Founding – Technical conditions of delivery

Part 2: Additional requirements for steel castings

English version of DIN EN 1559-2

DIN EN 1559-2

ICS 77.140.80

Supersedes DIN 1690-2, June 1985 edition.

Gießereiwesen – Technische Lieferbedingungen – Teil 2: Zusätzliche Anforderungen an Stahlgussstücke

European Standard EN 1559-2 : 2000 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by ECISS.

The responsible German body involved in its preparation was the *Normenausschuss Gießereiwesen* (Foundry Practice Standards Committee), Technical Committee *Stahlguss*.

DIN V 17006-100 is the standard corresponding to CEN/CR 10260 referred to in clause 2 of the EN.

Amendments

DIN 1690-2, June 1985 edition, has been superseded by the specifications of EN 1559-2.

Previous edition

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National Annex NA

Standard referred to

(and not included in **Normative references**)

DIN V 17006-100 Designation systems for steel – Additional symbols for steel names

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EN 1559-2

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ICS 77.140.80

English version

Founding – Technical conditions of delivery

Part 2: Additional requirements for steel castings

Fonderie – Conditions techniques de fourniture – Partie 2: Spécifications complémentaires pour les pièces moulées en acier

Gießereiwesen – Technische Lieferbedingungen – Teil 2: Zusätzliche Anforderungen an Stahlgussstücke

This European Standard was approved by CEN on 2000-01-03.

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 1559-2 : 2000 E

Contents

Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 31 "Steel castings", 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of an identical text or by endorsement, at the latest by August 2000, and conflicting national standards shall be withdrawn at the latest by August 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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.*

Introduction

This European Standard retains 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 standard is as follows :

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

— 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 may be agreed at the time of enquiry and order (optional) ;

— subclauses without dot marking are mandatory.

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 standard is also applicable to nickel and cobalt alloy castings.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 444, *Non-destructive testing - General principles for the radiographic examination of metallic materials by X and gamma-rays.*

EN 462-1, *Non-destructive testing - Image quality of radiographs - Part 1 : Image quality indicators (wire type), determination of image quality value.*

EN 473, *Qualification and certification of NDT personnel - General principles.*

EN 571-1, *Non destructive testing - Penetrant testing - Part 1 : General principles.*

EN 583-1, *Non-destructive testing - Ultrasonic examination - Part 1 : General principles.*

EN 1369, *Founding - Magnetic particle inspection.*

EN 1370, *Founding - Surface roughness inspection by visualtactile comparators.*

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

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

EN 1559-1:1997, *Founding - Technical conditions of delivery - Part 1 : General.*

EN 10002-1, *Metallic materials - Tensile testing - Part 1 : Method of test (at ambient temperature).*

EN 10002-5, *Metallic materials - Tensile testing - Part 5 : Method of test at elevated temperature.*

EN 10003-1, *Metallic materials - Brinell hardness test - Part 1 : Test method.*

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

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

EN 10045-1, *Metallic materials - Charpy impact test - Part 1 : Test method.*

EN 12454, *Founding - Visual examination of surface discontinuities - Steel sand castings.*

prEN 12680-1:1996, *Founding - Ultrasonic inspection - Part 1 : Steel castings.*

prEN 12681:1996, *Founding - Radiographic inspection.*

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 3651-1:1998).*

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 sulphuric acid (ISO 3651-2 :1998).*

prEN ISO 9934-1:2000, *Non-destructive testing - Magnetic particle testing - Part 1 : General principles (ISO/FDIS 9934-1:2000).*

CR 10260, *Designation systems for steels - Additional symbols.*

3 Terms and definitions

For the purposes of this Standard, the following terms and definitions 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 (ruling) wall thickness

NOTE The definition given in EN 1559-1:1997 applies to steel castings.

■3.9
inspection

■3.10
continuous inspection

■3.11
inspection representative

■3.12
test unit

■3.13
sample casting

■3.14
sample

3.14.1
test block
term used for sample in steel foundry industry

■3.15
test piece

■3.16
sequential testing

3.17
excavation
cavity produced by the removal of cast material prior to subsequent welding

NOTE 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

[See also checklist in annex A].

4.1 • Mandatory information

In addition to EN 1559-1 :

The relevant (ruling) wall thickness shall be agreed.

4.2 •• Optional information

In addition to EN 1559-1 :

For specific uses some optional requirements can become mandatory according to product standard.

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 and CR 10260.

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 normally 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 ■

6.2.2.6 ●● Mapping

Major production welds may be reported by indicating their zone and extent in the form of drawings or photographs.

6.2.2.7 ●● Criteria for excavation

Criteria other than those defined in 3.17 can be agreed.

6.2.2.8 ●● Documents

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

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... 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 :

Permissible deviations between the specified cast analysis and the check analysis on test blocks are given in table 1.

