INTERNATIONAL STANDARD 2892

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Austenitic cast iron

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2892 was drawn up by Technical Committee ISO/TC 25, *Cast iron,* and circulated to the Member Bodies in September 1972.

It has been approved by the Member Bodies of the following countries :

Belgium	India	Spain
Brazil	Ireland	Sweden
Canada	Italy	Thailand
Czechoslovakia	Mexico	Turkey
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France	Romania	
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No Member Body expressed disapproval of the document.

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Austenitic cast iron

0 INTRODUCTION

Austenitic cast irons are high alloy materials in which the metallic matrix has been rendered austenitic at ambient temperature by the use of alloying elements and in which the carbon is present predominantly as either flake or spheroidal graphite. Carbides are often also present, particularly in the high chromium grades.

Spheroidal graphite grades of austenitic cast iron have mechanical properties superior to those of the flake graphite types. Generally they exhibit superior resistance to heat and corrosion and have other physical properties which differ from those of the flake graphite types of similar basic composition.

Martensite may be present subject to an agreement between the manufacturer and the purchaser.

1 SCOPE AND FIELD OF APPLICATION

This International Standard relates to nine grades of flake graphite austenitic cast iron and eleven grades of spheroidal or nodular graphite austenitic cast iron intended for subsequent use in the manufacture of castings. These grades of material are based on chemical composition and mechanical properties.

2 REFERENCES

ISO/R 83, *Charpy impact test (U-notch) for steel.*

ISO148, *Steel – Charpy impact test (V-notch).*[1)]

ISO/R 945, *Designation of the microstructure of graphite in cast iron.*

3 SYMBOLS AND ABBREVIATIONS

Each grade having a microstructure of flake graphite in accordance with Form I of ISO/R 945 is designated by the initial letter "L".

Each grade having a microstructure of spheroidal or nodular graphite in accordance with Form V and Form VI of ISO/R 945 is designated by the initial letter "S".

In each case the initial letter is followed by appropriately spaced chemical symbols and figures indicating the alloying elements and their approximate mean levels, as shown in the following examples :

Examples

1) L – Ni Cu Cr 15 6 3 (Refer to Table 1 for actual composition)

2) S – Ni Si Cr 20 5 2 (Refer to Table 2 for actual composition)

4 PRODUCTION

The method of producing austenitic cast irons is left to the discretion of the manufacturer, who should ensure that the property requirements, defined in this International Standard, are complied with for the grade of material required on the order.

1) At present at the stage of draft. (Revision of ISO/R 148.)

In cases where a purchaser has special requirements, these shall be stated on the order, and form the basis of an agreement between the purchaser and the manufacturer.

5 CHARACTERISTICS, PROPERTIES AND APPLICATIONS

5.1 Chemical composition

5.1.1 The chemical composition of the grades of austenitic cast iron shall be in accordance with Table 1 for flake graphite types and Table 2 for spheroidal graphite types.

5.1.2 Unless otherwise specified, other elements may be present, at the discretion of the manufacturer, providing they do not alter the microstructure substantially, nor affect the properties adversely. If the presence of any element specified in Tables 1 and 2 is required outside the limits indicated, or if any other element is required, such as molybdenum, the permissible amount shall be agreed between the manufacturer and the purchaser, and specified on the order.

5.2 Mechanical properties

5.2.1 The mechanical properties of the grades of austenitic cast iron shall be in accordance with Table 1 for flake graphite types and Table 3 for spheroidal graphite types (see section 7).

5.2.2 Other requirements, such as mechanical properties at specified points on the subsequent casting, specimens to be cast integrally with, or machined from, the casting, shall be agreed between the manufacturer and the purchaser and specified on the order.

5.3 Physical properties and uses

A summary of the properties of each grade of material and the uses for which each is recommended is given in the Appendix, Table 6 for flake graphite types and in Table 9 for spheroidal graphite types, for information purposes only.

All the grades of austenitic cast iron have good resistance to heat and corrosion and are substantially non-magnetic. Other physical properties, such as a controlled range of thermal expansion, high resistance to impact at low temperatures, good bearing qualities and resistance to abrasion, are applicable to individual grades.

More detailed physical properties are given for each grade in other tables of the Appendix, for information purposes only. In this Appendix, Tables 4 and 5 give the properties of the flake graphite types, Tables 7 and 8 give the properties of the spheroidal graphite types and Table 10 gives mechanical property data at low temperatures down to − 196 °C related to Grade S − Ni Mn 23 4.

