BS EN 1559-1:2011

BSI Standards Publication

Founding — Technical conditions of delivery

Part 1: General

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National foreword

This British Standard is the UK implementation of EN 1559-1:2011. It supersedes BS EN 1559-1:1997 which is withdrawn.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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Foreword

This document (EN 1559-1:2011) has been prepared by Technical Committee CEN/TC 190 “Foundry technology”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by August 2011, and conflicting national standards shall be withdrawn at the latest by August 2011.

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 1559-1:1997.

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

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 1 “Technical conditions of delivery and cast iron designation” to revise EN 1559-1:1997.

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

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

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

— 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 alloy castings*

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

— EN 1559-6, *Founding — Technical conditions of delivery — Part 6: Additional requirements for zinc alloy 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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard uses a system of identification for delivery conditions with the following structure:

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

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

— subclauses without dot marking are mandatory.

The purchaser specifies the requirements of the casting(s) to fulfil the intended use.

The manufacturer produces the casting(s) to the requirements stated.

It is recommended that full consultations between the manufacturer and the purchaser are made.

1 Scope

This part of EN 1559 specifies the general technical delivery conditions for castings made from cast metallic materials except copper alloy castings.

This part of EN 1559 is not applicable to metallic castings for further reprocessing such as forging ingots and continuously cast billets and blooms.

NOTE 1 Technical delivery conditions for copper alloy castings are specified in EN 1982.

NOTE 2 Additional technical delivery condition requirements which are specific to particular materials are specified in the following parts of this standard series: EN 1559-2 for cast steel; EN 1559-3 for cast iron; EN 1559-4 for cast aluminium; EN 1559-5 for cast magnesium; EN 1559-6 for cast zinc.

2 Normative references

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

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

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 alloy castings*

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

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

EN 1560, *Founding — Designation system for cast iron — Material symbols and material numbers*

EN 1754, *Magnesium and magnesium alloys — Magnesium and magnesium alloy anodes, ingots and castings — Designation system*

EN 1780-1, *Aluminium and aluminium alloys — Designation of alloyed aluminium ingots for remelting, master alloys and castings — Part 1: Numerical designation system*

EN 1780-2, *Aluminium and aluminium alloys — Designation of alloyed aluminium ingots for remelting, master alloys and castings — Part 2: Chemical symbol based designation system*

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

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

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 12844, *Zinc and zinc alloys — Castings – Specifications*

EN 12883, *Founding — Equipment for the production of lost patterns for the lost wax casting process*

EN 12890, *Founding — Patterns, pattern equipment and coreboxes for the production of sand moulds and sand cores*

EN 12892, *Founding — Equipment for the production of lost patterns for the lost foam casting process*

EN ISO 10135, *Geometrical product specifications (GPS) — Drawing indications for moulded parts in technical product documentation (TPD) (ISO 10135:2007)*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

ISO 5459, *Technical drawings — Geometrical tolerancing — Datums and datum-systems for geometrical tolerances*

3 Terms and definitions

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

3.1
purchaser
person or body who places an order

3.2
manufacturer
person or body who produces castings

3.3
casting
workpiece that has been shaped by solidification of a liquid metal or alloy in a mould

3.4
as-cast casting
casting that has not received any kind of finishing treatment after casting beyond removal of casting appendages, such as gates, risers and flash and removal of residues of the moulding material where necessary

3.5
as-delivered casting
casting manufactured to the delivery requirements of the order

3.6
initial sample
casting, completely manufactured by means of the equipment and processes used for series production under the appropriate control conditions

NOTE The initial sample is to furnish the proof that the manufacturer is in the position to comply with the quality requirements (dimensions, material, function, etc.) requested by the purchaser.

3.7
preliminary sample
casting which corresponds to a large degree to the "initial sample", but has either not or only partially been manufactured by means of the equipment and processes used for series production

3.8
relevant wall thickness
wall thickness representative of the casting, defined for the determination of the size of the cast samples to which the mechanical properties apply

NOTE Not always appropriate to all materials.

