UDC 669.13 : 669.112.227.1 September 1981

Austenitic cast iron

DIN 1694

Austenitisches Gusseisen

Supersedes 10.66 edition

As it is current practice in standards published by the International Organization for Standardization (ISO), the comma has been used throughout as a decimal marker.

For connection with International Standard **ISO 2892 — 1973** issued by the International Organization for Standardization (ISO), see Explanations.

Dimensions in mm

1 Field of application

This standard applies to the material properties and composition of flake graphite austenitic cast iron and spheroidal or nodular graphite austenitic cast iron and castings made from them.

This standard is supplemented by the general technical delivery conditions for metal castings contained in DIN 1690 Part 1.

2 Concept

Austenitic cast iron is the term used to designate high alloy iron-carbon casting materials in which the metallic matrix has been rendered austenitic by addition of alloying elements and in which the carbon is present predominantly as graphite.

3 Material

Austenitic cast iron is classified into the material groups flake graphite austenitic cast iron (GGL) and spheroidal graphite austenitic cast iron (GGG).

This classification of grades is based on the main alloy constituents, see table 1 for GGL and table 2 for GGG. Where there is a horizontal dash in the table column no value is specified.

It is at the purchaser's discretion to select the grade. The casting manufacturer shall test the suitability of the grade for producing the required casting.

4 Designation

In the order and on drawings the symbols or material numbers given in tables 1 and 2 must be used for designating the grade of material.

Example:

Designation of a flake graphite austenitic cast iron with symbol GGL-NiCr 30 3 or material number 0.6676:

Cast iron DIN 1694 – GGL-NiCr 30 3

or

Cast iron DIN 1694 – 0.6676

5 Production

The method of production is left to the discretion of the casting manufacturer unless otherwise agreed.

6 Requirements

6.1 Chemical composition

A tabular representation of the chemical composition is given in table 1 for GGL and table 2 for GGG.

6.2 Mechanical properties

Tables 1 and 2 apply with regard to the mechanical properties determined on specimens taken from separately cast test pieces.

Any other requirements, such as mechanical properties at specified points on the casting, specimens to be cast integrally with, or machined from, the casting, or additional requirements, for example mechanical properties, for which reference data are given in Supplement 1 to DIN 1694, must be specifically agreed at the time of ordering.

6.3 Physical properties

Reference data regarding physical properties which may, if necessary, be agreed at the time of ordering are given in Supplement 1 to DIN 1694.

6.4 General condition of castings

The specifications in DIN 1690 Part 1 apply.

6.5 Shape and dimensions

The specifications in DIN 1690 Part 1 apply.

Shrinkage is generally in the range from 1,5 to 2,5 %.

6.6 Machining allowances

Surfaces to be machined must be specified by the purchaser in the drawings forming the basis for the order and the machining allowances must be determined by agreement with the casting manufacturer; see also DIN 1680 Part 1 and Part 2.

In other respects, the specifications in DIN 1690 Part 1 apply.

