



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS G 5510 : 2012

(JFS/JSA)

Austenitic iron castings

ICS 77.140.80

Reference number : JIS G 5510 : 2012 (E)

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Date of Establishment: 1987-11-01

Date of Revision: 2012-01-20

Date of Public Notice in Official Gazette: 2012-01-20

Investigated by: Japanese Industrial Standards Committee
Standards Board
Technical Committee on Iron and Steel

JIS G 5510:2012, First English edition published in 2012-05

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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Printed in Japan

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Foundry Society (JFS)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 5510:1999** is replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, or utility model right. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, or utility model right.

Austenitic iron castings

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **ISO 2892** published in 2007 with some modifications of the technical contents.

The portions given dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies austenitic iron castings (hereafter referred to as “castings”).

This Standard specifies the grades of castings in terms of the following **a)** to **c)**.

- a) Graphite form and matrix structure (including either flake or spheroidal graphite in an austenitic matrix)
- b) Chemical composition as given for each of the grades
- c) Mechanical properties obtained from separately cast samples

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows:

ISO 2892:2007 *Austenitic cast irons—Classification* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0403 *Castings—System of dimensional tolerances and machining allowances*

JIS G 0201 *Glossary of terms used in iron and steel (Heat treatment)*

JIS G 0320 *Standard test method for heat analysis of steel products*

JIS Z 2241 *Metallic materials—Tensile testing—Method of test at room temperature*

NOTE : Corresponding International Standard: ISO 6892-1 *Metallic materials—Tensile testing—Part 1: Method of test at room temperature* (MOD)

JIS Z 2242 *Method for Charpy pendulum impact test of metallic materials*

JIS Z 8401 *Guide to the rounding of numbers*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS G 0201** and the following apply.

3.1 austenitic iron castings

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, and in which the graphite is present in flake or spheroidal form

3.2 graphite spheroidizing treatment

process which brings the liquid iron in contact with a substance to produce graphite in the predominantly spheroidal form (process in which the spheroidizing agent is added to the liquid iron to spheroidize the crystallized graphite)

3.3 matrix

main parts of alloy structure, in which small quantity of other structures, deposited or crystallized, are dispersed

It refers to, for example, the main part of a cast iron where graphite is dispersed.

3.4 cavity

generic term for defects that are hollows generated in castings

Cavities are classified into shrinkage cavities generated at parts where solidification was delayed due to density difference between liquid and solid, small air holes that are gas absorbed in metal during melting and remained through solidification without being discharged into air, and blowholes (inclusion cavity).

3.5 separately cast sample

sample which is prepared separately from the castings, by casting with the mould having the comparable thermal behaviour to the castings and under the same conditions as the castings

3.6 cast-on sample

sample prepared by casting with a mould having the comparable thermal behaviour to the castings attached on a prescribed position of the casting or in the runner system

3.7 in-mould treatment (in-mould technique)

graphite spheroidizing treatment of castings in which molten metal is spheroidized inside the casting mould by being poured into the mould by way of a reaction chamber containing magnesium alloy installed within the runner inside the mould

4 Symbol of grade and graphite form

The castings are classified into 19 grades, and the symbols of these grades and graphite forms are shown in table 1.

A cross-reference table comparing grade symbols of **JIS** to those of International Standards and foreign standards is given in Annex D.

Table 1 Symbols of grades and graphite forms

Graphite form	Symbol of grade
Flake	FCA-NiMn 13 7
	FCA-NiCuCr 15 6 2
	FCA-NiCuCr 15 6 3
	FCA-NiCr 20 2
	FCA-NiSiCr 20 5 3
	FCA-NiSiCr 30 5 5
	FCA-Ni 35
Spheroidal	FCDA-NiMn 13 7
	FCDA-NiCr 20 2
	FCDA-NiCrNb 20 2
	FCDA-NiCr 20 3
	FCDA-Ni 22
	FCDA-NiMn 23 4
	FCDA-NiCr 30 1
	FCDA-NiCr 30 3
	FCDA-NiSiCr 30 5 5
	FCDA-Ni 35
	FCDA-NiCr 35 3
	FCDA-NiSiCr 35 5 2

5 Order information

The following information shall be supplied by the purchaser to the manufacturer.

- a) The grade of material of the castings as shown in table 1.
- b) Any special requirements that have been agreed upon between the manufacturer and the purchaser.