3.9
inspection
activities such as measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity

3.10
continuous inspection
regular inspection of the characteristics and/or manufacturing parameters of a casting manufactured over a period of time, normally in large quantities and always to the same specification

NOTE This inspection is carried out according to an agreed procedure and may include agreed statistical methods.

3.11
inspection representative
one or more individuals who is/are either the inspector designated in the official regulations, the manufacturer's authorized representative, who is functionally independent of the production process, acting on behalf of the purchaser, or the purchaser's authorized representative

3.12
test unit
number of pieces or the tonnage of castings to be accepted or rejected together, on the basis of the tests carried out on test pieces in accordance with the requirements of the relevant specification, material standard or order

NOTE This term is sometimes referred to as "inspection lot" or "test batch".

3.13
sample casting
casting selected from a test unit for the purpose of obtaining test pieces

3.14
sample
sufficient quantity of material for the purpose of producing one or more test pieces

NOTE 1 The sample can be separately cast, cast side-by-side, cast on or cut from the casting itself.

NOTE 2 In certain cases, the sample can be the sample casting itself.

3.15
test piece
part of the sample, with specified dimensions, machined or unmachined, brought to a required condition for submission to a given test

NOTE In certain cases the test piece can be the sample itself.

3.16
sequential testing
group or series of tests from which the average and individual results are used to demonstrate that the requirements of the order and/or product standard or material standard have been satisfied

3.17
acceptance criteria
limits of test results, agreed between manufacturer and purchaser at the time of the order which show conformity to specified requirements of the casting(s)

3.18
drawing
technical information, given on an information carrier, graphically presented in accordance with agreed rules and usually to scale

3.19
finishing welding
production welding carried out in order to ensure the agreed quality of the casting

3.20
joint welding
production welding used to assemble components together to obtain an integral unit

4 Information to be supplied by the purchaser

4.1 Mandatory information

See also checklist in Annex A.

The purchaser shall give clear information in the enquiry and order, in particular on:

a) number of castings to be supplied, the permissible deviations from this number, and the schedule of delivery;

b) specification of the cast material.

In the case of castings made of standardized cast material, the following shall be specified:

1) the number of the relevant material standard;

2) the designation of the cast material either by symbol or by number;

c) relevant drawings, standards and technical specifications; in case of numerical data exchange, provision shall be made for integrity of data;

d) supply of pattern equipment, core boxes, permanent moulds;

e) requirements regarding the outer and inner conditions of the castings;

f) relevant information for machining, such as location and clamping points.

4.2 ●● Optional information

See also checklist in Annex A.

When applicable, the enquiry and order shall include other requirements, such as:

a) relevant wall thickness of the castings;

b) the as-delivered condition, e.g. heat treatment, surface treatment;

c) additional properties not specified in the material standard;

d) mass of the castings;

e) delivery of preliminary samples;

f) delivery of initial samples;

g) method and the extent (area and/or frequency) of non-destructive testing;

h) method and the extent (area and/or frequency) of machining to be carried out by the manufacturer;

i) surface areas for further operations by the purchaser, such as local surface treatments, welding operations, etc.;

j) the type and the extent (area and/or frequency) of special tests to be carried out by the manufacturer and the conditions applicable to such tests;

k) criteria for statistical sampling;

l) special measures to be taken or specifications to be observed for manufacture or testing of castings, particularly with regard to the testing of production welds, in cases where castings are partly or completely subject to special stress conditions;

m) whether traceability is required;

n) type of documents covering the tests performed;

o) type of surface protection and packing for storage and transport arrangement;

p) repairs and storage arrangements for patterns and tools;

q) formation of a test unit unless already defined by material specification;

r) agreement of production welding;

s) any other special requirements, e.g. metallographic structure, corrosion resistance, machinability;

t) application of a quality assurance system, e.g. EN ISO 9001:2008;

u) any requirement regarding confidentiality (including sub contracting).

4.3 Drawings, patterns and tools

4.3.1 ● The purchaser shall make available to the manufacturer the necessary drawing(s), e.g. drawing(s) of the as-cast casting and/or the finished machined casting. The identification of the relevant drawing(s) shall be specified in the enquiry and order.

