquiry and order.

This European Standard is also applicable to nickel and cobalt alloy castings.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1369, *Founding - Magnetic particle testing*

EN 1370, *Founding - Examination of surface condition*

EN 1371-1, *Founding - Liquid penetrant testing - Part 1: Sand, gravity die and low pressure die castings*

EN 1371-2, *Founding - Liquid penetrant inspection - Part 2: Investment castings*

EN 1559-1:2011, *Founding - Technical conditions of delivery - Part 1: General*

EN 10027-1, *Designation systems for steels - Part 1: Steel names*

EN 10027-2, *Designation systems for steels - Part 2: Numerical system*

EN 12680-1, *Founding - Ultrasonic examination - Part 1: Steel castings for general purposes*

EN 12680-2, *Founding - Ultrasonic examination - Part 2: Steel castings for highly stressed components*

EN 12681, *Founding - Radiographic examination*

EN 13018, *Non-destructive testing - Visual testing - General principles*

EN 14784-1, *Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 1: Classification of systems*

EN 14784-2, *Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 2: General principles for testing of metallic materials using X-rays and gamma rays*

EN ISO 148-1, *Metallic materials - Charpy pendulum impact test - Part 1: Test method (ISO 148-1)*

EN ISO 3452-1, *Non-destructive testing - Penetrant testing - Part 1: General principles (ISO 3452-1)*

EN ISO 3651-1, *Determination of resistance to intergranular corrosion of stainless steels - Part 1: Austenitic and ferritic-austenitic (duplex) stainless steels - Corrosion test in nitric acid medium by measurement of loss in mass (Huey test) (ISO 3651-1)*

EN ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels - Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels - Corrosion test in media containing sulfuric acid (ISO 3651-2)*

EN ISO 5579, *Non-destructive testing - Radiographic testing of metallic materials using film and X- or gamma rays - Basic rules (ISO 5579)*

EN ISO 6506-1, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1)*

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

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

EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 9934-1, *Non-destructive testing - Magnetic particle testing - Part 1: General principles (ISO 9934-1)*

EN ISO 16810, *Non-destructive testing - Ultrasonic testing - General principles (ISO 16810)*

EN ISO 19232-1, *Non-destructive testing - Image quality of radiographs - Part 1: Determination of the image quality value using wire-type image quality indicators (ISO 19232-1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1559-1:2011 and the following apply.

3.1
purchaser ■

3.2
manufacturer ■

3.3
casting ■

3.4
as-cast casting ■

3.5
as-delivered casting ■

3.6
initial sample ■

3.7
preliminary sample ■

3.8
relevant wall thickness ■

3.9
inspection ■

3.10
continuous inspection ■

3.11
inspection representative ■

3.12
test unit ■

3.13
sample casting ■

3.14
sample ■

Note 1 to entry: In steel foundry industry the term used for sample is “test block”.

3.15
test piece ■

3.16
sequential testing ■

3.17
acceptance criteria ■

3.18
drawing ■

3.19
finishing welding ■

3.20
joint welding ■

3.21
excavation
cavity produced by the removal of cast material prior to subsequent welding

Note 1 to entry: It can be of minor or major nature according to its depth (over 40 % of the section thickness the excavations are major).

4 Information to be supplied by the purchaser

4.1 • Mandatory information

In addition to EN 1559-1:2011, the relevant wall thickness shall be given in the order.

4.2 •• Optional information

In addition to EN 1559-1:2011, for specific uses, some optional requirements may become mandatory according to the product standards.

4.3 ■ Drawings, patterns and tools

4.4 ■ Information on the mass

4.5 ■ Preliminary sample

4.6 ■ Initial sample

5 Designations

Cast steels shall be designated in accordance with EN 10027-1 and EN 10027-2.

NOTE Designations of steel casting materials are given in the applicable product standards.

6 Manufacture

6.1 Manufacturing process

6.1.1 Melting

The steel or alloy shall be produced by an electric melting process or by any other process involving secondary refining.

6.1.2 •• Heat treatment

6.1.2.1 The type of heat treatment is usually defined by the product standard. If this information is not available, the heat treatment type can be agreed between the purchaser and the manufacturer.

