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Cast steels and alloys with special physical properties

Aciers et alliages moulés avec caractéristiques physiques particulières

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ISO/FDIS 19960

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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).

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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.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 11, *Steel castings*.

This third edition cancels and replaces the second edition (ISO 19960:2015), of which it constitutes a minor revision. The changes are as follows:

- the unit of N/mm² in [Table 2](#) was revised to MPa;
- GX5Ni36S in [Table 4](#) was corrected to GX5NiS36.

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.

Cast steels and alloys with special physical properties

1 Scope

This document specifies cast steel and alloy grades with special physical properties. The cast steel and alloy grades covered by this document are used in applications which require low linear thermal expansion, or low ferromagnetic responses, or low galling properties.

NOTE [Annex A](#) gives information on ISO grade designation and available UNS numbers which are similar to the ISO grade designations.

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 4990, *Steel castings — General technical delivery requirements*

ISO 11970, *Specification and qualification of welding procedures for production welding of steel castings*

3 Terms and definitions

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

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

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

3.1

galling

damage or breaking of the surface by friction or abrasion

4 General conditions for delivery

Materials furnished according to this document shall conform to the applicable requirements of ISO 4990 including the supplementary requirements that are indicated on the enquiry and purchase order.

5 Chemical composition

The cast steel and alloy grades shall conform to the requirements for chemical composition specified in [Table 1](#).

6 Mechanical properties

Cast steel and alloy grades shall conform to the mechanical property requirements given in [Table 2](#) up to the maximum ruling thickness. Verification of impact properties is not required except when indicated by the customer. Test blocks used to verify the mechanical properties shall not have a thickness exceeding 100 mm. For blocks taken from castings, the test bar location and the mechanical properties required shall be agreed between the manufacturer and purchaser.

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For grades GX3NiCo32, GX3NiCo29-17, and G-NiCr13SnBiMo, no mechanical properties are specified.

7 Heat treatment

Castings shall be heat treated in accordance with the requirements of [Table 3](#).

8 Welding

Castings shall be welded in accordance with the procedures described in ISO 11970.

9 Verification of physical properties

When physical properties are specified, the method of measurement and acceptance requirements shall be the subject of an agreement between the manufacturer and purchaser. Typical values for some physical properties are given in [Table 4](#).

10 Supplementary requirements

A list of standardized supplementary requirements for use at the option of the purchaser is included in ISO 4990. The subclauses of ISO 4990 which are ordinarily considered suitable for use with this document are given in [Annex A](#). Other supplementary requirements, whether or not in ISO 4990, may be used with this document upon agreement by the manufacturer and purchaser.

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Table 1 — Chemical composition, mass fraction in %^d

Grade designation Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Co	Others
GX12CrNi18-11 ^a	1.3955	0,15	1,00	2,0	0,045	0,030	16,5 to 18,5	0,75	10,0 to 12,0			
GX2CrNi18-13 ^a	1.3940	0,030	1,00	2,0	0,035	0,020	16,5 to 18,5	-	12,0 to 14,0	0,10 to 0,20		
GX2CrNiMoN18-14 ^a	1.3960	0,030	1,00	2,0	0,035	0,020	16,5 to 18,5	2,5 to 3,0	13,0 to 15,0	0,15 to 0,25		
GX2CrNiN19-11 ^a	1.3939	0,030	1,5	2,0	0,035	0,020	18,0 to 20,0	1,0	10,0 to 12,0	0,10 to 0,20		
GX3CrNiMnSi17-9-8 ^a	1.3975	0,05	3,5 to 4,5	7,0 to 9,0	0,045	0,030	16,0 to 18,0	1,0	8,0 to 9,0	0,08 to 0,18		
GX4CrNiMnN22-12-5 ^a	1.3956	0,06	1,0	4,0 to 6,0	0,040	0,030	20,5 to 23,5	1,50 to 3,00	11,5 to 13,5	0,20 to 0,40		Nb: 0,10 to 0,30 V: 0,10 to 0,30
GX2CrNiMnMoNNb21-16-5-3 ^a	1.3967	0,030	1,0	4,0 to 6,0	0,025	0,010	20,0 to 21,5	3,0 to 3,5	15,0 to 17,0	0,20 to 0,35		Nb: 0,25
GX3NiCo32 ^b	1.3983	0,05	0,50	0,6	0,030	0,02	0,25	1,0	30,5 to 33,5		4,0 to 6,5	Al: 0,10
GX1NiCo29-17 ^b	1.3988	0,05	0,50	0,5	0,030	0,02	0,25	1,0	28,0 to 30,0		16,0 to 18,0	
GX3Ni36 ^b	1.3961	0,05	0,5	0,5	0,030	0,02	0,25	1,0	35,0 to 37,0			
GX5NiS36 ^b	1.3963	0,05	0,5	0,5	0,030	0,10 to 0,20	0,25	1,0	35,0 to 37,0			
G-NiCr13SnBiMo ^c	2.4712	0,05	0,5	1,5	0,030	0,030	11,0 to 14,0	2,0 to 3,5	balance			Fe: 2,0 Bi: 3,0 to 5,0 Sn: 3,0 to 5,0

^a Low ferromagnetic response grades with magnetic permeability, $\mu_r \leq 1,01$.^b For low linear-expansion grades see [Table 4](#).^c Low galling grade.^d Single value indicates maximum.