Unless otherwise agreed, the drawing(s) shall conform to international or national drawing standards. If modifications to the purchaser's drawing(s) are necessary, they shall be agreed between the manufacturer and the purchaser. Any modification of the drawing should be uniquely identified. Unless otherwise agreed the patterns and tools shall conform, where applicable, to EN 12883, EN 12890 and EN 12892.

It shall be stated whether a taper is to be added, subtracted or averaged. The drawing indications shall be in accordance with EN ISO 10135.

When applicable, the surfaces to be machined, the required machining allowances and datums (for datums see ISO 5459) for machining and for the dimensional check shall be specified on the drawing(s).

4.3.2 ●● If the purchaser is making available to the manufacturer pattern equipment, tooling or permanent moulds, their identification shall be specified in the order. The surfaces of the casting to be machined shall be clearly identified and, when necessary, indicated on the drawing(s).

Unless otherwise required, the purchaser decides the shape, sizes and suitability for the purpose of the pattern equipment, tooling or permanent moulds, expendable patterns and inserts supplied.

The manufacturer of the casting shall check that the patterns, etc. are useable and complete.

The purchaser may require the manufacturer to fully inspect the equipment supplied or to satisfy himself that the sufficient machining allowances for his manufacturing work and any subsequent machining are available.

4.3.3 ● For general tolerances and machining allowances for castings, EN ISO 8062-3 shall apply unless otherwise specified by the purchaser.

The casting tolerance grade and, where applicable, the required machining allowance grade shall be specified on the drawing or in the order.

4.4 ●● Information on the mass

If there is a tolerance on the mass for castings, agreement shall be made by the time of ordering as to whether the mass of a casting shall be the same as the mass calculated from the drawing or the mass of an initial sample with sizes within the size tolerances. When the mass is calculated from the drawing, then any modifications to the mould and/or the casting process and all machining allowances shall be taken into account.

4.5 ●● Preliminary sample

The supply of preliminary samples may be agreed.

If preliminary samples are to be used only for checking dimensions but may deviate from the agreed material properties, this shall be agreed between the manufacturer and the purchaser.

If the agreed tolerances are exceeded on the preliminary sample, and if the purchaser gives his approval for such deviations, the new limit values shall be agreed.

The terms of approval shall be previously agreed and described in a contractual document.

4.6 ●● Initial sample

The supply of initial samples may be agreed.

If the agreed limit values or tolerances are exceeded on the initial sample, and if the purchaser gives his approval for such deviations, the new limit values or tolerances shall be agreed.

The terms of approval shall be previously agreed and described in a contractual document.

5 Designations

Designations of cast materials shall be in accordance with the following European Standards where applicable:

a) Cast steel: EN 10027-1 and EN 10027-2;

b) Cast iron: EN 1560;

c) Cast magnesium: EN 1754;

d) Cast aluminium: EN 1780-1 and EN 1780-2;

e) Cast zinc: EN 12844.

6 Manufacture

6.1 ●● Manufacturing process

The manufacturing process shall be left to the discretion of the manufacturer unless otherwise agreed by the time of ordering or otherwise specified in the product standard.

NOTE The manufacturing process covers all operations up to the delivery of the casting(s).

If requested in the order, the melting and moulding processes shall be indicated to the purchaser for information.

6.2 Welding operations

6.2.1 General

The terms and definitions contained in the relevant European Standards for welding shall apply.

6.2.2 ●● Production welding

6.2.2.1 Production welding includes finishing welding and joint welding.

When joint welding is required, the purchaser shall give clear information in the inquiry and order.

6.2.2.2 ●● According to the weldability of the material, the geometry of the weld and the shape and the purpose of the casting three options are available for finishing welding.

Unless the option of choice is laid down in any relevant product standard and/or delivery standards, then the parties shall agree on one or more of the options below:

a) manufacturer may undertake finishing welding without reference back to the purchaser;

b) manufacturer shall inform the purchaser that finishing welding has been undertaken;

c) manufacturer shall obtain the purchaser's agreement prior to undertake finishing welding.