6.1.2.2 If required, the purchaser shall be informed of the heat treatment conditions.

6.2 Welding operations

6.2.1 ■ General

6.2.2 ■ Production welding

6.2.2.1 ■

6.2.2.2 ■

6.2.2.3 ■

6.2.2.4 ■

6.2.2.5 ■

In addition to EN 1559-1:2011 major production welds may be reported by indicating their location and extent in the form of drawings, sketches or photographs.

If agreed between the manufacturer and the purchaser, the documents related to the production welding shall be supplied to the purchaser.

6.2.2.6 ■

6.2.2.7 •• Criteria for excavation

Criteria other than those defined in 3.21 can be agreed.

6.3 Further processing

Unless previously agreed the manufacturer shall not be held responsible for the consequences of any further processing, e.g. welding, heat treatment, etc. undertaken by the purchaser after delivery of the castings by the manufacturer.

7 Requirements

7.1 ■ General

7.2 Material

7.2.1 Chemical composition

In addition to EN 1559-1:2011, Table 1 specifies permissible deviations above the maximum limits or below the minimum limits of the chemical requirements of the applicable product specification for the results of product analysis carried out on test blocks or on the product itself.

NOTE 1 Table 1 does not apply to cast analysis as specified in the product standards. For the term cast analysis the term heat analysis can be used.

NOTE 2 For methods of determination of the chemical composition, see CEN/TR 10261.

Table 1 — Permissible deviations above the maximum or below the minimum limits of the chemical requirements of the applicable product specification for the results of product analysis

Element	Specified range (mass fraction in %)	Permissible deviations (mass fraction in %)	Element	Specified range (mass fraction in %)	Permissible deviations (mass fraction in %)
Carbon	≤ 0,030	+ 0,005	Copper	≤ 2,00	±0,10
	> 0,030 ≤ 0,080	±0,01		> 2,00 ≤ 5,00	±0,20
	> 0,080 ≤ 0,30	±0,02	Nitrogen	≤ 0,30	±0,02
	> 0,30 ≤ 0,60	±0,03	Niobium	≤ 1,00	±0,05
	> 0,60 ≤ 1,20	±0,05		> 1,00	±0,10
	> 1,20 ≤ 2,00	±0,06	Molybdenum	≤ 1,00	±0,07
	> 2,00	±0,08		> 1,00 ≤ 2,00	±0,10
Silicon	≤ 2,00	±0,10		> 2,00 ≤ 5,00	±0,15
	> 2,00	±0,20		> 5,00 ≤ 10,00	±0,20
Manganese	≤ 0,70	±0,06		> 10,00 ≤ 20,00	±0,25
	> 0,70 ≤ 2,00	±0,10		> 20,00 ≤ 30,00	±0,30
	> 2,00 ≤ 10,00	±0,25		> 30,00	±0,50
	> 10,00	±0,40	Vanadium	≤ 0,30	±0,03
Sulfur and	≤ 0,045	±0,005		> 0,30 ≤ 1,00	±0,07
Phosphorus	> 0,045 ≤ 0,060	±0,010	Tungsten	≤ 1,00	±0,05
Chromium	≤ 2,00	±0,10		> 1,00 ≤ 3,00	±0,10
	> 2,00 ≤ 10,00	±0,20		> 3,00 ≤ 6,00	±0,15
	> 10,00 ≤ 15,00	±0,30	Cobalt	≤ 1,00	±0,07
	> 15,00 ≤ 20,00	±0,40		> 1,00 ≤ 2,00	±0,10
	> 20,00	±0,50		> 2,00 ≤ 5,00	±0,15
Nickel	≤ 1,00	±0,07		> 5,00 ≤ 10,00	±0,20
	> 1,00 ≤ 2,00	±0,10		> 10,00 ≤ 20,00	±0,25
	> 2,00 ≤ 5,00	±0,15		> 20,00 ≤ 30,00	±0,30
	> 5,00 ≤ 10,00	±0,20		> 30,00	±0,50
	> 10,00 ≤ 20,00	±0,25	Titanium	≤ 1,00	±0,05
	> 20,00 ≤ 30,00	±0,30		> 1,00 ≤ 3,00	±0,07
	> 30,00	±0,50		> 3,00	±0,10

7.2.2 Mechanical properties

In addition to EN 1559-1:2011:

•• If mechanical properties are not specified in a product standard then they can be agreed between the purchaser and the manufacturer.

