INTERNATIONAL STANDARD

ISO 12725

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Nickel and nickel alloy castings

Pièces moulées en nickel et alliages de nickel

Reference number
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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.

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.

International Standard ISO 12725 was prepared by Technical Committee ISO/TC 155, *Nickel and nickel alloys*, Subcommittee SC 2, *Wrought and cast nickel and nickel alloys*.

Annex A of this International Standard is for information only.

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Nickel and nickel alloy castings

1 Scope

This International Standard specifies requirements for nickel and nickel alloy castings. The grades covered 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 standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4990:1986, *Steel castings — General technical delivery requirements.*

ISO 6372-1:1989, *Nickel and nickel alloys — Terms and definitions — Part 1: Materials.*

ISO 6372-3:1989, *Nickel and nickel alloys — Terms and definitions — Part 3: Wrought products and castings.*

ISO 6892:—[1], *Metallic materials — Tensile testing at ambient temperature.*

ISO/TR 9721:1992, *Nickel and nickel alloys — Rules for material description based on chemical symbols.*

3 Definitions

For the purposes of this International Standard, the definitions for nickel and nickel alloys given in ISO 6372-1 and for castings given in ISO 6372-3 as well as the following apply.

3.1 master heat: A single furnace charge of refined alloy which may either be poured directly into castings or into remelt alloy for individual melts.

3.2 melt: A single furnace charge poured into castings. When master heats are used to prepare melts, a melt analysis should be reported.

1) To be published. (Revision of ISO 6892:1984)

4 Alloy identification

For the purposes of this International Standard, the principles for alloy identification given in ISO/TR 9721 apply for the description. To differentiate between wrought nickel and nickel alloys, the description shall be preceded by "C-" to indicate that the description applies to cast material.

5 General requirements for delivery

5.1 General

Materials furnished in accordance with this International Standard shall conform to the applicable requirements in ISO 4990, including the supplementary requirements that are indicated on the purchase order. Failure to comply with the applicable requirements of ISO 4990 constitutes nonconformance with this International Standard.

5.2 Priority

In case of conflict with ISO 4990, the requirements of this International Standard, as modified by the purchase order, shall apply.

6 Manufacture

6.1 Melting

Nickel and nickel alloys shall be made 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.

6.3 Repair by welding

6.3.1 General

Selection of welding repair 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 repair material may be agreed between purchaser and manufacturer.

6.3.2 Restriction

Castings made from grade NC4030 shall not be repaired by welding.

7 Requirements

7.1 Composition

Materials shall conform to the chemical composition requirements given in table 2.

7.2 Mechanical properties

Materials shall be tested in accordance with ISO 6892 and conform to the mechanical property requirements given in table 3.

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 included in ISO 4990. Those considered useful in connection with this International Standard are in the following subclauses of ISO 4990.

— 9.1.2 Reporting of the steelmaking (melting) process.

— 9.1.4 Dividing up the cast.

— 9.1.6 Mass and tolerance on mass.

— 9.3 Chemical analysis for residual elements.

— 9.7.2 Details of the heat treatment.

— 9.8.2 Weld maps.

— 9.9.1 Liquid penetrant inspection.

— 9.9.3 Radiographic examination.

— 9.10.1 Intergranular corrosion test.

— 9.10.3 Pressure-tightness.

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

8 Test procedures

8.1 Chemical analysis

8.1.1 The method of chemical analysis shall be at the discretion of the manufacturer; however, in cases of dispute, the method specified in the relevant International Standard shall be used. If no International Standard exists, an analytical method that can be validated with a reference standard acceptable to the purchaser shall be used.

8.1.2 For a list of ISO analytical standards, see annex A.

Table 1 — Heat treatment of cast nickel and nickel alloys

Alloy identification[1)]		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.

1) For alloy identification either the number or the description may be used.