The order may require an approved procedure and/or a technical welding sheet and/or suitably qualified welders.

6.2.2.3 ●● With due regard to the material and the shape of the casting, production welds shall be made in such a manner that the values obtained for the relevant properties of the weld metal and the heat-affected zone, are sufficient to correspond to the requirements of the parent material.

Agreements may be made regarding the filler metals used. Otherwise, the manufacturer shall decide this, where applicable, in accordance with the recommendations of the standard covering the material, or his experiences.

The areas where production welds are to be made shall be prepared and inspected so as to ensure a satisfactory weld. No plugs or similar devices shall be used when carrying out the welding work unless agreements to the contrary have been made with the purchaser. If filler pieces are inserted in the case of large weld areas, these shall be similar to parent material.

6.2.2.4 ●● If a casting is locally or completely subject to exceptional stresses and if these require special measures or compliance with special specifications during manufacture or testing of the casting, agreements may be made with the manufacturer by the time of ordering with regard to production welds and their inspection.

6.2.2.5 ●● Documentation for production welded areas may be agreed.

6.2.2.6 ●● If necessary, after production welding the casting shall be subjected to heat treatment. For this purpose, the specifications given in the material standards shall be observed.

7 Requirements

7.1 General

Requirements related to materials or to castings shall be considered separately.

The castings shall comply with the requirements of the order. Consequently, the manufacturer shall carry out appropriate process control and inspection to ensure that the delivery complies with the requirements of the order, irrespective of the type of inspection document required (see 8.2).

7.2 Material

7.2.1 Chemical composition

If not otherwise specified in the enquiry and order the requirements of the relevant material standard shall apply with regard to the chemical composition of the cast material.

If not otherwise specified in the enquiry and order the data on the chemical composition of the cast material shall relate to the liquid metal, i.e. ladle analysis.

If neither the relevant material standards nor the order or enquiry include any data on the chemical composition of the cast material, e.g. in cases where the material is specified by mechanical properties only, the choice of a suitable chemical composition shall be left to the manufacturer.

7.2.2 Mechanical properties

If not otherwise specified in the enquiry and order, the requirements of the relevant material standard shall apply with regard to the properties of the material.

7.2.3 ●● Other properties

Other material properties may be specified, such as corrosion resistance, creep resistance, structure or specific physical properties.

7.3 Casting

7.3.1 Chemical composition

When a chemical analysis is required to be carried out on a casting the permissible deviations shall conform to those given in the material standard or to those which have been agreed between the purchaser and the manufacturer. When applicable, the sampling position shall be agreed between the purchaser and the manufacturer.

7.3.2 ●● Mechanical properties

When particular properties, e.g. yield strength, tensile strength, hardness, apply to certain areas of the casting or to the complete casting, these properties shall be agreed by the time of the order. In such cases, additionally, the position, the shape of the sample, the sampling conditions and the acceptance criteria shall be agreed between the purchaser and the manufacturer.

7.3.3 Outer and inner conditions (non-destructive testing)

7.3.3.1 ● If applicable, the outer and inner conditions of the casting(s) shall be agreed.

They shall specify:

— the method of non-destructive testing to be used;

— the extent (area and/or frequency) of testing;

— the acceptance criteria.

In those areas where non-destructive testing has been agreed, the required surface condition shall be ensured by the use of an appropriate process.

References to discontinuities shall be expressed according to relevant NDT-standard.

7.3.3.2 Where minor surface defects do not impair the application or if the surface of the casting corresponds to that of the initial sample, they need not be removed.

NOTE Examples of minor surface defects include small areas of sand or slag, small cold laps, small scabs, small shrink-holes, groups of small pores, residues of the moulding material, uneven areas, flash.

7.3.3.3 Unacceptable external and internal discontinuities may be recovered by methods specified in EN 1559-2 to EN 1559-6. A conforming procedure may be agreed between the purchaser and the manufacturer. In the case of as-cast castings, it is recommended that the purchaser discusses with the manufacturer the choice of any non-destructive testing and criteria to determine the acceptability of a subsequently machined surface. Unless specifically agreed, discontinuities to be removed during normal machining are not to be regarded as a non-conformity.