•• Brinell hardness test (specific to some products).

The tensile strength test may be replaced by a Brinell hardness test to be carried out in accordance with EN ISO 6506-1. The hardness tolerance range shall be agreed at the time of enquiry and order.

7.2.3 ■ Other properties

7.3 Casting

7.3.1 ■ Chemical composition

7.3.2 ■ Mechanical properties

7.3.3 Outer and inner conditions (non-destructive testing)

In addition to EN 1559-1:2011:

• The castings shall be subjected to non-destructive examinations under conditions agreed at the time of enquiry and order.

Every order shall include information about:

— non-destructive methods to be used (visual, magnetic particle, liquid penetrant, ultrasonic, radiographic...);

— severity levels for every method;

— areas of the casting to be tested (location and extent);

— percentage and/or frequency of castings to be inspected.

Different acceptance criteria can be specified for different areas of the same casting (e.g. inner and outer zones). Moreover, for the same area of the casting different acceptance criteria can be specified according to the non-destructive methods selected.

The testing is performed according to the relevant European Standards given in Table 2.

Table 2 — Testing methods

Testing method	Symbol	General principles	Testing conditions
Visual	VT	EN 13018	EN 1370
Liquid penetrant	PT	EN ISO 3452-1	EN 1371-1, EN 1371-2
Magnetic particle	MT	EN ISO 9934-1	EN 1369
Ultrasonic	UT	EN ISO 16810	EN 12680-1, EN 12680-2
Radiographic	RT	EN ISO 5579, EN ISO 19232-1, EN 14784-1, EN 14784-2	EN 12681

7.3.3.1 ••

The selection of a non-destructive testing method is dependent on the thickness and material of the casting and the position, orientation and size of the discontinuities in the relevant section:

a) methods:

aa) for surface testing (including excavations) liquid penetrant or magnetic particle testing can be used. However, for non-magnetic steel castings, only liquid penetrant can be used;

ab) for inner zones, the alternatives are:

— for ferritic and pearlitic steels:

— thin castings[1)], preferably radiography;

— thick castings[1)], preferably ultrasonic;

— for austenitic and ferritic-austenitic steels, nickel and cobalt base alloys: radiography only;

b) acceptance criteria (severity levels):

ba) for all non-destructive testing methods, the acceptance criteria (severity levels) are graded with increasing number or extent of indications;

bb) the choice of an acceptance criterion (or severity level) shall be made according to the use, shape and testing method for the casting;

bc) unless otherwise agreed at the time of enquiry and order, when, after conducting the radiographic and the ultrasonic test in combination, it is demonstrated that a discontinuity is situated in the inner zone section (see EN 12680-1) this additional zone information shall make the casting acceptable at one level less severe, e.g. level 3 instead of 2;

bd) for finishing welds the requirements of the parent metal are valid. For joint welds, special requirements shall be agreed at the time of enquiry and order;

be) for surface inspection severity levels 001, 01 and 1 (PT or MT), and for internal testing severity level 1 (UT or RT) shall only be used for special applications;

c) qualification of non-destructive testing operators.

Testing shall be performed, by agreement at the time of enquiry and order, under the responsibility of a certified operator, in accordance with EN ISO 9712 or in accordance with an equivalent certification scheme.

7.3.3.2 ■

7.3.3.3 ■

7.3.3.4

In addition to EN 1559-1:2011:

The surface roughness examination shall be carried out under the examination conditions of EN 1370.

7.3.4 ■ Conditions of the casting

7.3.4.1

In addition to EN 1559-1:2011:

The results of dimensional measurements shall not be rounded off.

7.3.4.2 ■

1) The border line between thin and thick castings cannot be specified precisely. It is usually in the range from 40 mm to 80 mm.

7.3.5 •• Mass of the casting

In addition to EN 1559-1:2011:

The mass of castings made of non-alloyed or low-alloyed steels (content of any element not greater than 5 %) shall be calculated on the basis of a density of 7,80 kg/dm^3.

For alloyed steels, the mass shall be calculated using the density given in the corresponding product standard.

7.3.6 •• Additional requirements regarding the condition of the casting

In addition to EN 1559-1:2011:

One or more of the following additional requirements can be applied, but only when specified in the enquiry and order.