6 Responsibility of the manufacturer

The method of producing castings 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 Standard are met for the material grade specified in the order.

7 Castings

7.1 Chemical composition

- a) The chemical composition of the grades of castings shall be in accordance with table 2 for flake graphite series and in accordance with table 3 for spheroidal graphite series when they are tested in accordance with 9.1.

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.

- b) If the presence of any other element than specified, such as molybdenum, is required, their content shall be agreed between the manufacturer and the purchaser.

Table 2 Chemical composition of flake graphite series

Unit: %

Symbol of grade	Chemical composition						
	C	Si	Mn	Ni	Cr	P	Cu
FCA-NiMn 13 7	3.0 max.	1.5 to 3.0	6.0 to 7.0	12.0 to 14.0	0.2 max.	0.25 max.	0.5 max.
FCA-NiCuCr 15 6 2	3.0 max.	1.0 to 2.8	0.5 to 1.5	13.5 to 17.5	1.0 to 3.5	0.25 max.	5.5 to 7.5
FCA-NiCuCr 15 6 3	3.0 max.	1.0 to 2.8	0.5 to 1.5	13.5 to 17.5	2.5 to 3.5	0.25 max.	5.5 to 7.5
FCA-NiCr 20 2	3.0 max.	1.0 to 2.8	0.5 to 1.5	18.0 to 22.0	1.0 to 2.5	0.25 max.	0.5 max.
FCA-NiSiCr 20 5 3	2.5 max.	4.5 to 5.5	0.5 to 1.5	18.0 to 22.0	1.5 to 4.5	0.25 max.	0.5 max.
FCA-NiSiCr 30 5 5	2.5 max.	5.0 to 6.0	0.5 to 1.5	29.0 to 32.0	4.5 to 5.5	0.25 max.	0.5 max.
FCA-Ni 35	2.4 max.	1.0 to 2.0	0.5 to 1.5	34.0 to 36.0	0.2 max.	0.25 max.	0.5 max.

Table 3 Chemical composition of spheroidal graphite series

Unit: %

Symbol of grade	Chemical composition						
	C	Si	Mn	Ni	Cr	P	Cu
FCDA-NiMn 13 7	3.0 max.	2.0 to 3.0	6.0 to 7.0	12.0 to 14.0	0.2 max.	0.08 max.	0.5 max.
FCDA-NiCr 20 2	3.0 max.	1.5 to 3.0	0.5 to 1.5	18.0 to 22.0	1.0 to 3.5	0.08 max.	0.5 max.
FCDA-NiCrNb 20 2 ^{a)}	3.0 max.	1.5 to 2.4	0.5 to 1.5	18.0 to 22.0	1.0 to 3.5	0.08 max.	0.5 max.
FCDA-NiCr 20 3	3.0 max.	1.5 to 3.0	0.5 to 1.5	18.0 to 22.0	2.5 to 3.5	0.08 max.	0.5 max.
FCDA-Ni 22	3.0 max.	1.5 to 3.0	1.5 to 2.5	21.0 to 24.0	0.5 max.	0.08 max.	0.5 max.
FCDA-NiMn 23 4	2.6 max.	1.5 to 2.5	4.0 to 4.5	22.0 to 24.0	0.2 max.	0.08 max.	0.5 max.
FCDA-NiCr 30 1	2.6 max.	1.5 to 3.0	0.5 to 1.5	28.0 to 32.0	1.0 to 1.5	0.08 max.	0.5 max.
FCDA-NiCr 30 3	2.6 max.	1.5 to 3.0	0.5 to 1.5	28.0 to 32.0	2.5 to 3.5	0.08 max.	0.5 max.
FCDA-NiSiCr 30 5 5	2.6 max.	5.0 to 6.0	0.5 to 1.5	28.0 to 32.0	4.5 to 5.5	0.08 max.	0.5 max.
FCDA-Ni 35	2.4 max.	1.5 to 3.0	0.5 to 1.5	34.0 to 36.0	0.2 max.	0.08 max.	0.5 max.
FCDA-NiCr 35 3	2.4 max.	1.5 to 3.0	1.5 to 2.5	34.0 to 36.0	2.0 to 3.0	0.08 max.	0.5 max.
FCDA-NiSiCr 35 5 2	2.0 max.	4.0 to 6.0	0.5 to 1.5	34.0 to 36.0	1.5 to 2.5	0.08 max.	0.5 max.
Note ^{a)} Good weldability of FCDA-NiCrNb 20 2 with: Nb ≤ 0.353 – 0.032 (%Si + 64 × %Mg). The normal range of Nb is 0.12 % to 0.20 %.							