7.3.3.4 ●● If required, the surface condition including burrs and parting line flash shall be agreed upon.

NOTE Examples of acceptable surfaces include surface comparators or another casting used as a reference comparator, etc.

7.3.4 Condition of the casting

7.3.4.1 Shape and size

The shapes and sizes of the castings shall conform to the requirements of the order and shall be as indicated on the supplied drawings, models or templates.

● The enquiry and order shall detail the dimensional tolerances and the machining allowances to be specified, preferably in accordance with EN ISO 8062-1, prCEN ISO/TS 8062-2 and EN ISO 8062-3.

7.3.4.2 Fettling and finishing

Unless otherwise agreed by the time of ordering, the castings shall be supplied fettled, but unmachined. Gates and feeders shall be removed. Residues of moulding and foreign material and scale shall be removed from accessible surfaces.

7.3.5 ●● Mass of the casting

If applicable, the mass and its tolerance shall be agreed by the time of ordering.

7.3.6 ●● Additional requirements regarding the condition of the casting

Additional requirements regarding the condition of the casting, e.g. pressure or leak tightness to particular media, at specified pressures and temperatures, or the microstructure, shall be specified by the time of ordering.

If it is required that the manufacture is approved on the basis of initial or preliminary samples, this shall be agreed by the time of ordering.

8 Inspection

8.1 General

8.1.1 The manufacturer shall take the necessary measures to ensure compliance with the agreed requirements. The inspection shall be carried out by competent persons.

8.1.2 During the inspection, the manufacturer shall ensure traceability between the sample castings, samples, test pieces and the test units to which they belong.

8.1.3 ●● The purchaser may agree with the manufacturer suitable measures and levels of quality inspection, whether the inspectors have to be qualified and/or certificated, the requisite level of this certification and the extent of the documentation of test results.

8.2 Type of inspection documents and type of inspection

8.2.1 ● Types of inspection and testing

When ordering, the purchaser shall state which type of document, if any, is required (see EN 10204).

8.2.2 ●● Non-specific inspection

The purchaser may require, that on the basis of non-specific inspection a declaration of compliance with the order ("type 2.1" according to EN 10204:2004) or a test report ("type 2.2" according to EN 10204:2004) is to be furnished by the manufacturer. When the purchaser requires a test report he shall indicate for which casting characteristics test results shall be given in this document.

8.2.3 ●● Specific inspection

8.2.3.1 ●● Information to be supplied

When the purchaser specifies that compliance with the requirements of the order is to be verified by specific inspection, the enquiry and order shall cover:

— type of document required in accordance with EN 10204: the inspection certificate "type 3.1" or "type 3.2"; and if not specified in the product or material standard: the test unit and the number of samples per test unit;

— conditions for sampling and for the preparation of the samples and test pieces;

— identification of test units, if any;

— test methods.

In the case of inspection certificate "type 3.2" (see EN 10204:2004), appropriate contact details of the inspection body shall be given in the order.

8.2.3.2 ●● Place of specific inspection

If the necessary facilities are not available at the manufacturer's works, the specific inspection and testing shall be carried out at another place agreed between the two parties, or at an establishment accredited by a recognized organization, preferably in the country of manufacture. In this latter case, the castings shall not be delivered before receipt of the inspection results by the manufacturer.

8.2.3.3 Submission for specific inspection to the inspection representative

The inspection representative shall be informed, by the manufacturer or his authorized representative, of the date of availability of part or all of the consignment for specific inspection and testing. Reference shall be made to the order. The submission note referring to the order or to the available parts of the order shall be delivered to the inspection representative not later than the beginning of the inspection procedure.

The manufacturer and the inspection representative shall agree the time and date of the inspection in order to avoid interference with the normal operation of the works.

If the external inspection representative does not attend on the agreed date, and in order not to disturb the manufacturing process, the inspection representative authorized by the manufacturer may carry out on agreement with the purchaser the acceptance operations himself and provide the purchaser, or his representative, with the inspection document, unless this was expressly forbidden.