Continued on pages 2 to 9

Table 1. Flake graphite austenitic cast iron

Grade		Composition, percentage mass proportions [1]						Tensile strength [2] R_m	Properties [3]	Notes on the use
Symbol	Material number	C max.	Si	Mn	Ni	Cr	Cu	N/mm² min.		
GGL-NiMn 13 7	0.6652	3,0	1,5 to 3,0	6,0 to 7,0	12,0 to 14,0	0,2 max.	–	140	Non-magnetizable	Non-magnetizable castings, e.g. pressure covers for turbine generator sets, housings for switchgear, insulator flanges, terminals, ducts
GGL-NiCuCr 15 6 2	0.6655	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	Good corrosion resistance, particularly to alkalis, dilute acids, sea water and salt solutions; fairly good heat resistance, good bearing properties, high coefficient of thermal expansion, non-magnetizable with low chromium content	Pumps, valves, furnace components, bushings, piston ring carriers for light alloy metal pistons, non-magnetizable castings
GGL-NiCuCr 15 6 3	0.6656	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	Better resistance to corrosion and erosion than GGL-NiCuCr 15 6 2	Pumps, valves, furnace components, bushings, piston ring carriers for light alloy metal pistons
GGL-NiCr 20 2	0.6660	3,0	1,0 to 2,8	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	–	170	Similar to GGL-NiCuCr 15 6 2, but more resistant to corrosion by alkalis, good heat resistance, good bearing properties, high coefficient of thermal expansion, non-magnetizable with low chromium content	As GGL-NiCuCr 15 6 2, but to be preferred for pumps handling alkalis, boilers for caustic alkalis, and use in the soap, food processing, artificial silk and plastics industries; for use generally where copper-free materials are required.
GGL-NiCr 20 3	0.6661	3,0	1,0 to 2,8	0,5 to 1,5	18,0 to 22,0	2,5 to 3,5	–	190	As GGL-NiCr 20 2, but more resistant to erosion, heat and growth	
GGL-NiSiCr 20 5 3	0.6667	2,5	3,5 to 5,5	0,5 to 1,5	18,0 to 22,0	1,5 to 4,5	–	190	Good corrosion resistance, even to dilute sulfuric acid, very good heat resistance	Pump components, valves, castings for industrial furnaces
GGL-NiCr 30 3	0.6676	2,5	1,0 to 2,0	0,5 to 0,8	28,0 to 32,0	2,5 to 3,5	–	190	Resistant to heat and thermal shock up to 800 °C, good corrosion resistance at high temperatures, particularly resistant to erosion in wet steam and salt slurries, average coefficient of thermal expansion	Pumps, boilers, valves, filter parts, exhaust gas manifolds, turbocharger housings
GGL-NiSiCr 30 5 5	0.6680	2,5	5,0 to 6,0	0,5 to 1,5	29,0 to 32,0	4,5 to 5,5	–	170	Particularly resistant to corrosion, erosion and heat; average coefficient of thermal expansion	As GGL-NiSiCr 20 5 3

[1] These values apply to the casting.
[2] On separately cast test pieces (see clauses 6.2 to 10)
[3] The properties specified depend on the chemical composition. If required, narrower limits on the chemical composition must be agreed.

Table 2. Spheroidal graphite austenitic cast iron

Grade		Composition, percentage mass proportions [2], [3]						Mechanical properties [1]				Properties [5]	Notes on the use
Symbol	Material number	C	Si	Mn	Ni	Cr	Others	Tensile strength R_m	0,2 % proof stress	Elongation A	Notch impact strength A_v (ISO-V-notch specimen)		
		max.						N/mm²	N/mm²	%	J		
								min.					
GGG-NiMn 13 7	0.7652	3,0	2,0 to 3,0	6,0 to 7,0	12,0 to 14,0	–	–	390	210	15	16	Non-magnetizable, similar to GGL-NiMn 13 7 but with improved mechanical properties	Non-magnetizable castings, e.g. pressure covers for turbine generator sets, housings for switchgear, insulator flanges, terminals, ducts
GGG-NiCr 20 2	0.7660	3,0	1,5 to 3,0	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	–	370	210	7	13	Similar to GGL-NiCr 20 2 in relation to composition, corrosion and heat resistance, however because of the spheroidal graphite structure, has improved mechanical properties. Good bearing properties, high coefficient of thermal expansion. Non-magnetizable with low chromium content. Increased high-temperature strength if 1 % by weight of Mo is added	Pumps, valves, compressors, bushings, turbocharger housings, exhaust gas manifolds, non-magnetizable castings

[1] On separately cast test pieces (see subclauses 6.2 and 11.2)

[2] These values apply to the casting.

[3] Phosphorus, maximum 0,08 %, unless otherwise specified.

[5] The properties specified depend on the chemical composition. If required, narrower limits for the chemical composition must be agreed.

