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## Nickel and nickel alloy castings

*Pièces moulées en nickel et alliages de nickel*

**iTeh STANDARD PREVIEW**  
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ISO 12725:2019

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## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 155, *Nickel and nickel alloys*.

This second edition cancels and replaces the first edition (ISO 12725:1997) which has been technically revised. The main changes compared with the previous edition are as follows:

- the normative references have been updated;
- [Clause 5](#), “General requirements for delivery”, has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Nickel and nickel alloy castings

## 1 Scope

This document specifies requirements for nickel and nickel alloy castings.

The grades specified represent types of alloys suitable for a broad range of application in a wide variety of corrosive and high temperature environments.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 6372, *Nickel and nickel alloys — Terms and definitions*

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

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6372 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

## 4 Alloy identification

For the purposes of this document, the principles for alloy identification are as given in [Annex A](#).

## 5 General requirements for delivery

### 5.1 Information to be supplied by the purchaser

The enquiry and order should include the following information.

- a) A description of the casting(s) by pattern number and/or drawing. When a pattern is supplied, a complete list of the pattern equipment should be included. When a drawing is not supplied, the casting is purchased on the basis of the pattern. In this case, the foundry shall not be responsible for the dimensions of the part.

NOTE Machining allowances, dimensional tolerances, and geometrical tolerances can be selected from ISO 8062-3.

All modifications to be made to the drawing, for the technical requirements of the manufacturer, shall be agreed between the manufacturer and the purchaser.

- b) The material standard, delivery condition and grade.

## 5.2 Additional information to be supplied

Where appropriate, the enquiry and order should include additional information, for example:

- a) any supplementary requirements in accordance with [Annex B](#);
- b) the non-destructive testing procedures to be used, the extent of the non-destructive testing and the acceptance criteria;
- c) the type of inspection document to be provided at the time of supply;
- d) the size of a test lot, (see [B.2.2](#));
- e) the procedures for marking (in accordance with [Clause 8](#)), machining, protection, packaging, loading, dispatching and the destination;
- f) the submission of sample castings for approval before production quantities are produced;
- g) the methods of statistical control to be used.

## 6 Manufacture

### 6.1 Melting

Nickel and nickel alloys shall be melted by the electric furnace process with or without separate refining, such as argon-oxygen decarburization (AOD) or by the vacuum induction melting process.

### 6.2 Heat treatment

Castings shall be heat treated in accordance with the procedures given in [Table 1](#).

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### 6.3 Welding

#### 6.3.1 General

Selection of welding material, which shall be compatible with the casting composition, is generally left to the discretion of the manufacturer. However, as a supplementary requirement, selection of weld material may be agreed between the manufacturer and the purchaser.

NOTE ISO 11970 gives terms and definitions used for welding purposes for steel castings.

#### 6.3.2 Restriction

Castings made from grades NC2000 and NC4030 shall not be welded.

## 7 Requirements

### 7.1 Composition

Materials shall conform to the chemical composition requirements given in [Table 2](#).

The methods of determination of the chemical composition shall be at the discretion of the manufacturer. However, in cases of dispute, the method specified in an appropriate document shall be used. If no International Standard exists, an analytical method appropriately validated and acceptable by the purchaser shall be used.

**Table 1 — Heat treatment for nickel and nickel alloy castings**

Alloy identification <sup>a</sup>		Heat treatment
Number	Description	
NC2100	C-Ni99, -HC	As cast.
NC4020	C-NiCu30Si	As cast.
NC4135	C-NiCu30	As cast.
NC4030	C-NiCu30Si3	As cast.
NC4130	C-NiCu30Nb2Si2	As cast.
NC0012	C-NiMo31	Heat to 1 095 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC0007	C-NiMo30Fe5	Heat to 1 095 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC6985	C-NiCr22Fe20Mo7Cu2	Heat to 1 095 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC6625	C-NiCr22Mo9Nb4	Heat to 1 175 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC6455	C-NiCr16Mo16	Heat to 1 175 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC0002	C-NiMo17Cr16Fe6W4	Heat to 1 175 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC6022	C-NiCr21Mo14Fe4W3	Heat to 1 205 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC0107	C-NiCr18Mo18	Heat to 1 175 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC6040	C-NiCr15Fe	Class 1: As-cast. Class 2: Heat to 1 040 °C minimum, hold for sufficient time to bring castings to temperature and quench in water or rapid cool by other means.
NC8826	C-NiFe30Cr20Mo3CuNb	Heat to 930 °C to 980 °C, hold for sufficient time to bring castings to temperature and allow to air cool.
NC2000	C-NiSi9Cu3	Heat to 970 °C to 1 000 °C, hold for sufficient time to bring castings to temperature and allow to air cool.

<sup>a</sup> For alloy identification, either the number or the description may be used.