Details of these supplementary requirements shall be agreed by the manufacturer and the purchaser at the time of enquiry and order. Unless otherwise agreed the specified tests shall be carried out by the manufacturer before delivery of the casting.

If not specified in the product standard the following tests can be requested:

— ferrite content in austenitic and austenitic-ferritic steels;

— tensile test at elevated temperature;

— creep test;

— pressure or leak tightness test;

— homogeneity of batches (hardness test);

— intergranular corrosion test;

— test for magnetic properties;

— any other test agreed.

If not specified in the product standard the following manufacturing conditions and delivery conditions may be requested in the enquiry and order:

— melting process;

— details of the applied heat treatment;

— approval of the manufacturing procedure;

— fabrication and testing programme;

— formation of batches;

— other requirements.

8 Inspection

8.1 ■General

8.2 ■ Type of inspection documents and type of inspection

8.3 ■ Test unit

8.3.1 •• Formation of test units

In addition to EN 1559-1:2011 other test units can be defined by agreement between the manufacturer and the purchaser.

8.3.2 •• Size of test units

8.3.3 ■ Inspection frequency

8.4 Samples

8.4.1 In addition to EN 1559-1:2011 mechanical properties shall be measured on test pieces taken from test blocks, up to a maximum block wall thickness of 150 mm.

The test block thickness shall not exceed 150 mm, even when the characteristics specified in the product standard are given for a thickness greater than 150 mm.

Each test piece shall be taken from the test blocks as follows:

— if the section thickness is ≤ 28 mm the axis of the test piece shall be equidistant from the cast surfaces;

— if the section thickness is greater than 28 mm and up to 56 mm, the axis of the test piece shall be at 14 mm from the cast surface;

— if the section thickness is greater than 56 mm, the axis of the test piece shall be at least one quarter thickness from the cast surface.

By agreement, the test blocks can be separately cast, gated-on or cast integral: in these cases they are directly filled through the casting and their filling conditions can be defined.

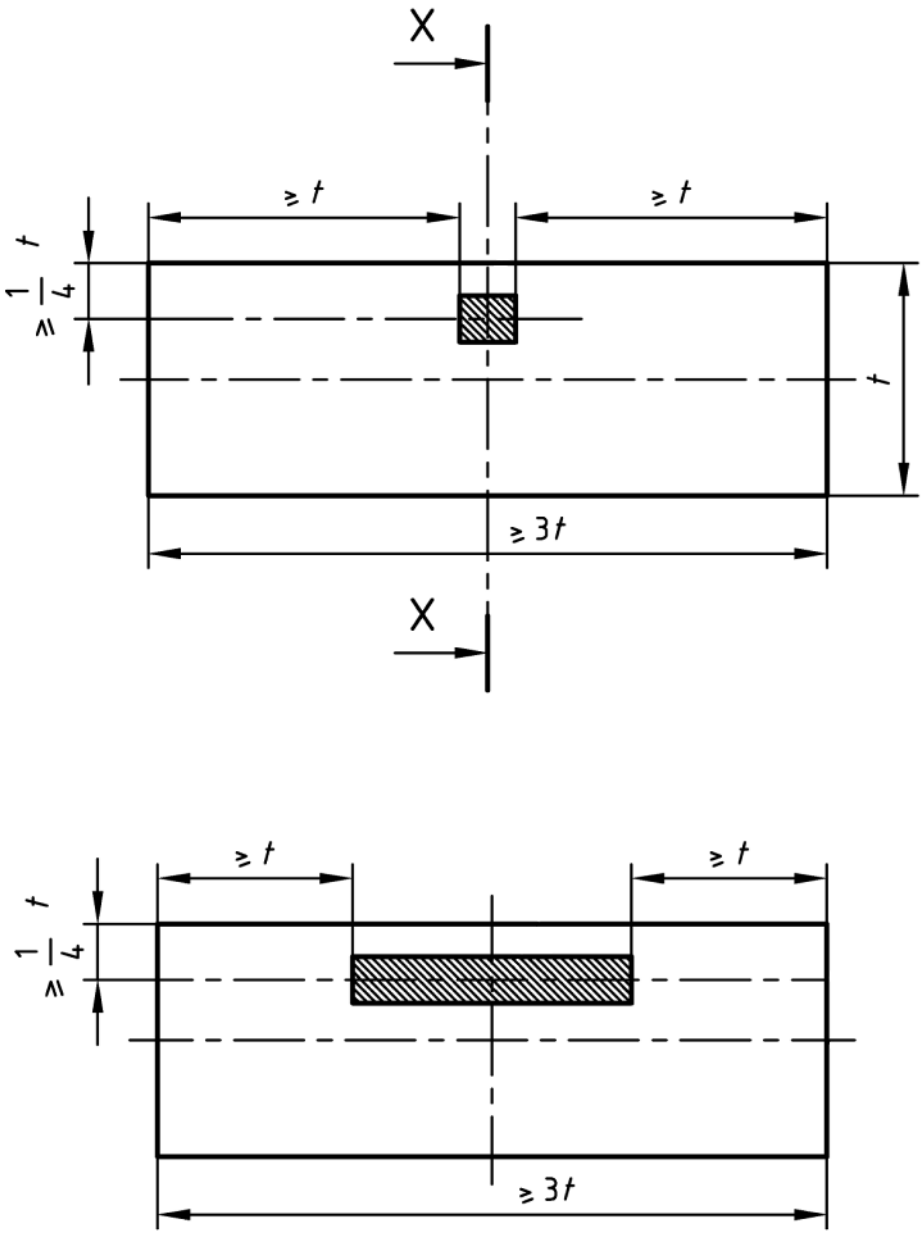
The geometry of test blocks can be agreed at the time of enquiry and order. It can be selected as follows:

a) test block t x t:

   — the cross section of the test block is t x t where t is the relevant wall thickness (see 4.1);

b) test block t x 3t x 3t:

   — when the relevant wall thickness is greater than 56 mm, the dimensions of the test block may be taken as: t x 3t x 3t (where t is the relevant wall thickness). The position of test pieces shall be as shown in Figure 1.



Key

t relevant thickness

Figure 1 — Sampling condition of test pieces in a t x 3t x 3t test block

8.4.2 ■

8.4.3 ■

8.4.4 ■

8.4.5 ■

8.5 Test procedures

8.5.1 Test method and equipment

In addition to EN 1559-1:2011:

a) tensile test at room temperature:

— the test method shall be according to EN ISO 6892-1. The initial gauge length shall be $L_o = 5{,}65\sqrt{S_o}$ where S_o is the cross section of the test piece;

b) •• tensile test at elevated temperature:

— the test shall be according to EN ISO 6892-2. The test temperature shall be one of those specified in the product standard and agreed between the purchaser and the manufacturer;

c) impact test:

— the shape and dimensions of the test piece (V-notch) and test method shall be according to EN ISO 148-1; if not specified in the product standard, the absorbed energy value is defined as KV_2 in Joules to be determined by three test pieces at the temperature given in the product standard.

The average value of energy shall not be smaller than the specified value indicated in the product standard for the specified grade; one of the individual values may be smaller than specified, provided that it is not smaller than 70 % of this specified value;

d) •• ferrite content:

— if not specified in the product standard the ferrite content can be determined either:

— by calculation using the chemical composition on the material; or

— on the product, by testing at a location agreed at the time of enquiry and order.

e) •• hardness test:

— the Brinell hardness test shall be carried out in accordance with EN ISO 6506-1. Before conducting the hardness test, a sufficient metal layer shall be removed by any means that does not affect the structure or properties of the material. This is not necessary if prior machining makes it possible to satisfy this condition;

f) •• homogeneity of test units (hardness test):

— the homogeneity of the test units shall be verified on a percentage of castings and with a hardness range to be agreed. The hardness shall be tested at the same location on each casting;

g) •• pressure or leak testing:

— pressure or leak testing conditions (surface condition of the casting, test pressure, fluid, temperature and time) together with the interpretation of the results shall be agreed at the time of enquiry and order;

— the castings subjected to the test shall not receive any coating or protective covering before the test;

h) •• intergranular corrosion test:

— an intergranular corrosion test shall be carried out in accordance with EN ISO 3651-1 or EN ISO 3651-2 as agreed between the purchaser and the manufacturer at the time of enquiry and order;

i) •• tests for magnetic properties:

— the specified characteristic is normally magnetic induction. The testing procedure to be used to determine magnetic induction and the shape of the test piece shall be agreed at the time of enquiry and order;

j) •• other tests for any other properties shall be agreed.