Table 2. (continued)

Grade		Composition, percentage mass proportions [2], [3]						Mechanical properties [1]				Properties [5]	Notes on the use
Symbol	Material number	C max.	Si	Mn	Ni	Cr	Others	Tensile strength R_m N/mm² min.	0,2% proof stress N/mm² min.	Elongation A % min.	Notch impact strength A_v (ISO-V-notch specimen) J min.		
GGG-NiCrNb 20 2 [4]	0.7659	3,0	1,5 to 2,4	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	Mg. max. 0,08 P max. 0,04 Nb 0,1 to 0,2	370	210	7	13	Suitable for production welding, the other properties being as for GGG-NiCr 20 2	As for GGG-NiCr 20 2
GGG-NiCr 20 3	0.7661	3,0	1,5 to 3,0	0,5 to 1,5	18,0 to 22,0	2,5 to 3,5	–	390	210	7	–	Similar to GGG-NiCr 20 2 but more resistant to erosion and heat	Pumps, valves, compressors, bushings, turbocharger housings, exhaust gas manifolds
GGG-NiSiCr 20 5 2	0.7665	3,0	4,5 to 5,5	0,5 to 1,5	18,0 to 22,0	1,0 to 2,5	–	370	210	10	–	Good corrosion resistance, even to dilute sulfuric acid. Very good heat resistance. Better mechanical properties than GGL-NiSiCr 20 5 3	Pump components, valves, castings for industrial furnaces subject to high mechanical stress
GGG-Ni 22	0.7670	3,0	1,0 to 3,0	1,5 to 2,5	21,0 to 24,0	–	–	370	170	20	20	High ductility. Lower corrosion and heat resistance than GGG-NiCr 20 2. High coefficient of thermal expansion. Remains tough down to – 100 °C. Non-magnetizable	Pumps, valves, compressors, bushings, turbocharger housings. Exhaust gas manifolds, non-magnetizable castings
GGG-NiMn 23 4	0.7673	2,6	1,5 to 2,5	4,0 to 4,5	22,0 to 24,0	–	–	440	210	25	24	Particularly high ductility. Remains tough down to – 196 °C, non-magnetizable	Castings for refrigeration engineering for use down to – 196 °C

[1] to [3] see page 3

[4] The difference in the silicon content and the other specifications compared with GGG-NiCr 20 2 takes into account the weldability of the material. As regards the silicon, magnesium, phosphorus and niobium content of the chemical composition, compliance with the conditions given in the expressions below is a condition for maintaining the particularly good weldability of the material:

$$0{,}0286 \cdot (\%Si + 64 \cdot \%Mg - 5{,}6) + 8 \cdot (\%P - 0{,}025) \leqq \%Nb$$

$$\%Nb \leqq 0{,}353 - 0{,}032 \cdot (\%Si + 64 \cdot \%Mg)$$

$$\%Nb \leqq 0{,}353 - 0{,}032 \cdot (\%Si + 64 \cdot \%Mg)$$

[5] See page 3

Table 2. (continued)