In cases 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.

5.4 Heat treatment

The castings may 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.

5.5 Applications

Comments on the typical applications for which each grade may be used are given in the Appendix, Tables 6 and 9.

TABLE 1 — **Chemical composition and mechanical properties of flake graphite austenitic cast irons**

Grade	Chemical composition						Mechanical property
	C max. %	Si %	Mn %	Ni %	Cr %	Cu %	Tensile strength (R_m) min. N/mm²
L − Ni Mn 13 7	3,0	1,5 to 3,0	6,0 to 7,0	12,0 to 14,0	0,2 max.	0,5 max.	140
L − Ni Cu Cr 15 6 2	3,0	1,0 to 2,8	0,5 to 1,5	13,5 to 17,5	1,0 to 2,5	5,5 to 7,5	170
L − Ni Cu Cr 15 6 3	3,0	1,0 to 2,8	0,5 to 1,5	13,5 to 17,5	2,5 to 3,5	5,5 to 7,5	190
L − Ni Cr 20 2	3,0	1,0 to 2,8	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	0,5 max.	170
L − Ni Cr 20 3	3,0	1,0 to 2,8	0,5 to 1,5	18,0 to 22,0	2,5 to 3,5	0,5 max.	190
L − Ni Si Cr 20 5 3	2,5	4,5 to 5,5	0,5 to 1,5	18,0 to 22,0	1,5 to 4,5	0,5 max.	190
L − Ni Cr 30 3	2,5	1,0 to 2,0	0,5 to 1,5	28,0 to 32,0	2,5 to 3,5	0,5 max.	190
L − Ni Si Cr 30 5 5	2,5	5,0 to 6,0	0,5 to 1,5	29,0 to 32,0	4,5 to 5,5	0,5 max.	170
L − Ni 35	2,4	1,0 to 2,0	0,5 to 1,5	34,0 to 36,0	0,2 max.	0,5 max.	120

TABLE 2 – **Chemical composition of spheroidal graphite austenitic cast irons**

Grade	Chemical composition						
	C max. %	Si %	Mn %	Ni %	Cr %	P max. %	Cu max. %
S – Ni Mn 13 7	3,0	2,0 to 3,0	6,0 to 7,0	12,0 to 14,0	0,2 max.	0,080	0,5
S – Ni Cr 20 2	3,0	1,5 to 3,0	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	0,080	0,5
S – Ni Cr 20 3	3,0	1,5 to 3,0	0,5 to 1,5	18,0 to 22,0	2,5 to 3,5	0,080	0,5
S – Ni Si Cr 20 5 2	3,0	4,5 to 5,5	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	0,080	0,5
S – Ni 22	3,0	1,0 to 3,0	1,5 to 2,5	21,0 to 24,0	0,5 max.	0,080	0,5
S – Ni Mn 23 4	2,6	1,5 to 2,5	4,0 to 4,5	22,0 to 24,0	0,2 max.	0,080	0,5
S – Ni Cr 30 1	2,6	1,5 to 3,0	0,5 to 1,5	28,0 to 32,0	1,0 to 1,5	0,080	0,5
S – Ni Cr 30 3	2,6	1,5 to 3,0	0,5 to 1,5	28,0 to 32,0	2,5 to 3,5	0,080	0,5
S – Ni Si Cr 30 5 5	2,6	5,0 to 6,0	0,5 to 1,5	28,0 to 32,0	4,5 to 5,5	0,080	0,5
S – Ni 35	2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	0,2 max.	0,080	0,5
S – Ni Cr 35 3	2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	2,0 to 3,0	0,080	0,5

TABLE 3 – **Mechanical properties of spheroidal graphite austenitic cast irons**

Grade	Mechanical properties				
	Tensile strength (R_m) min. N/mm²	0,2 % Proof stress ($R_{p0,2}$) min. N/mm²	Elongation (A) min. %	Minimum mean impact value on 3 tests	
				V-notch (Charpy) in accordance with ISO 148 J [1]	U-notch (Mesnager) in accordance with Figure 5 J [1]
S – Ni Mn 13 7	390	210	15	16	not indicated
S – Ni Cr 20 2	370	210	7	13	16
S – Ni Cr 20 3	390	210	7	not indicated	not indicated
S – Ni Si Cr 20 5 2	370	210	10	not indicated	not indicated
S – Ni 22	370	170	20	20	24
S – Ni Mn 23 4	440	210	25	24	28
S – Ni Cr 30 1	370	210	13	not indicated	not indicated
S – Ni Cr 30 3	370	210	7	not indicated	not indicated
S – Ni Si Cr 30 5 5	390	240	not indicated	not indicated	not indicated
S – Ni 35	370	210	20	not indicated	not indicated
S – Ni Cr 35 3	370	210	7	not indicated	not indicated

1) 1 J = 1 N·m.

