INTERNATIONAL STANDARD

ISO 2892

Second edition
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Austenitic cast irons — Classification

Fontes austénitiques — Classification

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 2892 was prepared by Technical Committee ISO/TC 25, *Cast irons and pig irons*, Subcommittee SC 6, *High alloy cast irons*.

This second edition cancels and replaces the first edition (ISO 2892:1973), which has been technically revised.

This International Standard is one of a number that have been prepared by ISO/TC 25/SC 6 under the auspices of ISO/TC 25 for the family of cast irons. The Secretariats of ISO/TC 25 and ISO/TC 25/SC 6 are held by BSI; however, the funding and resources for the Secretariats are provided by the Cast Metals Federation in the United Kingdom.

Introduction

This International Standard deals with the classification of a range of cast irons, principally used for their heat resistance, corrosion resistance and low temperature properties, as well as for their special physical properties and wear properties.

The austenitic cast irons are a range of highly alloyed cast irons containing nickel, and, according to the grade: manganese, copper, chromium, niobium, and an elevated silicon content.

Carbon is present either as flake (lamellar) or spheroidal graphite and, in some grades, carbides.

Typical applications for the various grades are given in Annex A.

Austenitic cast irons — Classification

1 Scope

This International Standard specifies the grades of austenitic cast irons in terms of

— graphite form and matrix structure: either flake (lamellar) or spheroidal graphite in an austenitic matrix,

— chemical composition as given for each of the grades, and

— mechanical properties obtained from separately cast samples.

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.

ISO 148-3:—[1)], *Metallic materials — Charpy pendulum impact test — Part 3: Preparation and characterization of Charpy V-notch test pieces for indirect verification of pendulum impact machines*

ISO/TR 15931, *Designation system for cast irons and pig irons*

ISO 6892, *Metallic materials — Tensile testing — Method of testing at ambient temperature*

3 Terms and definitions

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

3.1
austenitic cast iron
cast material with an austenitic matrix which is iron and carbon based and alloyed with nickel and manganese, copper and/or chromium in order to stabilize the austenitic structure at room temperature

NOTE The graphite can be present in flake (lamellar) or spheroidal form.

3.2
graphite spheroidizing treatment
process which brings the liquid iron into contact with a substance to produce graphite in the predominantly spheroidal (nodular) form during solidification

NOTE This process is only used for the spheroidal graphite grades.

1) To be published. (Revision of ISO 148-3:1998)

4 Designations

The material shall be designated by symbol, in accordance with the designations given in Tables 1 to 4.

NOTE 1 The symbols given in this International Standard comply with the guidance given in ISO TR 15931.

NOTE 2 According to the designation system given in ISO/TR 15931, the designations of the material grades have been changed. For comparison, see Annex D.

5 Order information

The following information shall be supplied by the purchaser:

a) the complete designation of the material;

b) any special requirements that have been agreed upon between the manufacturer and the purchaser by the time of acceptance of the order.

6 Manufacture

The method of producing austenitic cast iron and any heat treatment, unless otherwise specified by the purchaser, shall be left to the discretion of the manufacturer. The manufacturer shall ensure that the requirements of this International Standard are met for the material grade specified in the order.

7 Requirements

7.1 Chemical composition

7.1.1 The chemical composition of the grades of austenitic cast iron shall be in accordance with Table 1 for engineering grades and Table 2 for special purpose grades.

NOTE Unless otherwise specified, other elements may be present, at the discretion of the manufacturer, provided that they do not alter the structure or adversely affect the properties.

7.1.2 If the presence of any element specified in Tables 1 and 2 is required outside the limits indicated, or, if any other elements are required, their content shall be agreed between the manufacturer and the purchaser, and specified in the order.

Table 1 — Chemical composition of austenitic cast irons — Engineering grades

Graphite form	Material designation	Chemical composition in % (mass fraction)						
		C	Si	Mn	Ni	Cr	P	Cu
Flake (lamellar)	ISO 2892/JLA/XNi15Cu6Cr2	⩽ 3,0	1,0 to 2,8	0,5 to 1,5	13,5 to 17,5	1,0 to 3,5	⩽ 0,25	5,5 to 7,5
Spheroidal	ISO 2892/JSA/XNi20Cr2	⩽ 3,0	1,5 to 3,0	0,5 to 1,5	18,0 to 22,0	1,0 to 3,5	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi23Mn4	⩽ 2,6	1,5 to 2,5	4,0 to 4,5	22,0 to 24,0	⩽ 0,2	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi20Cr2Nb[a]	⩽ 3,0	1,5 to 2,4	0,5 to 1,5	18,0 to 22,0	1,0 to 3,5	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi22	⩽ 3,0	1,5 to 3,0	1,5 to 2,5	21,0 to 24,0	⩽ 0,5	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi35	⩽ 2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	⩽ 0,2	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi35Si5Cr2	⩽ 2,0	4,0 to 6,0	0,5 to 1,5	34,0 to 36,0	1,5 to 2,5	⩽ 0,08	⩽ 0,5

NOTE In some cases, the elevated temperature strength can be improved by the addition of Mo (see Table A.1).

[a] Good weldability of this material with: % Nb ⩽ [0,353 - 0,032 (% Si + 64 x % Mg)]. The normal range of Nb is 0,12 % to 0,20 %.