Table 2 — Mechanical properties at room temperature

Grade designation		$R_{p0,2}$ min. MPa	R_m MPa	A min. %	KV min. J
Name	Number				
GX12CrNi18-11 ^a	1.3955	195	440 to 590	20	80
GX2CrNi18-13 ^a	1.3940	210	440 to 640	30	115
GX2CrNiMoN18-14 ^a	1.3960	240	490 to 690	30	80
GX2CrNi19-11 ^a	1.3939	180	≥440	30	
GX3CrNiMnSi17-9-8 ^a	1.3975	290	≥580	24	
GX4CrNiMnN22-12-5 ^a	1.3956	290	≥580	24	
GX2CrNiMnMoNNb21-16-5-3 ^a	1.3967	315	570 to 800	20	65
GX3Ni36 ^b	1.3961	275	≥395	28	
GX5NiS36 ^b	1.3963	275	≥395	25	

^a Low ferromagnetic response grades with magnetic permeability, $\mu_r \leq 1,01$.

^b For low linear-expansion grades, see [Table 4](#).

Table 3 — Heat treatment

Grade designation		Treatment ^a
Name	Number	
GX12CrNi18-11 ^b	1.3955	Solution anneal 1 050 °C to 1 150 °C; quench
GX2CrNi18-13 ^b	1.3940	Solution anneal 1 050 °C to 1 150 °C; quench
GX2CrNiMoN18-14 ^b	1.3960	Solution anneal 1 050 °C to 1 150 °C; quench
GX2CrNi19-11 ^b	1.3939	Solution anneal 1 050 °C min; quench
GX3CrNiMnSi17-9-8 ^b	1.3975	Solution anneal 1 050 °C min; quench
GX4CrNiMnN22-12-5 ^b	1.3956	Solution anneal 1 065 °C min; quench
GX2CrNiMnMoNNb21-16-5-3 ^b	1.3967	Solution anneal 1 080 °C to 1180 °C; quench
GX3NiCo32 ^c	1.3983	820 °C to 850 °C/quench + 300 to 350 °C/air
GX1NiCo29-17 ^c	1.3988	820 °C to 850 °C/quench + 300 to 350 °C/air
GX3Ni36 ^c	1.3961	820 °C to 850 °C/quench + 300 to 350 °C/air
GX5NiS36 ^c	1.3963	820 °C to 850 °C/quench + 300 to 350 °C/air
G-NiCr13SnBiMo ^d	2.4712	As cast

^a Temperatures are for information only.

^b Low ferromagnetic response grades with magnetic permeability, $\mu_r \leq 1,01$.

^c For low linear-expansion grades see [Table 4](#).

^d Low galling grade.

Table 4 — Typical values for physical properties

Grade designation		Coefficient of expansion (mm/mm) (10 ⁻⁶ K ⁻¹)				
Name	Number	20 °C to 100 °C	20 °C to 200 °C	20 °C to 300 °C	20 °C to 500 °C	20 °C to 800 °C
GX3NiCo32	1.3983	0,63	—	—	—	—
GX1NiCo29-17	1.3988	5,9	5,2	5,1	6,1	10,3
GX3Ni36	1.3961	1,3	2,1	4,2	—	—
GX5NiS36	1.3963	1,6	3,0	5,9	—	—

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Annex A (informative)

UNS cast grades similar to ISO cast grades

Table A.1 — UNS cast grades similar to ISO cast grades

Grade designation		UNS Numbers (similar grade) ^a
Name	Number	
GX12CrNi18-11	1.3955	-
GX2CrNi18-13	1.3940	J92500
GX2CrNiMoN18-14	1.3960	-
GX2CrNi19-11	1.3939	-
GX3CrNiMnSi17-9-8	1.3975	J92972
GX4CrNiMnN22-12-5	1.3956	J93790
GX2CrNiMnMoNNb21-16-5-3	1.3967	-
GX3NiCo32	1.3983	-
GX1NiCo29-17	1.3988	-
GX3Ni36	1.3961	-
GX5NiS36	1.3963	-
G-NiCr13SnBiMo	2.4712	N26055
NOTE The grade designations including the names and the numbers follow the rules of EN 10027-1 and EN 10027-2.		
^a The similar UNS (Unified Numbering System) grades may not be equivalent to the grades in this document.		