7.2 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. If the castings are heat treated, their samples shall be heat treated in the same furnace and at the same time as the castings, and for the same number of times as the castings. Annex B gives details of typical heat treatments that can be applied.

7.3 Mechanical properties

- a) For the mechanical properties of the grades of castings obtained from separately cast samples, the tensile strength of flake graphite series shall be in accordance with table 4 and the tensile strength, proof stress, elongation and Charpy absorption energy of spheroidal graphite series shall be in accordance with table 5. The test pieces shall be taken from one of the samples as shown in figure 1 to figure 3. In exceptional cases, by agreement between the manufacturer and the purchaser, the mechanical properties may be obtained from cast-on samples.
- b) Where the purchaser requires the mechanical properties to be taken from the castings or from cast-on samples, then their location and properties shall be agreed between the manufacturer and purchaser.
- c) Where other samples are requested, the mechanical properties shall be agreed upon between the manufacturer and the purchaser.

Table 4 Tensile strength of flake graphite series

Unit: N/mm²

Symbol of grade	Tensile strength
FCA-NiMn 13 7	140 min.
FCA-NiCuCr 15 6 2	170 min.
FCA-NiCuCr 15 6 3	190 min.
FCA-NiCr 20 2	170 min.
FCA-NiSiCr 20 5 3	190 min.
FCA-NiSiCr 30 5 5	170 min.
FCA-Ni 35	120 min.

Table 5 Mechanical properties of spheroidal graphite series

Symbol of grade	Tensile strength N/mm ²	0.2 % proof stress N/mm ²	Elongation %	Charpy absorption energy ^{a), b)} J ^{c)}	
				V-notch	U-notch
FCDA-NiMn 13 7	390 min.	210 min.	15 min.	16 min.	—
FCDA-NiCr 20 2	370 min.	210 min.	7 min.	13 min. ^{d)}	16 min. ^{d)}
FCDA-NiCrNb 20 2	370 min.	210 min.	7 min.	13 min. ^{d)}	16 min. ^{d)}
FCDA-NiCr 20 3	390 min.	210 min.	7 min.	—	—
FCDA-Ni 22	370 min.	170 min.	20 min.	20 min.	24 min.
FCDA-NiMn 23 4	440 min.	210 min.	25 min.	24 min.	28 min.
FCDA-NiCr 30 1	370 min.	210 min.	13 min.	—	—
FCDA-NiCr 30 3	370 min.	210 min.	7 min.	—	—
FCDA-NiSiCr 30 5 5	390 min.	240 min.	—	—	—
FCDA-Ni 35	370 min.	210 min.	20 min.	—	—
FCDA-NiCr 35 3	370 min.	210 min.	7 min.	—	—
FCDA-NiSiCr 35 5 2	370 min.	200 min.	10 min.	—	—
Notes ^{a)} For the impact test where both V-notch and U-notch values are given in the table, one of the values shall be applied. Unless otherwise specified by agreement between the purchaser and the manufacturer, the V-notch test shall be performed. ^{b)} Calculate the average of three impact tests, and round it off to an integer according to JIS Z 8401. ^{c)} 1 J = 1 N·m ^{d)} Applied by agreement between the purchaser and the manufacturer.					

7.4 Physical properties or particular mechanical properties

Where physical or particular mechanical properties are required, this shall form the subject of an agreement between the manufacturer and the purchaser. Annex E gives the instructional notes on the procedure of taking test pieces for the physical properties measurement.

For information purposes only, more detailed information on the typical mechanical and physical properties for flake graphite series are given in tables C.1 and table C.2, respectively, and those for spheroidal graphite series are given in tables C.3 and C.4, respectively. Further, mechanical properties at low temperatures at +20 °C to -196 °C for grade FCDA-NiMn 23 4 are given in table C.5, and typical mechanical properties at high temperatures for spheroidal graphite series are given in table C.6.

7.5 Internal soundness

The castings shall be tested for internal soundness in accordance with 9.4, and in the result of the test, shall be free from cavities or the like detrimental to use.

The criteria of acceptance or rejection for the degree of the internal soundness of castings shall be as agreed between the manufacturer and the purchaser.