Table 2 — Chemical composition of austenitic cast irons — Special purpose grades

Graphite form	Material designation	Chemical composition in % (mass fraction)						
		C	Si	Mn	Ni	Cr	P	Cu
Flake (lamellar)	ISO 2892/JLA/XNi13Mn7	⩽ 3,0	1,5 to 3,0	6,0 to 7,0	12,0 to 14,0	⩽ 0,2	⩽ 0,25	⩽ 0,5
Spheroidal	ISO 2892/JSA/XNi13Mn7	⩽ 3,0	2,0 to 3,0	6,0 to 7,0	12,0 to 14,0	⩽ 0,2	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi30Cr3	⩽ 2,6	1,5 to 3,0	0,5 to 1,5	28,0 to 32,0	2,5 to 3,5	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi30Si5Cr5	⩽ 2,6	5,0 to 6,0	0,5 to 1,5	28,0 to 32,0	4,5 to 5,5	⩽ 0,08	⩽ 0,5
	ISO 2892/JSA/XNi35Cr3	⩽ 2,4	1,5 to 3,0	1,5 to 2,5	34,0 to 36,0	2,0 to 3,0	⩽ 0,08	⩽ 0,5

NOTE In some grades, the elevated temperature strength can be improved by the addition of Mo.

7.2 Mechanical properties

7.2.1 The mechanical properties of the grades of austenitic cast iron shall be obtained from separately cast test samples and shall be in accordance with Table 3 for engineering grades and Table 4 for special purpose grades.

In exceptional cases, by agreement between the manufacturer and the purchaser, the mechanical properties may be obtained from cast-on samples.

NOTE Austenitic cast irons are suitable for pressure applications

Table 3 — Mechanical properties of austenitic cast irons — engineering grades

Graphite form	Material designation	Tensile strength R_m N/mm² min.	0,2 % proof stress $R_{p0,2}$ N/mm² min.	Elongation A % min.	Mean impact value on 3 tests Charpy V-notch J min.
Flake (lamellar)	ISO 2892/JLA/XNi15Cu6Cr2	170	—	—	—
Spheroidal	ISO 2892/JSA/XNi20Cr2	370	210	7	13 [a]
	ISO 2892/JSA/XNi23Mn4	440	210	25	24
	ISO 2892/JSA/XNi20Cr2Nb [b]	370	210	7	13 [a]
	ISO 2892/JSA/XNi22	370	170	20	20
	ISO 2892/JSA/XNi35	370	210	20	—
	ISO 2892/JSA/XNi35Si5Cr2	370	200	10	—

[a] Optional requirement, by agreement between the manufacturer and the purchaser.

[b] Good weld ability of this material with % Nb ⩽ [0,353 – 0,032 (% Si + 64 x % Mg)]. The normal range of Nb is 0,12% to 0,20%.

Table 4 — Mechanical properties of austenitic cast irons — special purpose grades

Graphite form	Material designation	Tensile strength R_m N/mm^2 min.	0,2% proof stress $R_{p0,2}$ N/mm^2 min.	Elongation A % min.	Mean impact value on 3 tests V-notch J min.
Flake (lamellar)	ISO 2892/JLA/XNi13Mn7	140	—	—	—
Spheroidal	ISO 2892/JSA/XNi13Mn7	390	210	15	16
	ISO 2892/JSA/XNi30Cr3	370	210	7	—
	ISO 2892/JSA/XNi30Si5Cr5	390	240	—	—
	ISO 2892/JSA/XNi35Cr3	370	210	7	—

7.2.2 Test pieces shall be taken from one of the samples given in Figure 1, 2, 3 or 6.

Where the purchaser requires the mechanical properties to be taken from the casting or from cast-on samples, then their location and properties shall be agreed between the manufacturer and purchaser and shall be specified on the order.

The mechanical properties given in Tables 3 and 4 apply to the Type II (II a and II b) sample highlighted in Figures 1 and 2, and also to the sample given in Figure 3. Where other sizes of samples are requested, the mechanical properties shall be agreed upon between the manufacturer and the purchaser by the time of the acceptance of the order.

7.3 Heat treatment

The castings shall be supplied either as cast or heat-treated at the discretion of the manufacturer, or, if so required by the user, by agreement between the manufacturer and the purchaser.

NOTE Annex B (informative) gives details of typical heat treatments that can be applied.

8 Characteristics and applications

A summary of properties for each grade of material and the uses for which each is recommended is given in Table A.1.

For information purposes only, more detailed information on the typical mechanical and physical properties is given for each grade in Tables C.1 and C.2. Table C.3 gives mechanical property data for grade ISO 2892/JSA/XNi23Mn4 at low temperatures down to −196 °C.

Where particular physical or mechanical properties are required, this shall be stated on the order, and form the subject of an agreement between the manufacturer and the purchaser.

NOTE Typical applications for which each grade may be used are given in Table A.1.

9 Sampling

9.1 General

Samples shall be provided to represent the casting(s) produced.

Samples shall be made from the same material as that used to produce the casting(s) which they represent.

Several types of sample (separately cast samples, cast-on samples, samples cut from a casting) can be used, depending on the mass and wall thickness of the casting. When the mass of the casting exceeds 2 000 kg and its thickness exceeds 200 mm, cast-on samples or samples cut from a casting should preferably be used.

9.2 Separately cast samples

9.2.1 Frequency and number of tests

Samples representative of the material shall be produced at a frequency in accordance with the in-process quality assurance procedures adopted by the manufacturer.

In the absence of an in-process quality assurance procedure or any other agreement between the manufacturer and the purchaser, a minimum of one tensile test shall be carried out to confirm the material, at a frequency to be agreed upon between the manufacturer and the purchaser by the time of acceptance of the order.