6 SAMPLING

The number of test samples shall be agreed between the manufacturer and the purchaser at the time of ordering.

7 TEST SAMPLES

7.1 Test samples (often called keel blocks) shall be poured at the same time as the castings represented. These test samples shall be poured from the same ladle of metal as that used to produce the castings in accordance with the agreed sampling procedure. They shall be poured separately.

In exceptional cases, and by agreement between the parties concerned, the test samples may be attached to the casting; in such cases their location shall be agreed between the manufacturer and the purchaser.

The test samples shall be cast in sand moulds.

7.2 Should the castings represented have to be heat treated, the test samples shall also be submitted to the same heat treatment.

7.3 The test pieces, representative of the flake graphite grades, shall either be prepared in accordance with 7.1 and 7.4 or be prepared from a separately cast round bar test sample of 25 mm diameter.

7.4 The test pieces representative of spheroidal graphite grades and used for the tests specified in section 8 shall be taken from the keel of the "U"-type test sample (the hatched section of Figure 1), the "Y"-type test sample (Figure 2) or the knock-off type test sample (Figure 3) and machined in accordance with Figure 4.

In principle, the test sample having an effective thickness 25 mm shall be used (i.e. type II a or II b for "U" test sample and type II for the "Y" test sample). However, if the mass effect of the test sample differs widely from that of the casting it represents, other test samples such as type I, III and IV of Figures 1 and 2 may be used by agreement between the purchaser and the manufacturer.

8 TESTING

8.1 Chemical analysis

The methods employed for determining the chemical composition of a material shall be in accordance with the appropriate International Standards.

8.2 Tensile test

The tensile test shall be carried out on a 14 mm diameter proportional test piece, as shown in Figure 4.

If, for technical reasons, it is necessary to use a test piece having a different diameter, it shall comply with the ratio :

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

where

L_0 is the original gauge length;

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

8.3 Impact test

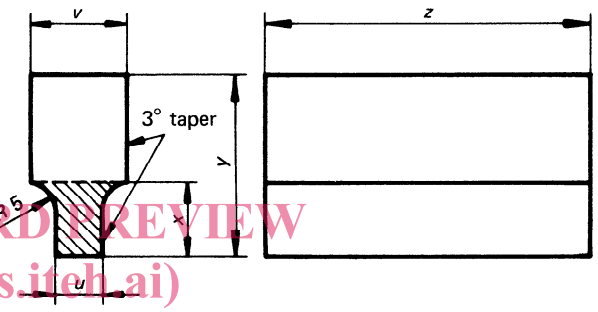
The impact test shall be carried out either on a V-notch (Charpy) test piece in accordance with ISO 148 or on a U-notch (Mesnager) test piece in accordance with ISO/R 83, except that the dimensions of the U-notch in the test piece shall be in accordance with Figure 5. The results shall be expressed in joules.

9 RETESTS

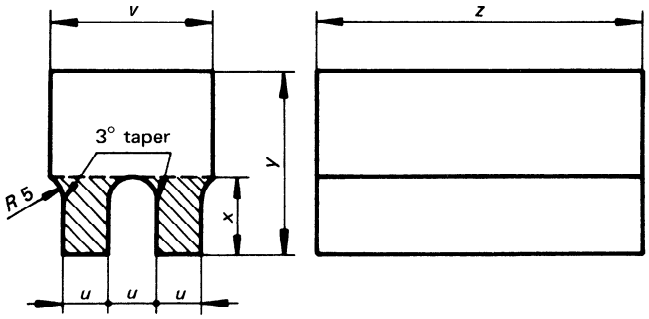
Should any of the test pieces fail to meet the specified property requirements, two further test pieces shall be tested. The test samples required for this shall be taken from the same melt and shall have been heat treated in the same manner as the castings represented.