NOTE For method of chemical analysis, see CR 10261.

Table 1 - Permissible deviations of the check analysis on cast steel test blocks from the specified cast analysis

Element	Specified cast analysis *a* [% by mass]	Permissible deviation [% by mass]
Carbon	$a \leq 0,03$	+ 0,005
	$0,03 < a \leq 0,08$	± 0,01
	$0,08 < a \leq 0,30$	± 0,02
	$0,30 < a \leq 0,60$	± 0,03
	$0,60 < a \leq 1,20$	± 0,05
	$1,20 < a \leq 2,00$	± 0,06
	$2,00 < a$	± 0,08
Silicon	$a \leq 2,00$	± 0,10
	$2,00 < a$	± 0,20
Manganese	$a \leq 0,70$	± 0,06
	$0,70 < a \leq 2,00$	± 0,10
	$2,00 < a \leq 10,00$	± 0,25
	$10,00 < a$	± 0,40
Sulphur and Phosphorus	$a \leq 0,040$	+ 0,005
Chromium	$a \leq 2,00$	± 0,10
	$2,00 < a \leq 10,00$	± 0,20
	$10,00 < a \leq 15,00$	± 0,30
	$15,00 < a \leq 20,00$	± 0,40
	$20,00 < a$	± 0,50
Molybdenum	$a \leq 1,00$	± 0,07
	$1,00 < a \leq 2,00$	± 0,10
	$2,00 < a \leq 5,00$	± 0,15
	$5,00 < a \leq 30,00$	± 0,20
Nickel	$a \leq 1,00$	± 0,07
	$1,00 < a \leq 2,00$	± 0,10
	$2,00 < a \leq 5,00$	± 0,15
	$5,00 < a \leq 10,00$	± 0,20
	$10,00 < a \leq 20,00$	± 0,25
	$20,00 < a \leq 30,00$	± 0,30
	$30,00 < a$	± 0,50
Niobium	$a \leq 1,00$	± 0,05
	$1,00 < a$	± 0,10
Vanadium	$a \leq 0,30$	± 0,03
	$0,30 < a < 1,00$	± 0,07
Copper	$a \leq 2,00$	± 0,12
	$2,00 < a < 5,00$	± 0,25
Nitrogen	$a \leq 0,30$	± 0,02
Tungsten	$a \leq 1,00$	± 0,05
	$1,00 < a \leq 3,00$	± 0,10
	$3,00 < a \leq 6,00$	± 0,15
Cobalt	$a \leq 25,00$	± 0,40
	$25,00 < a$	± 0,70

7.2.2 Mechanical properties

In addition to EN 1559-1 :

•• 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 measurement can be replaced by a Brinell hardness test to be carried out in accordance with EN 10003-1. 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

In addition to EN 1559-1 :

•• When a check analysis is required on the casting itself, its location in the casting and the permissible deviations on chemical composition shall be agreed between the purchaser and the manufacturer.

7.3.2 ■ Mechanical properties

7.3.3 Non destructive testing

In addition to EN 1559-1 :

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

Every order shall include information about :

— non destructive method involved (visual, magnetic particle, liquid penetrant, ultrasonic, radiographic...) ;

— severity levels for every method ;

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

— percentage of castings to be inspected.

However, 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 inspection is performed according to the relevant European Standards (see table 2) :

Table 2 — Inspection methods

Inspection method	Symbol	General principles	Inspection conditions
Visual	VT	no	EN 12454
Liquid penetrant	PT	EN 571-1	EN 1371-1, EN 1371-2
Magnetic particle	MT	prEN ISO 9934-1:2000	EN 1369
Ultrasonic	UT	EN 583-1	prEN 12680-1:1996
Radiographic	RT	EN 444, EN 462-1	prEN 12681:1996

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 defects in the relevant section :

a) methods :

— aa) for surface testing, including excavations liquid penetrant or magnetic particle inspections 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] ;
- weld preparation ; } preferably radiography ;

- thick castings [1] ;
- production welds ; } preferably ultrasonic ;

- for austenitic and austenitic-ferritic 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 criterium (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 prEN 12680-1:1996, 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 inspection severity level 1 (UT or RT) shall only be used for special applications ;

c) qualification of non destructive testing operators.

Inspections shall be performed, by agreement at the time of enquiry and order, under the responsibility of a certified operator, in accordance with EN 473 or in accordance with an equivalent certification scheme.

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

7.3.3.2 ■

7.3.3.3 ■

7.3.3.4

In addition to EN 1559-1 :

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

7.3.4 ■ Conditions of the casting

7.3.4.1

In addition to EN 1559-1 :

The results of dimensional measurements shall not be rounded off.