When impact tests are agreed upon by the time of acceptance of the order, samples shall be produced at a frequency to be agreed upon between the manufacturer and the purchaser.

9.2.2 Samples

The samples shall be cast separately in sand moulds at the same time as the castings and under representative manufacturing conditions. The moulds used to cast the separately cast samples shall have comparable thermal behaviour to the moulding material used to cast the castings.

It is an option of the manufacturer to use an adequate running system which reproduces conditions similar to those of the castings.

The samples shall meet the requirements of Figure 1, 2, 3 or 6.

The samples shall be removed from the mould at a temperature similar to that at which the castings are removed.

If the graphite spheroidizing treatment is carried out in the mould (in-mould method), the samples shall be

— either cast alongside the castings, with a joint running system, or

— cast separately, using a similar treatment method in the sample mould as the method used to produce the castings.

Where applicable, the samples shall be given the same heat treatment as the castings which they represent.

The tensile test piece shown in Figure 4 and, if applicable, the impact test piece shown in Figure 5 shall be machined from a sample shown in Figure 1 or 2 (hatched part) or from the sample shown in Figure 3. Unless otherwise agreed, the choice of the option is left to the discretion of the manufacturer.

Samples for chemical analysis shall be cast in a manner which ensures that the accurate chemical composition can be determined.

10 Testing

10.1 Chemical analysis

The methods used to determine the chemical composition of the material shall be in accordance with recognized standards. Any requirement for traceability shall be agreed upon between the manufacturer and the purchaser by the time of acceptance of the order.

NOTE Spectrographic, X-ray or wet chemical laboratory techniques are acceptable methods of analysis.

10.2 Tensile test

The tensile test shall be carried out in accordance with ISO 6892.

The tensile test piece shall conform to the dimensions given in Figure 4 and shall be machined from the hatched section of one of the samples shown in Figure 1, 2, 3 or 6. Unless otherwise agreed, the selection of the sample type and option shall be left to the discretion of the manufacturer.

If, for technical reasons, it is necessary to use a tensile test piece having a different diameter to that specified in Figure 4, its original gauge length shall conform to the following formula:

$$L_0 = 5{,}65 \times \sqrt{S_0} = 5 \times d$$

where

L_0 is the original gauge length;

S_0 is the original cross-sectional area of the test piece;

d is the diameter of the test piece along the gauge length.

10.3 Impact test

Where applicable, the impact test shall be carried out on three Charpy V-notched impact test pieces in accordance with ISO 148-3.

NOTE 1 Annex C gives information on other properties.

NOTE 2 Annex D gives cross-references to other standards.

11 Retests

11.1 Need for retests

Retests shall be carried out if a test is not valid (see 11.2).

Retests are permitted to be carried out if a test result does not meet the mechanical property requirements for the specified grade (see 11.3).

11.2 Test validity

A test is not valid in the following cases:

a) a faulty mounting of the test piece or defective operation of the test machine;

b) a defective test piece because of incorrect pouring or incorrect machining;

c) a fracture of the tensile test piece outside the gauge length;

d) a casting defect in the test piece, evident after fracture.

In the above cases, a new test piece shall be taken from the same sample or from a duplicate sample cast at the same time to replace those invalid test results.

11.3 Nonconforming test results

If any test gives results which do not conform to the specified requirements, for reasons other than those given in 11.2, the manufacturer shall have the option to conduct retests. If the manufacturer conducts retests, two retests shall be carried out for each failed test.

If the results of both retests meet the specified requirements, the material shall be deemed to conform to this International Standard.

If the results of one or both retests fail to meet the specified requirements, the material shall be deemed not to conform to this International Standard.

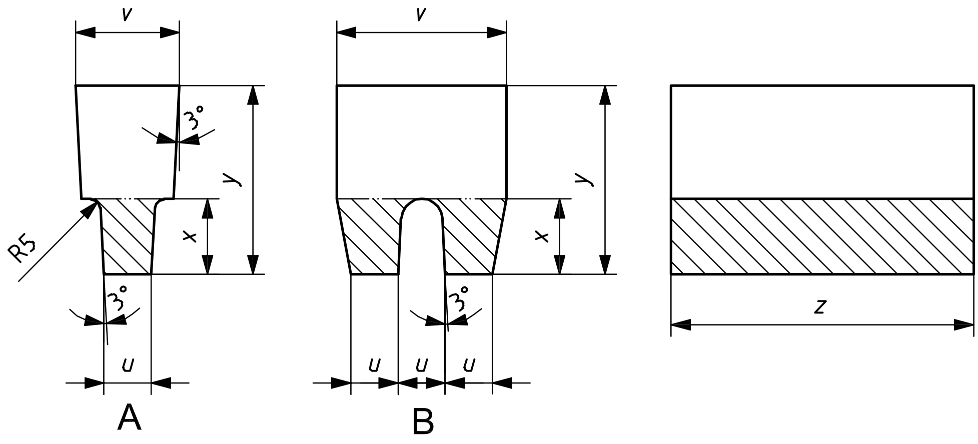
11.4 Heat treatment of samples and castings

Unless otherwise specified, in the case of castings in the as-cast condition with mechanical properties not in conformance with this International Standard, a heat treatment may be carried out.

In the case of castings which have undergone a heat treatment and for which the test results are not satisfactory, the manufacturer shall be permitted to re-heat-treat the castings and the representative samples. In this event, the samples shall receive the same number of heat treatments as the castings.

If the results of the tests carried out on the test pieces machined from the re-heat-treated samples are satisfactory, then the re-heat-treated castings shall be regarded as conforming to this International Standard.