Grade		Composition, percentage mass proportions [2], [3]						Mechanical properties [1]				Properties [5]	Notes on the use
								Tensile strength R_m	0,2 % proof stress	Elongation A	Notch impact strength A_v (ISO-V-notch specimen)		
Symbol	Material number	C	Si	Mn	Ni	Cr	Others	N/mm²	N/mm²	%	J		
		max.						min.					
GGG-NiCr 30 1	0.7677	2,6	1,5 to 3,0	0,5 to 1,5	28,0 to 32,0	1,0 to 1,5	–	370	210	13	–	Similar to GGL-NiCr 30 3; good bearing properties	Pumps, boilers, valves, filter parts, exhaust gas manifolds, turbocharger housings
GGG-NiCr 30 3	0.7676	2,6	1,5 to 3,0	0,5 to 1,5	28,0 to 32,0	2,5 to 3,5	–	370	210	7	–	Similar to GGL-NiCr 30 3, but with improved mechanical properties, particularly resistant to thermal shock and having good high-temperature strength when 1 % by weight of molybdenum is added	
GGG-NiSiCr 30 5 2	0.7679	2,6	4,0 to 6,0	0,5 to 1,5	29,0 to 32,0	1,5 to 2,5	–	380	210	10	–	Particularly high corrosion, erosion and heat resistance, average coefficient of thermal expansion, but higher ductility and toughness than GGG-NiSiCr 30 5 5	Pumps, fittings, exhaust gas manifolds, turbocharger housings, castings for industrial furnaces
GGG-NiSiCr 30 5 5	0.7680	2,6	4,0 to 6,0	0,5 to 1,5	28,0 to 32,0	4,5 to 5,5	–	390	240	–	–	Particularly high corrosion, erosion and heat resistance, average coefficient of thermal expansion	
GGG-Ni 35	0.7683	2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	–	–	370	210	20	–	Low coefficient of thermal expansion, resistance to thermal shock	Parts with dimensional stability for machine tools, scientific instruments, glass moulds
GGG-NiCr 35 3	0.7685	2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	2,0 to 3,0	–	370	210	7	–	Similar to GGG-Ni 35, but with improved high-temperature strength, particularly when 1 % by weight of molybdenum is added	Gas turbine housing parts, glass moulds
GGG-NiSiCr 35 5 2	0.7688	2,0	4,0 to 6,0	0,5 to 1,5	34,0 to 36,0	1,5 to 2,5	–	370	200	10	–	Heat resistant, higher ductility and higher creep strength than GGG-NiCr 35 3	Gas turbine housing parts, exhaust gas manifolds, turbocharger housing

[1] to [3] and [5] see page 3

6.7 Weights

The density values used for calculating the weights are dependent on the grade of alloy and are between 7,3 kg/dm³ and 7,7 kg/dm³. Reference values of density for the various materials are given in Supplement 1 to DIN 1694.

7 Patterns

The specifications in DIN 1690 Part 1 apply.

8 Heat treatment

Castings made of austenitic cast iron materials are preferably supplied in the as-cast condition (without heat treatment).

On the other hand heat treatment is advisable for particular castings, in order to

- reduce casting stresses,
- reduce casting stresses after welding,
- obtain high dimensional stability,
- obtain particular mechanical and physical properties.

Heat treatments must be agreed between the purchaser and the manufacturer.

9 Welding

Any welding — predominantly production welding — on austenitic cast iron castings must be agreed between the purchaser and the manufacturer.

If welding work is likely to be involved in manufacturing the castings, instead of grade GGG-NiCr 20 2 grade GGG-NiCrNb 20 2 shall be selected, which is particularly suitable for welding. According to the nature of the casting and the extent of the welding work, heat treatment may be necessary after welding.

10 Sampling

The general principles given in DIN 1605 Part 1 and DIN 1690 Part 1 apply as appropriate to sampling and testing of austenitic cast iron also. If the purchaser does not specify the shape and size of the test samples, the casting manufacturer shall decide these.

In the case of test samples to be cast integrally with or machined from the casting, specific agreements must be made at the time of ordering regarding their location.

In the case of austenitic cast iron, separately cast test samples are used for determining the mechanical properties in accordance with table 1 and table 2. In general, "Y" type test samples are taken as shown in figure 2. Castings and associated test samples must be cast as far as possible one immediately after the other from the same ladle. Sand moulds having the minimum thickness of surrounding sand layer specified in table 3 must be used for this purpose. The thickness a of the test samples must if possible be matched to the relevant wall thickness of the casting.

In addition to "Y" type test samples, it is also possible to use "U" type test samples as shown in figure 2 (for dimensions see table 4) or the simplified "U" type test sample (Lynchburg specimen) as shown in figure 3.

The shape of test sample must be agreed at the time of ordering.

If castings are heat treated, the associated separately cast test samples must be heat treated with them. Integrally cast test samples must only be separated after heat treatment.

11 Testing of material

11.1 Chemical composition

The chemical composition must be determined using the normal method. Proof of chemical composition may be agreed at the time of ordering.

11.2 Mechanical properties

If proof of compliance with the values given in tables 1 and 2 or other properties is required, this must be agreed at the time of ordering (see clause 6).