If either one of the additional test pieces fails to meet the specified property requirements, the castings represented shall be rejected.

Types I, IIa, III and IV

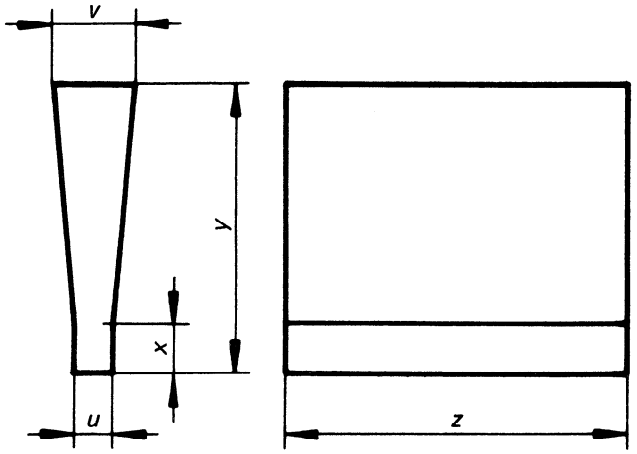


Type IIb



Dimension	Dimensions in millimetres for type				
	I	IIa	IIb	III	IV
u	12	25	25	50	75
v	40	55	90	90	125
x	30	40	40	60	65
y	80	100	100	150	165
z	A function of the test piece length				

FIGURE 1 — **"U"-type test samples**



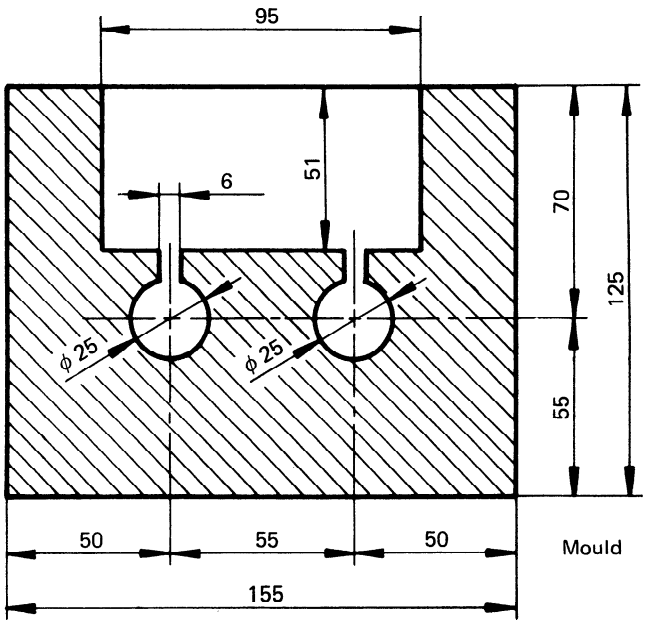
Dimension	Dimensions in millimetres for type			
	I	II	III	IV
u	12	25	50	75
v	40	55	100	125
x	25	40	50	65
y	135	140	150	175
z	A function of the test piece length			

NOTE – The thickness of the sand mound surrounding the test sample during casting shall be

- 40 mm minimum for types I and II,
- 80 mm minimum for types III and IV.

FIGURE 2 – **"Y"-type test samples**

Dimensions in millimetres



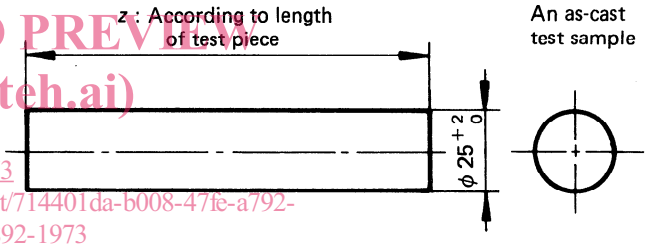
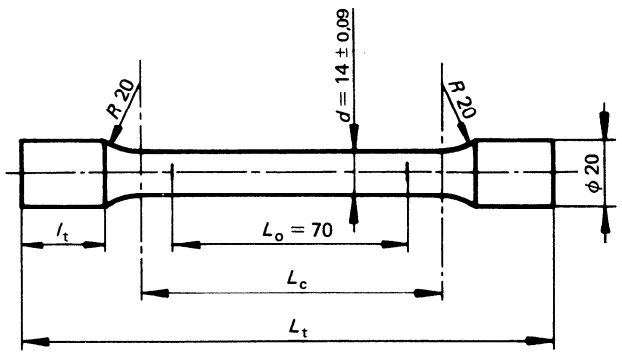


FIGURE 3 – **"Knock-off" type test samples**

Dimensions in millimetres



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

L_o is the original gauge length; here $L_o = 5\,d$.

d is the original diameter of the test piece.