The number of re-heat treatment cycles shall not exceed two.



Key

A Types I, II a, III and IV

B Type II b

Dimensions in millimetres

Dimension	Type				
	I	**II a**	**II b**	**III**	**IV**
u	12,5	25	25	50	75
v	40	55	90	90	125
x	30	40	40 or 50	60	65
y [a]	80	100	100	150	165
z [b]	A function of the test piece length				

[a] For information only.

[b] z shall be chosen to allow a test piece of the dimensions shown in Figure 4 to be machined from the sample.

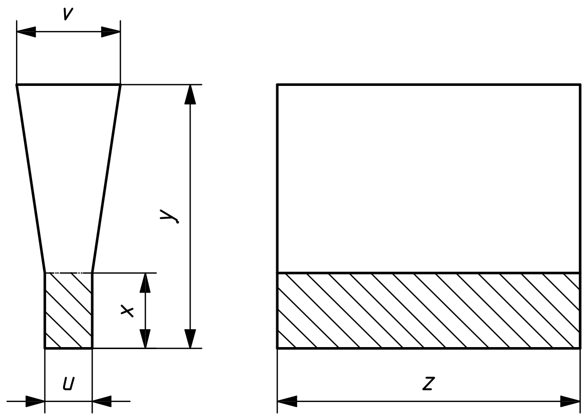
The thickness of the sand mould surrounding the samples shall be:

— 40 mm minimum for Types I, II a and II b;

— 80 mm minimum for Types III and IV.

NOTE For the manufacture of thin-walled castings or castings in metal moulds, the tensile properties may, by agreement between the manufacturer and the purchaser, be determined on test pieces taken from samples of thickness u less than 12,5 mm.

Figure 1 — Separately cast samples (option 1)



Dimensions in millimetres

Dimension	Type			
	I	II	III	IV
u	12,5	25	50	75
v	40	55	100	125
x	25	40	50	65
y [a]	135	140	150	175
z [b]	A function of the test piece length			

[a] For information only.

[b] *z* shall be chosen to allow a test piece of the dimensions shown in Figure 4 to be machined from the sample.

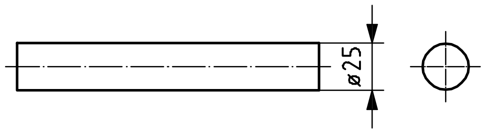
The thickness of the sand mould surrounding the samples shall be:

- 40 mm minimum for Types I, II a and II b;
- 80 mm minimum for Types III and IV.

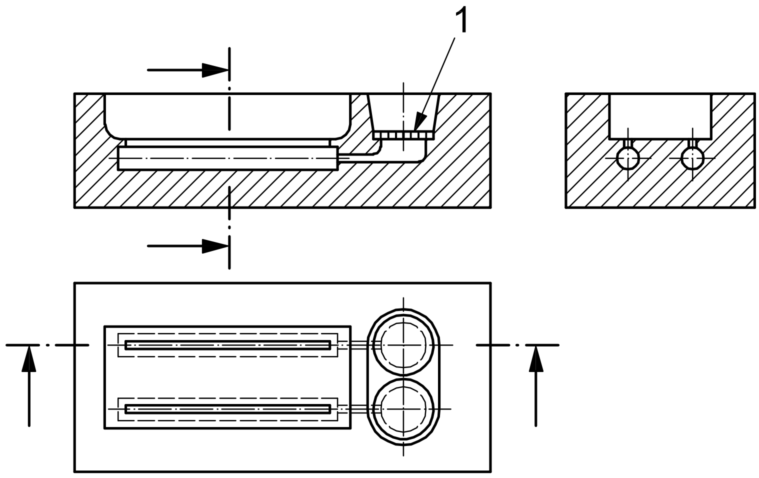
NOTE For the manufacture of thin-walled castings or castings in metal moulds, the tensile properties may, by agreement between the manufacturer and the purchaser, be determined on test pieces taken from samples of thickness *u* less than 12,5 mm.

Figure 2 — Separately cast sample (option 2)

Dimensions in millimetres



a) Sample

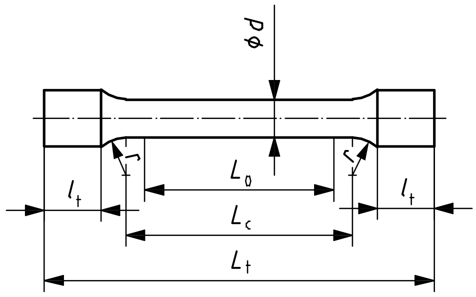


b) Schematic representation of the type of mould

Key

1 ceramic filter

Figure 3 — Separately cast sample (option 3)



Key

L_0 original gauge length, i.e. $L_0 = 5 \times d$

d diameter of the test piece along the gauge length

L_c parallel length; $L_c > L_0$ (in principle, $L_c - L_0 > d$)

L_t total length of the test piece, which depends on L_0 and L_c

Dimensions in millimetres

d	L_0	L_c [a] min.
5	25	30
7	35	42
10	50	60
14 [b]	70	84
20	100	120

[a] In principle.

[b] Preferred dimension.

NOTE The method of gripping the ends of the test piece, together with their length l_t, may be agreed upon between the manufacturer and the purchaser.