Table 2 — Composition of cast nickel and nickel alloys

Alloy identification[1)]		Composition % (*m*/*m*)[2)]												
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 33,0	3,5	1,50		Balance	0,030	0,030	2,00		Nb 0,5
NC4135	C-NiCu30	0,35			26,0 33,0	3,5	1,50		Balance	0,030	0,030	1,25		Nb 0,5
NC4030	C-NiCu30Si3	0,30			27,0 33,0	3,5	1,50		Balance	0,030	0,030	2,7 3,7		
NC4130	C-NiCu30Nb2Si2	0,30			26,0 33,0	3,5	1,50		Balance	0,030	0,030	1,0 2,0		Nb 1,0-3,0
NC0012	C-NiMo31	0,03		1,0		3,0	1,00	30,0 33,0	Balance	0,030	0,030	1,00		
NC0007	C-NiMo30Fe5	0,05		1,0		4,0 6,0	1,00	26,0 33,0	Balance	0,030	0,030	1,00		V 0,20-0,60
NC6985	C-NiCr22Fe20Mo7Cu2	0,02	5,0	21,5 23,5	1,5 2,5	18,0 21,0	1,00	6,0 8,0	Balance	0,025	0,030	1,00	1,50	Nb+Ta 0,5
NC6625	C-NiCr22Mo9Nb4	0,06		20,0 23,0		5,0	1,00	8,0 10,0	Balance	0,030	0,030	1,00		Nb 3,2-4,5
NC6455	C-NiCr16Mo16	0,02		15,0 17,5		2,0	1,00	15,0 17,5	Balance	0,030	0,030	0,80	1,00	
NC0002	C-NiMo17Cr16Fe6W4	0,06		15,5 17,5		4,5 7,5	1,00	16,0 18,0	Balance	0,030	0,030	1,00	3,8 5,3	V 0,20-0,40
NC6022	C-NiCr21Mo14Fe4W3	0,02		20,0 22,5		2,0 6,0	1,00	12,5 14,5	Balance	0,025	0,025	0,80	2,5 3,5	V 0,35
NC0107	C-NiCr18Mo18	0,03		17,0 20,0		3,0	1,00	17,0 20,0	Balance	0,030	0,030	1,00		
NC6040	C-NiCr15Fe	0,40		14,0 17,0		11,0	1,50		Balance	0,030	0,030	3,00		
NC8826	C-NiFe30Cr20Mo3CuNb	0,05		19,5 23,5	1,5 3,0	28,0 32,0	1,00	2,5 3,5	Balance	0,030	0,030	0,75 1,20		Nb 0,70-1,00
NC2000	C-NiSi9Cu3	0,12		1,0	2,0 4,0		1,50		Balance	0,030	0,030	8,5 10,0		

1) For alloy identification either the number or the description may be used.

2) Single values are maximum limits, except in the case of nickel for which single values are minimum.

Table 3 — Mechanical properties of cast nickel and nickel alloys

Alloy identification[1)]		Tensile strength R_m N/mm²	0,2 % proof stress $R_{p,\,0,2\,min}$ N/mm²	Elongation $A_{5,\,min}/A_{50,\,min}$ %
Number	Description			
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[2)]	—	—	—

1) For alloy identification either the number or the description may be used.

2) 300 HBN minimum.

Annex A
(informative)

List of ISO methods of analysis

[1] ISO 6351:1985, *Nickel — Determination of silver, bismuth, cadmium, cobalt, copper, iron, manganese, lead and zinc contents — Flame atomic absorption spectrometric method.*

[2] ISO 7523:1985, *Nickel — Determination of silver, arsenic, bismuth, cadmium, lead, antimony, selenium, tin, tellurium and thallium contents — Electrothermal atomic absorption spectrometric method.*

[3] ISO 7524:1985, *Nickel, ferronickel and nickel alloys — Determination of carbon content — Infra-red absorption method after induction furnace combustion.*

[4] ISO 7525:1985, *Nickel — Determination of sulfur content — Methylene blue molecular absorption spectrometric method after generation of hydrogen sulfide.*

[5] ISO 7526:1985, *Nickel, ferronickel and nickel alloys — Determination of sulfur content — Infra-red absorption method after induction furnace combustion.*

[6] ISO 7527:1985, *Nickel, ferronickel and nickel alloys — Determination of sulfur content — Iodimetric titration method after induction furnace combustion.*

[7] ISO 7528:1989, *Nickel alloys — Determination of iron content — Titrimetric method with potassium dichromate.*

[8] ISO 7529:1989, *Nickel alloys — Determination of chromium content — Potentiometric titration method with ammonium iron(II) sulfate.*

[9] ISO 7530-1:1990, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 1: General requirements and sample dissolution.*

[10] ISO 7530-2:1990, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 2: Determination of cobalt content.*

[11] ISO 7530-3:1990, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 3: Determination of chromium content.*

[12] ISO 7530-4:1990, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 4: Determination of copper content.*

[13] ISO 7530-5:1990, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 5: Determination of iron content.*

[14] ISO 7530-6:1990, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 6: Determination of manganese content.*

[15] ISO 7530-7:1992, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 7: Determination of aluminium content.*

[16] ISO 7530-8:1992, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 8: Determination of silicon content.*

[17] ISO 7530-9:1993, *Nickel alloys — Flame atomic absorption spectrometric analysis — Part 9: Determination of vanadium content.*

[18] ISO 9388:1992, *Nickel alloys — Determination of phosphorus content — Molybdenum blue molecular absorption spectrometric method.*

[19] ISO 9389:1989, *Nickel alloys — Determination of cobalt content — Potentiometric titration method with potassium hexacyanoferrate(III).*