Table 2 — Chemical composition of nickel and nickel alloy castings

Alloy identification <sup>a</sup>		Percentage in mass <sup>b</sup>												
Number	Description	C	Co	Cr	Cu	Fe	Mn	Mo	Ni	P	S	Si	W	Others
NC2100	C-Ni99, -HC	1,00	—	—	1,25	3,0	1,50	—	95,0	0,030	0,030	2,00	—	—
NC4020	C-NiCu30Si	0,35	—	—	26,0 to 33,0	3,5	1,50	—	Balance	0,030	0,030	2,00	—	Nb: 0,5
NC4135	C-NiCu30	0,35	—	—	26,0 to 33,0	3,5	1,50	—	Balance	0,030	0,030	1,25	—	Nb: 0,5
NC4030	C-NiCu30Si3	0,30	—	—	27,0 to 33,0	3,5	1,50	—	Balance	0,030	0,030	2,7 to 3,7	—	—
NC4130	C-NiCu30Nb2Si2	0,30	—	—	26,0 to 33,0	3,5	1,50	—	Balance	0,030	0,030	1,0 to 2,0	—	Nb: 1,0 to 3,0
NC0012	C-NiMo31	0,03	—	1,0	—	3,0	1,00	30,0 to 33,0	Balance	0,030	0,030	1,00	—	—
NC0007	C-NiMo30Fe5	0,05	—	1,0	—	4,0 to 6,0	1,00	26,0 to 33,0	Balance	0,030	0,030	1,00	—	V: 0,20 to 0,60
NC6985	C-NiCr22Fe20Mo7Cu2	0,02	5,0	21,5 to 23,5	1,5 to 2,5	18,0 to 21,0	1,00	6,0 to 8,0	Balance	0,025	0,030	1,00	1,50	Nb + Ta: 0,5
NC6625	C-NiCr22Mo9Nb4	0,60	—	20,0 to 23,0	—	5,0	1,00	8,0 to 10,0	Balance	0,030	0,030	1,00	—	Nb: 3,2 to 4,5
NC6455	C-NiCr16Mo16	0,02	—	15,0 to 17,5	—	2,0	1,00	15,0 to 17,5	Balance	0,030	0,030	0,80	1,00	—
NC0002	C-NiMo17Cr16Fe6W4	0,06	—	15,5 to 17,5	—	4,5 to 7,5	1,00	16,0 to 18,0	Balance	0,030	0,030	1,00	3,8 to 5,3	V: 0,20 to 0,40
NC6022	C-NiCr21Mo14Fe4W3	0,02	—	20,0 to 22,5	—	2,0 to 6,0	1,00	12,5 to 14,5	Balance	0,025	0,025	0,80	2,5 to 3,5	V: 0,35
NC0107	C-NiCr18Mo18	0,03	—	17,0 to 20,0	—	3,0	1,00	17,0 to 20,0	Balance	0,030	0,030	1,00	—	—
NC6040	C-NiCr15Fe	0,40	—	14,0 to 17,0	—	11,0	1,50	—	Balance	0,030	0,030	3,00	—	—
NC8826	C-NiFe30Cr20Mo-3CuNb	0,05	—	19,5 to 23,5	1,5 to 3,0	28,0 to 32,0	1,00	2,5 to 3,5	Balance	0,030	0,030	0,75 to 1,20	—	Nb: 0,70 to 1,00
NC2000	C-NiSi9Cu3	0,12	—	1,0	2,0 to 4,0	—	1,50	—	Balance	0,030	0,030	8,5 to 10,0	—	—

<sup>a</sup> For alloy identification, either the number or the description may be used.<sup>b</sup> Single values are maximum limits, except in the case of nickel for which single values are minimum.



## 7.2 Mechanical properties

Materials shall be tested in accordance with ISO 6892-1 and shall conform to the mechanical property requirements given in [Table 3](#).

Mechanical properties shall be measured on test pieces taken from test blocks. The test blocks may be cast separately, attached to the castings or cast integrally on the castings. When more than one ladle is used, the test block shall be cast integrally. The test blocks shall be produced from the same cast (heat) of nickel alloy and shall be heat treated in the production furnaces to the same procedure as the casting(s) they represent.

Unless otherwise specified, the test blocks shall be 28 mm minimum and the test pieces used for the mechanical tests shall be taken from test blocks with their axes at least 7 mm from the surface.

**Table 3 — Mechanical properties of nickel and nickel alloy castings**

Alloy identification <sup>a</sup>		Tensile strength	0,2 % proof stress	Elongation
Number	Description	$R_m$ MPa	$R_{p0,2}$ min. MPa	$A_5$ , min./ $A_{50}$ , min. %
NC2100	C-Ni99, -HC	345 to 545	125	10
NC4020	C-NiCu30Si	450 to 650	205	25
NC4135	C-NiCu30	450	170	25
NC4030	C-NiCu30Si3	690 to 890	415	10
NC4130	C-NiCu30Nb2Si2	450	225	25
NC0012	C-NiMo31	525 to 725	275	6
NC0007	C-NiMo30Fe5	525 to 725	275	20
NC6985	C-NiCr22Fe20Mo7Cu2	550 to 750	220	30
NC6625	C-NiCr22Mo9Nb4	485 to 685	275	25
NC6455	C-NiCr16Mo16	495 to 695	275	20
NC0002	C-NiMo17Cr16Fe6W4	495 to 695	275	4
NC6022	C-NiCr21Mo14Fe4W3	550	280	30
NC0107	C-NiCr18Mo18	495 to 695	275	25
NC6040	C-NiCr15Fe	485 to 685	195	30
NC8826	C-NiFe30Cr20Mo3CuNb	450 to 650	170	25
NC2000	C-NiSi9Cu3	—	—	—
<sup>a</sup> For alloy identification, either the number or the description may be used.				
<sup>b</sup> 300 HBW minimum.				

## 7.3 Supplementary requirements

**7.3.1** Supplementary requirements shall apply only when specified in the inquiry or purchase order and agreed upon by the manufacturer.

**7.3.2** A list of supplementary requirements for use at the option of the purchaser is given in [Annex B](#).

**7.3.3** Other supplementary requirements may be specified in the inquiry and purchase order, such as, but not limited to, welding production procedures.