Figure 4 — Tensile test piece

Dimensions in millimetres

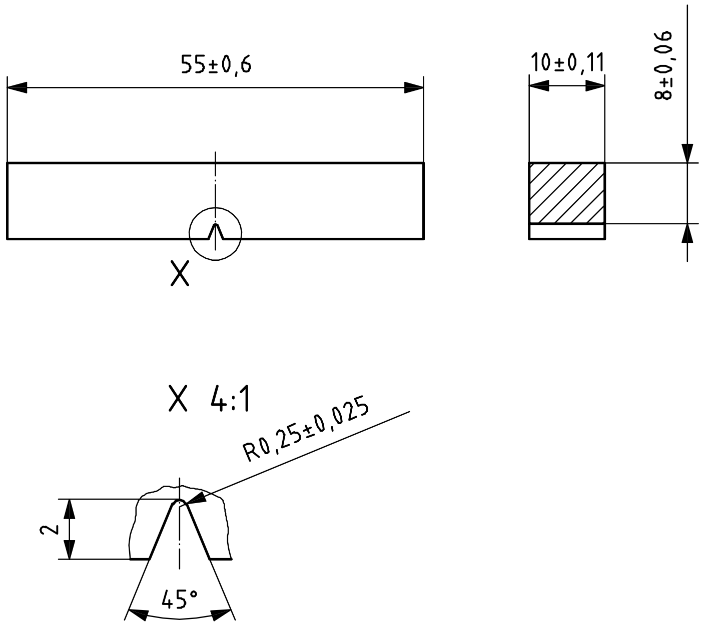
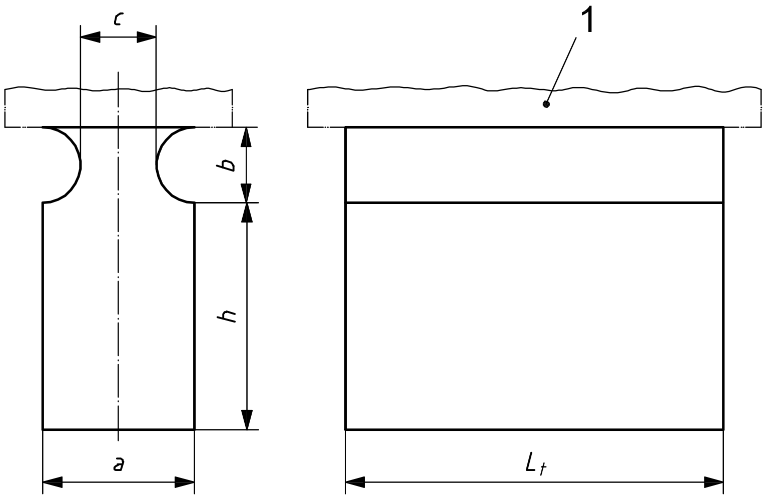


Figure 5 — Charpy V-notched impact test piece



Sample

Key

1 casting (or running system)

Dimensions in millimetres

Type	Relevant wall thickness of the casting t	a	b max.	c min.	h	L_t
A	$t \leqslant 12,5$	15	11	7,5	20 to 30	a
B	$12,5 < t \leqslant 30$	25	19	12,5	30 to 40	a
C	$30 < t \leqslant 60$	40	30	20	40 to 65	a
D	$60 < t \leqslant 200$	70	52,5	35	65 to 105	a

[a] L_t shall be chosen to allow a test piece of a dimension shown in Figure 4 to be machined from the sample.

The type of sample (A to D) shall be chosen in such a way as to provide approximately the same cooling conditions as for the casting to be represented.

Unless otherwise agreed, the manufacturer shall decide on the type of sample and it shall be located at a representative position on the casting.

NOTE If smaller dimensions are agreed upon between the manufacturer and the purchaser, the following relationships apply:

$$b = 0,75 \times a \text{ and } c = \frac{a}{2}$$

Figure 6 — Cast-on sample

Annex A
(informative)

Properties and applications of the austenitic cast-iron grades

Table A.1 — Properties and applications of the austenitic cast-iron grades

Material designation	Properties	Applications
Engineering grades		
ISO 2892/JLA/XNi15Cu6Cr2	Good corrosion resistance, particularly to alkalis, dilute acids, sea water and salt solutions; improved heat resistance, good bearing properties, high expansion coefficient, non-magnetisable with low chromium content.	Pumps, valves, furnace components, bushings, seatings for piston rings, non-magnetisable castings.
ISO 2892/JSA/XNi20Cr2	Good corrosion and heat resistance. Good bearing properties, high coefficient of thermal expansion. Non-magnetisable with low chromium content. Increased high-temperature resistance if 1 % Mo (mass fraction) is added.	Pumps, valves, compressors, bushings, turbocharger housings, exhaust gas manifolds. Non-magnetisable castings.
ISO 2892/JSA/XNi23Mn4	Particularly high ductility. Remains tough down to –196 °C. Non-magnetisable.	Castings for refrigeration engineering for use down to –196 °C.
ISO 2892/JSA/XNi20Cr2Nb	Suitable for production welding, the other properties being as for ISO 2892/JSA/XNi20Cr2.	As for ISO 2892/JSA/XNi20Cr2.
ISO 2892/JSA/XNi22	High ductility. Lower corrosion and heat resistance than ISO 2892/JSA/XNi20Cr2. High expansion coefficient. Remains tough down to –100 °C. Non-magnetisable.	Pumps, valves, compressors, bushings, turbocharger housings. Exhaust gas manifolds, non-magnetisable castings.
ISO 2892/JSA/XNi35	Lowest thermal expansion coefficient of all cast irons. Resistant to thermal shock.	Parts with dimensional stability for machine tools, scientific instruments. Moulds for glass.
ISO 2892/JSA/XNi35Si5Cr2	Especially heat resistant. Higher ductility and higher creep strength than ISO 2892/JSA/XNi35Cr3. Creep strength is improved when 1 % Mo (mass fraction) is added.	Gas turbine housing castings, exhaust gas manifolds, turbocharger housings.