7.3.4.2 ■

7.3.5 •• Mass of the casting

In addition to EN 1559-1 :

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

For other 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 :

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 material 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 material 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 Testing and documents on material testing

8.1 General

The results of the mechanical and chemical tests shall be rounded in one of the two following ways :

— by the procedure specified in the standard on tests methods ;

— by the generally accepted rules for rounding when the value obtained contains a greater number of significant figures than the specified value.

8.1.1 ■

8.1.2 ■

8.1.3 ■

8.2 ■ Inspection and testing

8.2.1 ■ Types of inspection and testing

8.2.2 ■ Non-specific inspection and testing

8.2.3 ■ Specific inspection

8.2.4 ■ Continuous inspection

8.2.5 ■ Place of specific inspection and testing

8.2.6 ■ Submission for specific inspection and testing to the inspection representative

8.2.7 ■ Rights and duties of the inspection representative

8.3 Test unit sampling

8.3.1 ●● Formation of test units

In addition to EN 1559-1 :

Other test units can be defined by agreement between the manufacturer and the purchaser.

8.3.2 ●● Size of test units

In addition to EN 1559-1 :

Unless specified in the product standard the size of test units shall be agreed at the time of enquiry and order.

8.3.3 ■ Inspection frequency

8.4 Samples (test blocks)

8.4.1 General

8.4.1.1 Condition of sampling

In addition to EN 1559-1 :

Mechanical properties shall be measured on test pieces taken from test blocks (see 8.4.1.2), 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.

Test pieces shall not be cut from the test block until the latter has been heat treated, with the relevant batch of castings if applicable (see 8.4.5).

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.

8.4.1.2 ●● Test blocks

In addition to EN 1559-1 :

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.

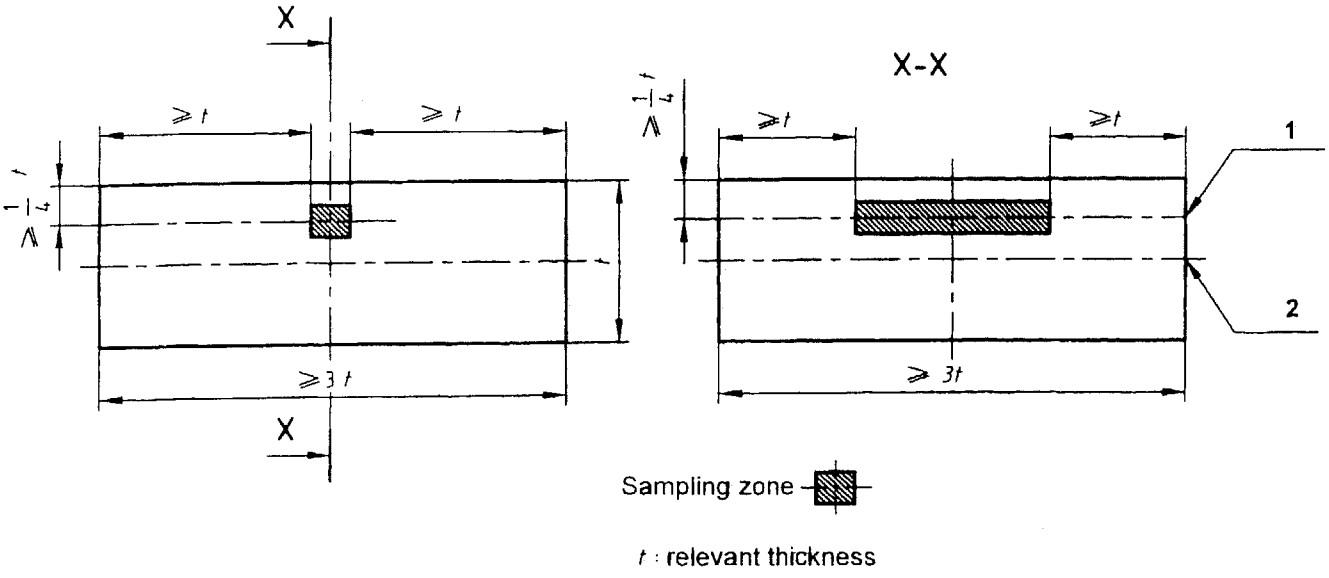
The geometry of test blocks can be agreed at the time of enquiry and order. It can be selected as follows :

a) test block t x t :

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

d) 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 in figure 1.



Key

1 Axis of test pieces
2 Sample

Figure 1 — Sampling condition of test pieces in a $t \times 3t \times 3t$ test block

8.4.2 ■

8.4.3 ■

8.4.4 ■

8.4.5 ■

8.5 Test methods

a) tensile test at room temperature :

— test method shall be according to EN 10002-1. 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 10002-5. 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 10045-1 ;

— when this test is specified, the absorbed energy value, in joules, is determined using three Charpy test pieces with V-notch, 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 value may be smaller than specified, provided that it is not smaller than 70 % of that 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 10003-1. 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 measured at the same location on each casting tested ;

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 measuring 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.