L_c is the parallel length; $L_c > L_o$ by agreement between the manufacturer and purchaser (in principle $L_c - L_o > d$).

L_t is the total length of the test piece according to L_c and l_t.

FIGURE 4 – **Tensile test piece**

Dimensions in millimetres

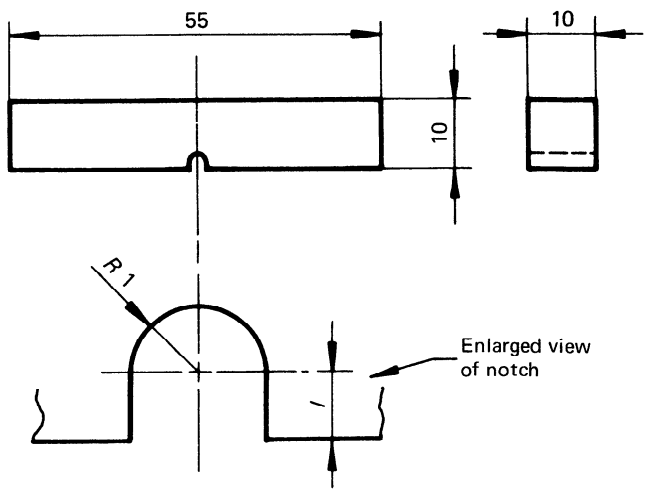


FIGURE 5 – **Dimensions of Mesnager U-notch test piece for the impact test**

APPENDIX

SUPPLEMENTARY DATA ON MECHANICAL AND PHYSICAL PROPERTIES AND TYPICAL APPLICATIONS OF AUSTENITIC CAST IRON (FOR INFORMATION PURPOSES ONLY)

Z.1 GENERAL

In determining the physical properties of austenitic cast iron, it should be borne in mind that the casting skin does not in general exhibit the same properties as the base material. This is valid in particular in determining electrical and magnetic properties. Therefore, before any such measurement is made, the casting skin must be carefully removed. In so doing, the material must not be subjected to mechanical stresses so severe that it exhibits plastic flow on the surface as, in that case, the surface will once again exhibit different properties from the base material. Therefore, the best test procedures are those in which the property to be measured is determined over a test piece volume that is not too small.

It is recommended that a round test piece, about 10 mm in diameter and 100 mm in length, should be carefully machined (low depth and speed of cut) from a test sample cast with the casting. The test piece must then be carefully pickled as traces of deformation martensite or ferromagnetic tool particles adhering to the surface tend to give incorrect measurements.

Z.2 DATA

Z.2.1 Flake graphite austenitic cast irons

Table 4 gives the mechanical properties.

Table 5 gives the physical properties.

Table 6 gives the typical applications and some characteristics.

Z.2.2 Spheroidal graphite austenitic cast irons

Table 7 gives the mechanical properties.

Table 8 gives the physical properties.

Table 9 gives the typical applications and some characteristics.

Table 10 gives typical mechanical properties of grade S – Ni Mn 23 4 at low temperatures (– 196 °C).

TABLE 4 – **Mechanical properties of flake graphite austenitic cast irons**

Grade	Mechanical properties				
	Tensile strength [1] (R_m) N/mm²	Compressive strength N/mm²	Elongation (A) %	Elastic modulus[2] (E) GN/m²	Brinell hardness HB
L – Ni Mn 13 7	140 to 220	630 to 840	not indicated	70 to 90	120 to 150
L – Ni Cu Cr 15 6 2	170 to 210	700 to 840	2	85 to 105	140 to 200
L – Ni Cu Cr 15 6 3	190 to 240	860 to 1 100	1 to 2	98 to 113	150 to 250
L – Ni Cr 20 2	170 to 210	700 to 840	2 to 3	85 to 105	120 to 215
L – Ni Cr 20 3	190 to 240	860 to 1 100	1 to 2	98 to 113	160 to 250
L – Ni Si Cr 20 5 3	190 to 280	860 to 1 100	2 to 3	110	140 to 250
L – Ni Cr 30 3	190 to 240	700 to 910	1 to 3	98 to 113	120 to 215
L – Ni Si Cr 30 5 5	170 to 240	560	not indicated	105	150 to 210
L – Ni 35	120 to 180	560 to 700	1 to 3	74	120 to 140

1) The minimum tensile strengths indicated are mandatory (see 5.2.1 and Table 1).