Table A.1 (*continued*)

Material designation	Properties	Applications
Special purpose grades		
ISO 2892/JLA/XNi13Mn7	Non-magnetisable.	Non-magnetisable castings, e.g. covers for turbine generator sets, housings for switchgear, insulator flanges, terminals, ducts.
ISO 2892/JSA/XNi13Mn7	Non-magnetisable, similar to ISO/JLA/XNi13Mn7 but with improved mechanical properties.	Non-magnetisable castings, e.g. covers for turbine generator sets, housings for switchgear, insulator flanges, terminals, ducts.
ISO 2892/JSA/XNi30Cr3	Mechanical properties similar to ISO2892/JSA/XNi20Cr2Nb, but better corrosion and heat resistance, intermediate expansion coefficient, particular resistance to thermal shock and good high-temperature resistance when 1 % Mo (mass fraction) is added.	Pumps, boilers, valves, filter parts, exhaust manifolds, turbocharger housings.
ISO 2892/JSA/XNi30Si5Cr5	Particularly high corrosion, erosion and heat resistance. Intermediate expansion coefficient.	Pumps, fittings, exhaust manifolds, turbocharger housings and castings for industrial furnaces.
ISO 2892/JSA/XNi35Cr3	Similar to ISO 2892/JSA/XNi35 but with improved high-temperature resistance particularly when 1 % Mo (mass fraction) is added.	Gas turbine housing parts. Moulds for glass.

Annex B
(informative)

Heat treatment

B.1 Stress relief

B.1.1 Application of stress relieving treatments

Stress relief can be applied to all grades of austenitic cast iron, but is particularly recommended under the following conditions:

a) when the casting is of such complexity that excessive residual casting stresses can be expected which could lead to dimensional changes during machining or in service;

b) when castings are intended for operation under conditions when stress corrosion cracking might otherwise occur: for example, when handling warm saline or highly alkaline solutions;

c) when it can be advantageous to carry out stress relieving after rough machining.

B.1.2 Recommended heat treatment method

The recommended stress-relief heat treatment is as follows:

a) heat up to between 625 °C and 650 °C at a rate not exceeding 150 K/h;

b) hold within this temperature range for 2 h plus 1 h, per 25 mm section thickness;

c) cool down to 200 °C in the furnace, at a rate not exceeding 100 K/h;

d) air cool.

B.1.3 Heat treatment for high-temperature stability

Where austenitic iron castings are used for a static or cyclic elevated temperature service at 500 °C or above, and where it is essential that close dimensional tolerances are held, a high-temperature structural stabilising heat treatment can be given.

The recommended high-temperature stabilising heat treatment is as follows:

a) heat up to between 875 °C and 900 °C at a rate not exceeding 150 K/h;

b) hold within this temperature range for 2 h plus 1 h, per 25 mm section thickness;

c) cool down to 500 °C in the furnace, at a rate not exceeding 50 K/h.

d) air cool.

Annex C
(informative)

Additional mechanical and physical properties

C.1 Data

C.1.1 Engineering grades of austenitic cast iron

Table A.1 gives the typical applications and some of the characteristics.

Table C.1 gives typical mechanical properties.

Table C.2 gives typical physical properties.

Table C.4 gives typical mechanical properties at elevated temperatures.

C.1.2 Special-purpose grades of austenitic cast iron

Table A.1 gives typical applications and some of the characteristics.

Table C.1 gives typical mechanical properties.

Table C.2 gives typical physical properties.

Table C.3 gives typical mechanical properties of grade ISO 2892/JSA/XNi23Mn4 at low temperatures (0 to –196 °C).

Table C.4 gives typical mechanical properties at elevated temperatures.

Table C.1 — Examples of values for mechanical properties of engineering and special purpose grades

Grade	Material designation	Tensile strength N/mm²	Compression strength N/mm²	0,2 % proof stress N/mm²	Elongation %	Charpy V impact resistance value J	Modulus of elasticity KN/mm²	Brinell hardness HBW
Engineering	ISO 2892/JLA/XNi15Cu6Cr2	170 to 210	700 to 840	—	2	—	85 to 105	120 to 215
	ISO 2892/JSA/XNi20Cr2	370 to 480	—	210 to 250	7 to 20	11 to 24	112 to 130	140 to 255
	ISO 2892/JSA/XNi23Mn4	440 to 480	—	210 to 240	25 to 45	20 to 30	120 to 140	150 to 180
	ISO 2892/JSA/XNi20Cr2Nb	370 to 480	—	210 to 250	8 to 20	11 to 24	112 to 130	140 to 200
	ISO 2892/JSA/XNi22	370 to 450	—	170 to 250	20 to 40	17 to 29	85 to 112	130 to 170
	ISO 2892/JSA/XNi35	370 to 420	—	210 to 240	20 to 40	18	112 to 140	130 to 180
	ISO 2892/JSA/XNi35Si5Cr2	380 to 500	—	210 to 270	10 to 20	7 to 12	130 to 150	130 to 170
Special purpose	ISO 2892/JLA/XNi13Mn7	140 to 220	630 to 840	—	—	—	70 to 90	120 to 150
	ISO 2892/JSA/XNi13Mn7	390 to 470	—	210 to 260	15 to 18	15 to 25	140 to 150	120 to 150
	ISO 2892/JSA/XNi30Cr3	370 to 480	—	210 to 260	7 to 18	5	92 to 105	140 to 200
	ISO 2892/JSA/XNi30Si5Cr5	390 to 500	—	240 to 310	1 to 4	1 to 3	90	170 to 250
	ISO 2892/JSA/XNi35Cr3	370 to 450	—	210 to 290	7 to 10	4	112 to 123	140 to 190