DIN 50 106, DIN 50 115, DIN 50 125, DIN 50 145 and DIN 50 351 apply for testing.

VDG Instruction sheet P 441, August 1962, "Richtreihen zur Kennzeichnung der Graphitausbildung" (Guidance for identifying graphite structure) [1] may be used for assessing the graphite structure.

11.3 Physical properties

Testing of the physical properties must be specifically agreed; for this purpose see also the reference data given in Supplement 1 to DIN 1694.

11.4 Number of test pieces

The number of test pieces must be agreed at the time of ordering.

11.5 Retests

The specifications in DIN 1690 Part 1 apply.

12 Certificates on tests and acceptance

The specifications in DIN 1690 Part 1 apply.

13 Objections

The specifications in DIN 1690 Part 1 apply.

---

[1] Obtainable from:
Bücherei des Vereins Deutscher Giessereifachleute, Postfach 82 25, D-4000 Düsseldorf 1

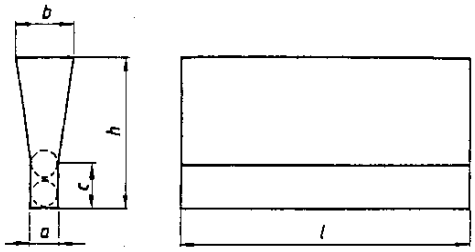
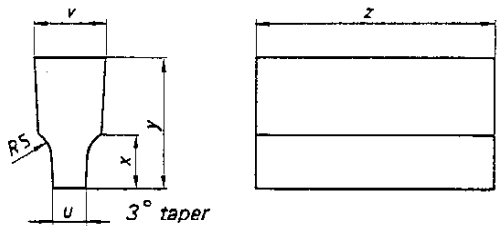


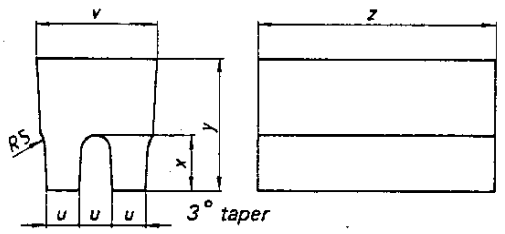
Figure 1. "Y" type test sample

Table 3. **Dimensions of "Y" type test sample as in figure 1**

Test samples						Tensile specimen according to DIN 50125	Thickness of sand layer surrounding the test sample minimum
No	*a*	*b*	*c*	*h*	*l*		
Y 1	12	40	25	135	160	B 6X30	40
Y 2	25	55	40	140	300	B 14X70	40
Y 3	50	100	50	150			80
Y 4	75	125	65	175			



a) "U" type test samples I, II*a*, III and IV



b) "U" type test sample II*b*

Figure 2. "U" type test samples

Table 4. **Dimensions of "U" type test samples as in figure 2**

Test samples						Tensile specimen according to DIN 50125	Thickness of sand layer surrounding the test sample minimum
No	*u*	*v*	*x*	*y*	*z*		
U I	12	40	30	80	According to the length of the test bar	B 6X30	80
U II*a*	25	55	40	100		B 14X70	
U IIb	25	90	40	100			
U III	50	90	60	150			
U IV	75	125	65	165			

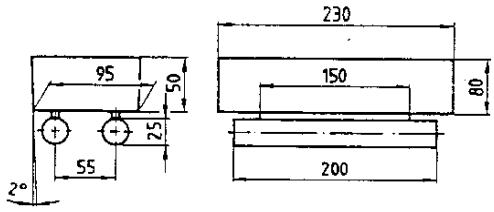


Figure 3. Simplified "U" type test sample (Lynchburg specimen)

Standards referred to and other documents

DIN	1605 Part 1	Testing of materials; mechanical testing of metals; general and acceptance
DIN	1680 Part 1	Rough castings; general tolerances and machining allowances; general
DIN	1680 Part 2	Rough castings; general tolerances system
DIN	1690 Part 1	General technical delivery conditions for metal castings
Supplement 1		
DIN	1694	Austenitic cast iron; reference data on mechanical and physical properties
DIN	50 106	Testing of metallic materials; compression test
DIN	50 115	Testing of metallic materials; notched bar impact bending test