2) 1 GN/m² = 1 N/mm² × 10^3

TABLE 5 — **Physical properties of flake graphite austenitic cast irons**

Grade	Physical properties					
	Nominal density Mg/m³	Thermal coefficient of expansion (20 to 200 °C) m/(m·°C) × 10^{-6}	Thermal conductivity W/(m·°C)	Specific heat J/(g·°C)	Specific electrical resistance Ω.mm²/m	Relative permeability μ (where H = 8 kA/m)
L — Ni Mn 13 7	7,3	17,7	37,7 to 41,9	0,46 to 0,50	1,4	1,02
L — Ni Cu Cr 15 6 2	7,3	18,7	37,7 to 41,9	0,46 to 0,50	1,6	1,03
L — Ni Cu Cr 15 6 3	7,3	18,7	37,7 to 41,9	0,46 to 0,50	1,1	1,05
L — Ni Cr 20 2	7,3	18,7	37,7 to 41,9	0,46 to 0,50	1,4	1,04
L — Ni Cr 20 3	7,3	18,7	37,7 to 41,9	0,46 to 0,50	1,2	1,04
L — Ni Si Cr 20 5 3	7,3	18,0	37,7 to 41,9	0,46 to 0,50	1,6	1,1
L — Ni Cr 30 3	7,3	12,4	37,7 to 41,9	0,46 to 0,50	not indicated	not indicated
L — Ni Si Cr 30 5 5	7,3	14,6	37,7 to 41,9	0,46 to 0,50	1,6	> 2
L — Ni 35	7,3	5,0	37,7 to 41,9	0,46 to 0,50	not indicated	not indicated

TABLE 6 — **Properties and typical applications of flake graphite austenitic cast irons**

Grade	Properties[1]	Typical applications
L — Ni Mn 13 7	Non-magnetic	Such applications as pressure covers for turbine generator sets, housings for switchgear, insulator flanges, terminals and ducts.
L — Ni Cu Cr 15 6 2	Good resistance to corrosion, particularly in alkalis, dilute acids, sea water and salt solutions. Good heat resistance, good bearing properties, high thermal expansion, non-magnetic at low chromium contents.	Such applications as pumps, valves, furnace components, bushings, piston ring carriers for light alloy metal pistons.
L — Ni Cu Cr 15 6 3	Better corrosion and erosion resistance than Grade L — Ni Cu Cr 15 6 2.	
L — Ni Cr 20 2	Similar to L — Ni Cu Cr 15 6 2, but more corrosion resistant to alkalis. High coefficient of thermal expansion.	As for L — Ni Xu Cr 15 6 2, but preferable for pumps handling alkalis, vessels for caustic alkalis, uses in the soap, food, artificial silk and plastics industries. Suitable where copper-free materials are required.
L — Ni Cr 20 3	As L — Ni Cr 20 2, but more resistant to erosion, heat and growth.	As L — Ni Cr 20 2, but preferred also for high temperature applications.
L — Ni Si Cr 20 5 3	Good resistance to corrosion, even to dilute sulphuric acid. More heat resistant than L — Ni Cr 20 2 and L — Ni Cr 20 3. This grade is not suitable for use in the temperature range 500 to 600 °C.	Such applications as pump components, valve castings for industrial furnaces.
L — Ni Cr 30 3	Resistant to heat and thermal shock up to 800 °C. Good corrosion resistance at high temperatures; excellent erosion resistance in wet steam and salt slurry; average thermal expansion.	Such applications as pumps, pressure vessels, valves, filter parts, exhaust gas manifolds, turbocharger housings.
L — Ni Si Cr 30 5 5	Particularly resistant to corrosion, erosion and heat; average thermal expansion.	Such applications as pump components, valve castings for industrial furnaces.
L — Ni 35	Resistant to thermal shock; low thermal expansion.	Such applications as parts with dimensional stability (for example machine tools), scientific instruments, glass moulds.

1) The properties given depend on chemical composition (see 5.1.2).