8.2.3.4 Rights and duties of the inspection representative

In order to carry out the agreed inspection, the inspection representative shall have free access, at any appropriate time, to the places where the castings to be inspected are manufactured and stored. He may select the sample castings from the test unit from which the samples are to be taken in conformity with the specifications. He shall have the right to be present during the selection of samples, preparation (machining and treatment) of test pieces and of witnessing the tests. He shall observe all the instructions in force in the manufacturer's works and particularly the safety rules. The manufacturer can reserve the right to have him accompanied by a representative of the works. The inspection procedures shall be carried out so that disturbance of the normal run of production is minimized.

8.2.4 ●● Continuous inspection

In special cases, the specific inspection of a casting can be replaced, by agreement, by continuous inspection of its characteristics and/or manufacturing, carried out by the manufacturer. The characteristics to be verified and their values, the frequency of the inspection and testing, and, if necessary, the required documents shall be agreed by the time of ordering. This agreement shall, where necessary, also define the right of the purchaser to verify this inspection.

8.3 Test unit

8.3.1 ●● Formation of test units

For each type of test, the test unit shall be specified in the product specification or the order.

The test unit can be formed by:

— a single casting;

— a quantity (number) of castings from a single melt which has undergone the same treatment;

— a quantity (number) of castings which have undergone the same heat treatment;

— a tonnage (mass) of castings.

8.3.2 ●● Size of test units

The size of test units shall be specified in the order.

8.3.3 ●● Inspection frequency

The inspection frequency shall be agreed either according to the details in the material standard, product standard, or in the purchaser's specification.

8.4 Samples

8.4.1 If required, samples shall be produced as specified in the appropriate material standard or agreed by the time of ordering. These can be:

— separately cast;

— cast side-by-side;

— cast on; or

— cut from the casting.

The thickness of the samples shall be in accordance with the relevant wall thickness of the casting, as specified in the applicable material standard.

8.4.2 If the drawing or the material standard or the order does not specify the type and position of the samples, that shall be at the discretion of the manufacturer.

8.4.3 ●● The number and size of the samples depend on the specified number of test pieces for the agreed tests including those for retesting.

8.4.4 Unless otherwise specified cast-on samples shall only be separated after their identification and, if any, heat treatment.

8.4.5 Separately cast samples, side-by-side cast samples, and those that have to be separated to allow machining, shall be identified. They shall, in case of heat treatment, be heat treated together with the test unit, unless otherwise specified in the relevant material standard.

8.5 Test procedures

8.5.1 Test method and equipment

Tests shall be carried out, and the results presented, in accordance with the corresponding European Standard. When no such European Standard exists the test methods to be used shall be agreed at the time of enquiry order.

NOTE Bibliography (see [1] to [5] and [13] to [17]) contains a list of some of the European Standards on testing and analysis.

All inspection measuring and test equipment used by the manufacturer to verify characteristics for which specific requirements are included in the order or product specification shall be calibrated and adjusted against certified equipment having a known valid traceability to nationally or internationally recognized standards, where such standards exist, and be so maintained. Where such standards do not exist, the calibration procedure shall be documented. The manufacturer or his authorized representative shall maintain calibration records for inspection, measuring and test equipment. The accuracy of the measuring or testing equipment shall be sufficient in relation to the specified values and tolerances.

The chemical composition may be determined by chemical, physical or spectrochemical methods of analysis according to recognized standards. In cases of arbitration, the method to be used shall be agreed.

8.5.2 Rounding of results of mechanical and chemical test

Unless otherwise specified in the order or product specification, for the purpose of deciding whether a test result meets a specified value, results of mechanical and chemical tests shall be expressed by or, if needed, be rounded to the same number of significant figures as in the specified value, using either the rules specified in the testing standards or the rules according to ISO 80000-1:2009, Annex B, rule B.

8.6 Invalidation of test results

The requirements given in the relevant material standard shall apply.