Table C.2 — Examples of values for physical properties of engineering and special purpose grades

Grade	Material designation	Density kg/dm³	Linear expansion coefficient (between 20 °C and 200 °C) µm/(m·K)	Thermal conductivity W/(m·K)	Specific heat capacity J/(g·K)	Resistivity µΩ·m	Permeability (where H = 79,58 A/cm)
Engineering	ISO 2892/JLA/XNi15Cu6Cr2	7,3	18,7	39,00	46 to 50	1,6	1,03
	ISO 2892/JSA/XNi20Cr2	7,4 to 7,45	18,7	12,60	46 to 50	1,0	1,05
	ISO 2892/JSA/XNi23Mn4	7,45	14,7	12,60	46 to 50	—	1,02
	ISO 2892/JSA/XNi20Cr2Nb	7,40	18,7	12,60	46 to 50	1,0	1,04
	ISO 2892/JSA/XNi22	7,40	18,40	12,60	46 to 50	1,0	1,02
	ISO 2892/JSA/XNi35	7,60	5,0	12,60	46 to 50	—	— [a]
	ISO 2892/JSA/XNi35Si5Cr2	7,45	15,10	12,60	46 to 50	—	— [a]
Special purpose	ISO 2892/JLA/XNi13Mn7	7,40	17,70	39,00	46 to 50	1,2	1,02
	ISO 2892/JSA/XNi13Mn7	7,30	18,20	12,60	46 to 50	1,0	1,02
	ISO 2892/JSA/XNi30Cr3	7,45	12,60	12,60	46 to 50	—	— [a]
	ISO 2892/JSA/XNi30Si5Cr5	7,45	14,40	12,60	46 to 50	—	1,10
	ISO 2892/JSA/XNi35Cr3	7,70	5,0	12,60	46 to 50	—	— [a]

[a] These grades are ferro-magnetic.

Table C.3 — Examples of values for low temperature mechanical properties of ISO2892/JSA/XNi23Mn4

Temperature °C	Tensile strength R_m N/mm²	0,2% proof stress $R_{p0,2}$ N/mm²	Elongation A %	Reduction in area after fracture %	Charpy V impact resistance value [a] J
+ 20	450	220	35	32	29
0	450	240	35	32	31
− 50	460	260	38	35	32
− 100	490	300	40	37	34
− 150	530	350	38	35	33
− 183	580	430	33	27	29
− 196	620	450	27	25	27

[a] 1 J = 1 N·m.

Table C.4 — Examples of values for mechanical properties of spheroidal graphite austenitic cast-iron grades at elevated temperatures

Property	Unit	Temperature	Engineering grades		Special purpose grades		
		°C	ISO2892/JSA/XNi20Cr2 ISO2892/JSA/XNi20Cr2Nb	ISO2892/JSA/XNi22	ISO2892/JSA/XNi30Cr3	ISO2892/JSA/XNi30Si5Cr5	ISO2892/JSA/XNi35Cr3
Tensile strength R_m	N/mm²	20	417	437	410	450	427
		430	380	368	—	—	—
		540	335	295	337	426	332
		650	250	197	293	337	286
		760	155	121	186	153	175
0,2% proof stress $R_{p0,2}$	N/mm²	20	246	240	276	312	288
		430	197	184	—	—	—
		540	197	165	199	291	181
		650	176	170	193	239	170
		760	119	117	107	130	131
Elongation (accelerated test)	%	20	10,5	35	7,5	3,5	7
		430	12	23	—	—	—
		540	10,5	19	7,5	4	9
		650	10,5	10	7	11	6,5
		760	15	13	18	30	24,5
Creep strength (1 000 h)	N/mm²	540	197	148	—	—	—
		595	(127)	(95)	165	120	176
		650	84	63	(105)	(67)	105
		705	(60)	(42)	68	44	70
		760	(39)	(28)	(42)	(21)	(39)
Stress required to reach a minimum creep rate of 1 % per 1 000 h	N/mm²	540	162	91	—	—	(190)
		595	(92)	(63)	—	—	(112)
		650	56	40	—	—	(67)
		705	(34)	(24)	—	—	56
Stress required to reach a minimum creep rate of 1 % per 10 000 h	N/mm²	540	63	—	—	—	—
		595	(39)	—	—	—	70
		650	24	—	—	—	—
		705	(15)	—	—	—	39
Creep elongation (1 000 h)	%	540	6	14	—	—	—
		595	—	—	7	10,5	6,5
		650	13	13	—	—	—
		705	—	—	12,5	25	13,5

The values in brackets are interpolated or extrapolated.