8.5.2 ■ Rounding of results of mechanical and chemical tests

8.6 ■ Invalidation of test results

8.7 Retests

8.7.1 ■ General

8.7.2 Non-sequential tests (individual values)

See 8.7.4.

8.7.3 Sequential tests

See 8.7.4.

8.7.4 Special conditions

8.7.4.1 When the results of mechanical tests do not comply with the requirements of the product standard, the manufacturer can, unless otherwise agreed at the time of enquiry and order, adopt one of the following procedures:

a) repeat the mechanical test which failed on two additional test pieces. If either of the two new test pieces does not give satisfactory results, the manufacturer may then follow the procedure specified in c);

b) in the case of impact tests, if the average value obtained from three tests does not reach the specified value, or if one of the individual values does not reach the specified minimum, the manufacturer may test three additional test pieces selected from the same test block or from another block from the same melt and heat treated test unit to represent the relevant castings. The manufacturer shall then add these results to those previously obtained, and recalculate the average. If this new average conforms to the average value specified, then the material represented shall be considered to be in conformity. When the new average value or any of these new individual values are not conforming with the specified requirements, the manufacturer may then follow the procedure specified in c);

c) submit the castings and test blocks to another heat treatment within the limits of the product standard, and then carry out all the mechanical tests required in the product standard on the test blocks. The castings and test blocks shall not undergo under any circumstances more than two additional heat treatment cycles (excluding tempering), without consulting the purchaser.

8.7.4.2 When the hardness test, carried out to verify the homogeneity of a test unit fails, then the following applies:

a) test all the castings in the test unit in order to eliminate those which are non-conforming the requirement. Then re-heat treat all non-conforming castings before presenting them for acceptance;

b) if the agreed hardness is not obtained on all tested castings, then a further heat treatment of all the castings in the test unit is permitted.

8.8 ■ Sorting and reprocessing

9 Marking

9.1 The castings shall be legibly marked to allow traceability through inspection documents, test pieces and castings.

9.2 •• The identification marks shall be stamped or cast on each piece in such a location and in such a manner as agreed at the time of enquiry and order.

10 ■ Packaging and surface protection

11 ■ Complaints

Annex A
(informative)

Mandatory and/or optional information checklist

This Annex A gives a checklist for quick information about different points that shall or may be agreed by the time of acceptance of the order. It relates to the relevant clauses or subclauses of EN 1559-1:2011 and EN 1559-2:2014.

Table A.1 — Checklist

Clause/ Subclause	Title	Agreement [a]		Remarks
		shall be specified •	may be specified ••	
4 Information to be supplied by the purchaser				
4.1	**Mandatory information**			
	a) Number of castings	1		
	b) Cast material and product standard	1		
	c) Specifications	1		See EN 1559-1:2011, 4.3
	d) Patterns	1		See EN 1559-1:2011, 4.3
	e) Outer and inner conditions	1		See 7.3.3 of EN 1559-1:2011 and of EN 1559-2:2014
	f) Machining			See EN 1559-1:2011, 4.2, 4.3 and 4.4
	Relevant wall thickness	2		
4.2	**Optional information**		1 and 2	See text itself
4.3	**Drawings, patterns and tools**			
	Taper, surfaces to machine, machining allowance (4.3.1)	1		
	Pattern supplied (4.3.2)		1	
	Machining allowance out of standard (4.3.3)	1		
4.4	**Information on the mass**		1	
4.5	**Preliminary sample**		1	
4.6	**Initial sample**		1	