If not otherwise specified in the relevant material standard, test results which are due to improper sampling and/or preparation of test pieces or tests carried out improperly shall be considered invalid.

Test results shall be disregarded where non-conforming results arise from defects found on one (or more) test piece(s) (improper structure, fracture outside the gauge marks of the tensile test piece, etc.) after the test has been carried out.

8.7 Retests

8.7.1 General

If not otherwise specified in the material standard, specific technical delivery condition standard or product standard, the following applies:

When one or more tests have given unsatisfactory or non-conforming results, the manufacturer may either withdraw the test unit concerned or retest in accordance with the procedures described in 8.7.2 and 8.7.3.

8.7.2 Non-sequential tests (individual values)

When the unsatisfactory or non-conforming result comes from tests for which no average, but only individual values are specified (e.g. tensile test, bend test, etc.), the following shall be carried out:

a) the test unit is a single piece

   Two new tests of the same type as the one giving an unsatisfactory or non-conforming result shall be carried out. Both new tests shall give satisfactory or conforming results. If not, the casting shall be rejected or reprocessed.

b) the test unit is more than one piece

   Unless otherwise agreed, the manufacturer may, at his discretion, retain or not retain in the test unit the sample casting from which the unsatisfactory or non-conforming test results have been obtained.

   1) If the sample casting is withdrawn from the test unit, the inspection representative shall designate, within the same test unit, two other sample castings of his choice. One more test of the same type shall then be carried out on test pieces from each of these sample castings, under the same conditions as for the first tests; both new tests shall give satisfactory or conforming results.

   2) If the sample casting is retained in the test unit, the procedure is as indicated in 1), but one of the new test pieces shall be taken from the sample casting retained in the test unit; both new tests shall give satisfactory or conforming results.

8.7.3 Sequential tests

Retests of sequential tests, e.g. impact test, shall be carried out in accordance with EN 1559-2, EN 1559-3, EN 1559-4, EN 1559-5 and EN1559-6 and/or the relevant material standard.

8.8 Sorting and reprocessing

The manufacturer shall have the right to carry out sorting and/or reprocessing (e.g. heat treatment, machining, etc.) of non-conforming castings, either before or after the retests, and to submit these castings as a new test unit in accordance with 8.3.

Where no reprocessing, only sorting, has been applied, the new inspection procedure shall only apply to the requirements which were not complied with at first inspection.

The manufacturer shall inform the inspection representative about the method of sorting and/or reprocessing used.

9 Marking

At delivery, the manufacturer shall have marked either the castings or the consignment with his identification and, additionally, in accordance with the product standard and/or with the agreement by the time of ordering with,

●● if required:

— traceability reference;

— designation of the alloy;

— other marking requested by the purchaser.

When a specific inspection is required the delivery units or products shall be marked so that traceability between these and the inspection document type 3.1 or 3.2 is ensured.

10 Packaging and surface protection

Packaging and/or surface protection, if any, for the transport or storage of castings shall be at the discretion of the manufacturer unless a specific agreement has been made by the time of acceptance of the order.

11 Complaints

In case of any complaint, the manufacturer shall be able to examine the validity of the complaint within a reasonable time.

If applicable, the sampling conditions and the test methods used to evaluate the disputed characteristics shall be in accordance with the requirements given in 8.4 and 8.5.

Unless otherwise agreed, complaints on technical matters may only be made, when the specified requirements are not met.

Annex A
(normative)

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 (marked by x, Table A.1). It relates to the relevant clauses or subclauses of this standard.