Annex D
(informative)

Cross-references to other standards

Table D.1 — Cross-references to other standards

Graphite form	ISO 2892:2007	ISO 2892:1973	EN 13835	International trade name	ASTM A 436: 1984	ASTM A 571: 1984	BS 3468: 1962	BS 3468: 1986	NF A 32-301:1992	DIN 1694:1981
Flake (lamellar) graphite	ISO 2892/JLA/XNi13Mn7	L-NiMn 13 7	EN-GJL-AXNiMn13-7	Nomag					FGL Ni13 Mn 7	GGL-NiMn 13 7
	ISO 2892/JLA/XNi15Cu6Cr2	L-NiCuCr 15 6 2	EN-GJL-AXNiCuCr15-6-2	Ni-Resist 1	Type 1		AUS 101A	F1	FGL Ni15 Cu6 Cr2	GGL-NiCuCr 15 6 2
	—	L-NiCuCr 15 6 3	—	Ni-Resist 1b	Type 1b		AUS 101B	F1	FGL Ni15 Cu6 Cr3	GGL-NiCuCr 15 6 3
	—	L-NiCr 20 2	—	Ni-Resist 2	Type 2		AUS 102A	F2	FGL Ni20 Cr2	GGL-NiCr 20 2
	—	L-NiCr 20 3	—	Ni-Resist 2b	Type 2b		AUS 102B	F2	FGL Ni20 Cr3	GGL-NiCr 20 3
	—	L-NiSiCr 20 5 3	—				AUS 104		FGL Ni20 Si5 Cr3	GGL-NiSiCr 20 5 3
	—	L-NiCr 30 3	—	Ni-Resist 3	Type 3		AUS 105	F3	FGL Ni30 Cr3	GGL-NiCr 30 3
	—	L-NiSiCr 30 5 5	—		Type 4				FGL Ni30 Si5 Cr5	GGL-NiSiCr 30 5 5
	—	L-Ni35	—		Type 5				FGL Ni35	
Spheroidal graphite	ISO 2892/JSA/XNi13Mn7	S-NiMn 13 7	EN-GJS-AXNiMn13-7	Nodumag				S6	FGS Ni13 Mn7	GGG-NiMn13 7
	ISO 2892/JSA/XNi20Cr2	S-NiCr 20 2	EN-GJS-AXNiCr20-2	Ni-Resist D-2		D2	AUS 202A	S2	FGS Ni20 Cr2	GGG-NiCr 20 2
	ISO 2892/JSA/XNi20Cr2Nb		EN-GJS-AXNiCrNb20-2					S2W	FGS Ni20 Cr2 Nb 0,15	GGG-NiCrNb 20 2
	—	S-NiCr 20 3	—			D2B	AUS 202B	S2B	FGS Ni20 Cr3	GGG-NiCr 20 3
	—		—	Nicrosilal spheronic					FGS Ni20 Si5 Cr2	GGG-NiSiCr 20 5 2
	ISO 2892/JSA/XNi22	S-Ni 22	EN-GJS-AXNi22	Ni-Resist D-2C		D2C	AUS 203	S2C	FGS Ni22	GGG-Ni 22
	ISO 2892/JSA/XNi23Mn4	S-NiMn 23 4	EN-GJS-AXNiMn23-4	Ni-Resist D-2M		D2M [a]		S2M	FGS Ni23 Mn4	GGG-NiMn 23 4
	—	S-NiCr 30 1	—	Ni-Resist D-3A		D3A			FGS Ni30 Cr1	GGG-NiCr 30 1

Table D.1 (*continued*)

Graphite form	ISO 2892:2007	ISO 2892:1973	EN 13835	International trade name	ASTM A 436: 1984	ASTM A 571: 1984	BS 3468: 1962	BS 3468: 1986	NF A 32-301:1992	DIN 1694:1981
Spheroidal graphite	ISO 2892/JSA/XNi30Cr3	S-NiCr 30 3	EN-GJS-AXNiCr30-3	Ni-Resist D-3		D3	AUS 205	S3	FGS Ni30 Cr3	GGG-NiCr 30 3
	—		—						FGS Ni30 Si5 Cr2	GGG-NiSiCr 30 5 2
	ISO 2892/JSA/XNi30Si5Cr5	S-NiSiCr 30 5 5	EN-GJS-AXNiSiCr30-5-5	Ni-Resist D-4		D4			FGS Ni30 Si5 Cr5	GGG-NiSiCr 30 5 5
	ISO 2892/JSA/XNi35	S-Ni 35	EN-GJS-AXNi35	Ni-Resist D-5		D5			FGS Ni35	GGG-Ni 35
	ISO 2892/JSA/XNi35Cr3	S-NiCr 35 3	EN-GJS-AXNiCr35-3	Ni-Resist D-5B		D5B			FGS Ni35 Cr3	GGG-NiCr 35 3
	ISO 2892/JSA/XNi35Si5Cr2		EN-GJS-AXNiSiCr35-5-2	Ni-Resist D-5S		D5S		S5S	FGS Ni35 Si5 Cr2	GGG-NiSiCr 35 5 2

Annex E
(informative)

Testing

In determining the physical properties of austenitic cast irons, it is important to bear in mind that the casting skin will not normally exhibit the same properties as the core of the casting. This is particularly the case for electrical and magnetic properties.

It is therefore advisable to

— prepare samples which are sufficiently large to avoid casting rim zone effects;

— remove the casting rim zone with care;

— avoid subjecting the material to mechanical stresses so severe that it exhibits plastic deformation on the surface.

If plastic deformation occurs, the new rim zone could once again exhibit properties differing from the material in the sample.

It is advisable to produce a test piece of about 10 mm in diameter and 100 mm in length by careful machining (low cutting depth and low cutting speed) from a sample cut from a casting. This procedure avoids martensite formation which could seriously alter the test results. The test piece should then be carefully pickled to remove any traces of abraded ferromagnetic tool particles adhering to its surface.

Bibliography

[1] ISO 945-1:—[2)], *Designation of microstructure of cast irons — Part 1: Graphite classification by visual analysis*

2) To be published. (Revision of ISO 945:1975)

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