Clause/ Subclause	Title	Agreement [a] shall be specified •	Agreement [a] may be specified ••	Remarks
5 Designation				
6 Manufacture				
6.1	**Manufacturing process**		1	
	Type of heat treatment (6.1.2.1)		2	
	Condition of the heat treatment (6.1.2.2)		2	
6.2	**Welding operations**			
	Production welding (6.2.2)		1	
	Welding procedure (6.2.2.2)		1	
	Areas where welding is permitted (6.2.2.3)		1	
	Exceptional stress (6.2.2.4)		1	
	Documentation of welded areas (6.2.2.5)		1	
	Documents (6.2.2.5)		2	
	Heat treatment after welding (6.2.2.6)		1	
	Criteria for excavation (6.2.2.7)		2	
7 Requirements				
7.2.1	**Chemical composition**			See text itself
7.2.2	**Mechanical properties**		1 and 2	Specified in product standard
	Hardness test (7.2.2)		2	
7.2.3	**Other properties**		1	
7.3	**Casting**			
	Chemical composition (7.3.1)		1	
	Mechanical properties (7.3.2)		1	
	Outer and inner conditions (non-destructive testing) (7.3.3) [b]	1 and 2		
	Non-destructive testing selection: method, criteria and operators qualification (7.3.3.1)		2	
	Minor surface defects (7.3.3.2)			See text EN 1559-1:2011
	Finishing methods (7.3.3.3)			See text EN 1559-1:2011
	Surface condition (7.3.3.4)		1	
	Condition of the casting (7.3.4)			See text EN 1559-1 :2011 and EN 1559-2:2014
	Dimensional tolerances (7.3.4.1)	1		See also EN 1559-2:2014
	Mass of the casting (7.3.5)		1	See also EN 1559-2:2014
	Additional requirements (7.3.6)		1 and 2	

Clause/ Subclause	Title	Agreement [a] shall be specified •	Agreement [a] may be specified ••	Remarks
8 Inspection				
8.1	**General**			
	Levels of quality inspection (8.1.3)		1	
	Qualification/Certification of inspectors (8.1.3)		1	
8.2	**Type of inspection documents and type of inspection**			
	Types (8.2.1)	1		
	Non-specific inspection (8.2.2)		1	
	Specific inspection (8.2.3)		1	
	Place of specific inspection (8.2.3.2)		1	
	Submission for specific inspection (8.2.3.3)		1	See text EN 1559-1:2011
	Rights and duties of the inspections representative (8.2.3.4)		1	See text EN 1559-1:2011
	Continuous inspection (8.2.4)		1	
8.3	**Test unit**			
	Formation of test units (8.3.1)		1 and 2	
	Size of test units (8.3.2)		1 and 2	
	Inspection frequency (8.3.3)		1	
8.4	**Samples**			
	Types (8.4.1)			See text EN 1559-1:2011
	Position (8.4.2)			See text EN 1559-1:2011
	Number and size (8.4.3)		1	
	Identification (8.4.5)			See text EN 1559-1:2011
8.5	**Test procedures**			
	Test method and equipment (8.5.1)			See text EN 1559-1:2011 and EN 1559-2:2014
	Tensile test at room temperature (a)		2	
	Tensile test at elevated temperature (b)		2	
	Impact test (c)		2	
	Ferrite content (d)		2	
	Hardness test (e)		2	
	Homogeneity of test units (f)		2	
	Pressure or leak testing (g)		2	
	Intergranular corrosion test (h)		2	
	Tests for magnetic properties (i)		2	
	Tests for any other properties (j)		2	
	Rounding of results of mechanical and chemical test (8.5.2)			See text EN 1559-1:2011 and EN 1559-2:2014
8.6	Invalidation of tests results			See text EN 1559-1:2011

Clause/ Subclause	Title	Agreement [a] shall be specified •	Agreement [a] may be specified ••	Remarks
8.7	Retests			See text EN 1559-1:2011 and EN 1559-2:2014
8.8	Sorting and reprocessing			See text EN 1559-1:2011
9 Marking				See text EN 1559-1:2011
	Traceability, alloy designation, other marking		1	See text EN 1559-2:2014
	Condition of identification marks		2	
10 Packaging and surface protection				See text EN 1559-1:2011
11 Complaints				See text EN 1559-1:2011

[a] "1": according to EN 1559–1:2011;
"2": according to EN 1559–2:2014.

[b] If not applicable, the purchaser shall inform the manufacturer that no non-destructive testing is required.

Annex B
(informative)

Significant technical changes between this European Standard and the previous edition

Table B.1 — Significant technical changes between this European Standard and the previous edition

Clause/Paragraph/Table/Figure	Change
General	Aligned with EN 1559-1:2011
Table 1	Aligned with Table 1 from ISO 4990
NOTE The technical changes referred to include the significant technical changes from the revised EN, but this is not an exhaustive list of all modifications from the previous version.	

Bibliography

CEN/TR 10261, *Iron and steel - European standards for the determination of chemical composition*

ISO 4990, *Steel castings - General technical delivery requirements*

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