Table A.1 — Checklist

Clause, subclause	Title	Agreement		Remarks
		shall be specified ●	may be specified ●●	
4 Information to be supplied by the purchaser				
4.1	Mandatory information			
	a) Number of castings	x		
	b) Cast material and material standard	x		
	c) Specifications	x		
	d) Patterns	x		see 4.3.1
	e) Outer and inner conditions	x		see 7.3.3.1
	f) Relevant information for machining	x		
4.2	Optional information		x	
4.3	Drawings, patterns and tools			
	Taper, surface to machine, machining allowance (4.3.1)	x		see also 7.3.4.1
	Pattern supplied (4.3.2)		x	
	Machining allowance out of standard (4.3.3)	x		
4.4	Information on the mass		x	see also 7.3.5
4.5	Preliminary sample		x	
4.6	Initial sample		x	
6 Manufacture				
6.1	Manufacturing process		x	
6.2	Welding operations			
	Production welding (6.2.2.1)		x	
	Welding procedure agreement (6.2.2.2)		x	
	Areas where welding is permitted (6.2.2.2)		x	
	Exceptional stress (6.2.2.3)		x	
	Documentation of welded areas (6.2.2.4)		x	
	Heat treatment after welding (6.2.2.5)		x	
7 Requirements				
7.2.1	Chemical composition			specified in material standard
7.2.2	Mechanical properties			specified in material standard
7.2.3	Other properties		x	

Table A.1 (*continued*)

Clause, subclause	Title	Agreement		Remarks
		shall be specified ●	may be specified ●●	
7.3.1	Chemical composition of the casting — Sampling position	 x		
7.3.2	Mechanical properties of the casting	x		
7.3.3	Outer and/or inner conditions Specification (7.3.3.1) Minor surface defects (7.3.3.2) Repair methods (7.3.3.3) Surface condition (7.3.3.4)	 x	 x	 see text see text
7.3.4	Condition of the casting Dimensional tolerances and machining allowances (7.3.4.1) Fettling and finishing (7.3.4.2)	 x		 see text
7.3.5	Mass of the casting		x	
7.3.6	Additional requirements		x	
8 Inspection				
8.1	General Traceability (8.1.2) Levels of quality inspection (8.1.3)		 x	 see text
8.2	Type of inspection documents and type of inspection Types (8.2.1) Non-specific inspection (8.2.2) Specific inspection (8.2.3) Information to be supplied (8.2.3.1) Place of specific inspection (8.2.3.2) Submission for specific inspection (8.2.3.3) Rights and duties of the inspection representative (8.2.3.4) Continuous inspection (8.2.4)	 x	 x x x x	 see text see text
8.3	Test unit Formation of test units (8.3.1) Size of test units (8.3.2) Inspection frequency (8.3.3)		 x x x	
8.4	Samples Types (8.4.1) Position (8.4.2) Number and size (8.4.3) Identification (8.4.5)		 x	 see text see text see text

Table A.1 (*continued*)

Clause, subclause	Title	Agreement		Remarks
		shall be specified ●	may be specified ●●	
8.5	Test procedures			see text
8.6	Invalidation of test results			see text
8.7	Retests			see text
8.8	Sorting and reprocessing			see text
9	Marking		x	
10	Packaging and surface protection			see text
11	Complaints			see text

Annex B
(informative)

Significant technical changes between this European Standard and the previous edition

Clause/Paragraph/Table/Figure	Change
3.17	Definition added: acceptance criteria
3.18	Definition added: drawing
3.19	Definition added: finishing welding
3.20	Definition added: joint welding
4.1	f) relevant information for machining, such as location and clamping points, has been added
8.1.2	Inserted paragraph: Alignment with EN 10021:2006, *General technical delivery conditions for steel products*
8.2.3	Changed title of paragraph: deleted “testing”
8.2.3.1	Inserted (last) clause: Alignment with EN 10021:2006, *General technical delivery conditions for steel products*
8.4.1	Inserted new production method of sample: Cast side-by-side
8.5.1	Inserted new paragraph "Test method and equipment": Alignment with EN 10021:2006, *General technical delivery conditions for steel products*
8.5.2	Inserted new paragraph "Rounding of results of mechanical and chemical test": Alignment with EN 10021:2006, *General technical delivery conditions for steel products*
8.6	New title: invalidation of test results
8.8	Changed 2nd clause: Alignment with EN 10021:2006, *General technical delivery conditions for steel products*
11	Changed 2nd clause: Alignment with EN 10021:2006, *General technical delivery conditions for steel products*
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NOTE The technical changes referred to include the significant technical changes from the EN revised but is not a exhaustive list of all modifications from the previous version.	

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