8.6 ■ Invalidation of tests

8.7 Retests

8.7.1 ■ General

8.7.2 Individual values (Non-sequential tests)

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 tests 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 be permitted under any circumstances to 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 reheat-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 permissible.

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 check list

This annex A gives a check list for quick information about different points that shall/may/can be agreed at the time of ordering. It relates to the relevant clauses or subclauses of EN 1559-1:1997 and EN 1559-2:2000.

Table A.1 - Check list

Clause, subclause	Title	Agreement [a] shall be specified	Agreement [a] may be specified	Remarks
4 Informations to be supplied by the purchaser				
4.1	**Mandatory information**			
	Number of castings (a)	1		
	Cast material and product standard (b)	1		
	Specifications (c)	1		See 4.3.1 of EN 1559-1:1997
	Patterns (d)	1		See 4.3.1 and 4.3.2 of EN 1559-1:1997
	Outer and inner conditions (e)	1		See 7.3.3 of EN 1559-1:1997 and EN 1559-2
	Relevant wall thickness	2		
4.2	**Optional information**		1 and 2	See text itself
4.3	**Drawings, patterns and other tools**			
	Taper, surfaces to be machined, machining allowance (4.3.1)	1		
	Pattern furnished (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	
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)		1	
	Welding procedure (6.2.2.2)		1	
	Areas where welding is permitted (6.2.2.2)		1	
	Exceptional stress (6.2.2.3)		1	
	Documentation of welded areas (6.2.2.4)		1	
	Heat treatment after welding (6.2.2.5)		1	
	Mapping (6.2.2.6)		2	
	Criteria for excavation (6.2.2.7)		2	
	Documents (6.2.2.8)		2	
7 Requirements				
7.2.1	**Chemical composition**			See text itself
7.2.2	**Mechanical properties**		1 and 2	Specified by product standard
	Hardness test (7.2.2)		2	
7.2.3	Other properties		1	

"to be continued"

Table A.1 *(suite)*

Clause, subclause	Title	Agreement [a] shall be specified	Agreement [a] may be specified	Remarks
7.3	**Casting**			
	Chemical composition (7.3.1)		2	
	Mechanical properties (7.3.2)		1	
	Non destructive testing requirements method, extent, criteria (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
	Finishing methods (7.3.3.3)			See text EN 1559-1
	Surface condition (7.3.3.4)		1	
	Condition of the casting (7.3.4.1)			See text EN 1559-1 and 2
	Dimensional tolerances (7.3.4.1)	1		See also EN 1559-2
	Manufacture with preliminary samples (7.3.4.1)		1	
	Fettling and finishing (7.3.4.2)		1	
	Mass of the casting (7.3.5)		1	See also EN 1559-2
	Additional requirements (7.3.6)		1 and 2	
8 Testing and documents on material testing				
8.1	**General**			
	Levels of quality insppection (8.1.2)		1	
	Qualification/Certification of inspectors (8.1.2)		1	
8.2	**Inspection and testing**			
	Types (8.2.1)	1		
	Non specific inspection (8.2.2)		1	
	Specific inspection (8.2.3)		1	
	ContinUous inspection (8.2.4)		1	
	Place of specific inspection (8.2.5)		1	
	Submission for specific inspection (8.2.6)			See text EN 1559-1
	Rights and duties of the inspections representative (8.2.7)			See text EN 1559-1
8.3	**Test unit sampling**			
	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
	Test block (8.4.1.2)		2	
	Position (8.4.2)			See text EN 1559-1
	Number and size (8.4.3)		1	
	Identification (8.4.5)			See text EN 1559-1
8.5	**Test methods**			
	Tensile test at elevated temperatrue (b)		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	

"to be continued"

Table A.1 *(suite)*

Clause, subclause	Title	Agreement [a]		Remarks
		shall be specified	may be specified	
8.6	**Invalidation of tests**			See text EN 1559-1
8.7	**Retests**			See text EN 1559-1 and 2
8.8	**Sorting or reprocessing**			See text EN 1559-1
9 Marking				See text EN 1559-1
9.1	**Traceability, alloy designation, other marking**		1	See text EN 1559-2
9.2	**Condition of identification marks**		2	
10 Packaging and surface protection				See text EN 1559-1
11 Complaints				See text EN 1559-1

[a] "1" means : according to EN 1559-1 ;
"2" means : according to EN 1559-2.

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

Bibliography

CR 10261, *ECISS Information Circular 11 – Iron and steel - Review of available methods of chemical analysis.*

ISO 8062, *Castings - System of dimensional tolerances and machining allowances.*