DIN 50 125	Testing of metallic materials; tensile test specimens; directions for their preparation
DIN 50 145	Testing of metallic materials; tensile test
DIN 50 351	Testing of metallic materials; Brinell hardness testing
ISO 2892	Austenitic cast iron
VDG Instruction sheet P 441	Guidelines for identifying graphite structure, August 1962 edition

Further standards

DIN 1691	Cast iron with lamellar graphite (grey cast iron)
DIN 1693 Part 1	Cast iron with nodular graphite; unalloyed and low alloy grades
DIN 1693 Part 2	Cast iron with nodular graphite; unalloyed and low alloy grades; properties in integrally cast test piece
DIN 1695	Abrasion-resistant alloyed cast iron

Previous edition

DIN 1694: 10.66

Amendments

The following amendments have been made compared with the October 1966 edition:

a) Grade GGL-Ni 35 has been deleted.

b) Grades GGG-NiCrNb 20 2, GGG-NiSiCr 30 5 2 and GGG NiSiCr 35 5 2 have been newly adopted.

c) The chemical composition and the information on mechanical properties and also the test samples to be used, have been brought into line with International Standard ISO 2892 – 1973 Austenitic cast iron

d) Since the general technical delivery conditions for metal castings are contained in the new Standard DIN 1690 Part 1, general specifications of this kind have been replaced by references to the relevant specifications in DIN 1690 Part 1 in some clauses of DIN 1694, so that this particular type of information is contained in only one standard.

e) The data in table 5 on code designations for austenitic grades of cast iron produced in Germany and abroad have been brought into line with the latest state of the art.

Explanations

The first edition of DIN 1694 in October 1966 served as the basis for International Standard ISO 2892 – 1973. Since then there have been further developments in the state of the art so that it became necessary to revise DIN 1694.

Austenitic cast irons have different properties, e.g. with regard to resistance to corrosion, erosion and heat, ability to withstand thermal shock, bearing properties and toughness at low temperatures down to – 196 °C, according to their composition and graphite structure. Moreover, according to the grade, such alloys may have a high, average or extremely low coefficient of thermal expansion. Some grades are non-magnetizable [1 to 3 and 11]. This great variety of properties has necessitated increasing the number of grades in the standard to 22. As cast-iron based materials, these grades have good casting properties [4, 5 and 8] and – particularly the low-Cr grades – also good workability [16].

As regards authorization for use of particular grades see AD Instruction sheets W 3/3, W 10 and VdTÜV Material sheets 368 and 367 [12 to 15].

Separately cast "Y" type test samples are preferably used for testing the mechanical properties. As an alternative to this type, "U" type test samples or simplified "U" type test samples (Lynchburg specimens) may be used (see also the test samples in ISO 2892).

Table 5 shows the symbols used in accordance with DIN 1694 together with the corresponding grade designations in the ISO Standard and the American and British Standards; the generally used commercial names are also appended.

Supplement 1 to DIN 1694 contains reference data on the mechanical and physical properties of austenitic cast irons. The amount of data contained in this new issue of the supplement has been substantially increased. Further information can be obtained from the literature [1 to 11 and 16 to 18].

Literature

[1] Die Ni-Resist-Gusseisenwerkstoffe (Ni-resist cast irons). Published by International Nickel Deutschland GmbH, Düsseldorf

[2] Austenitische Gusseisenwerkstoffe in der chemischen Industrie und der Erdölindustrie (Austenitic cast irons in chemical and mineral oil industries). Published by International Nickel Deutschland GmbH, Düsseldorf.

[3] Nickel, O.: Austenitisches Gusseisen mit Kugelgraphit (Spheroidal graphite austenitic cast iron). Legiertes Gusseisen. Vol. 2, Pt 3, Giesserei-Verlag, Düsseldorf

[4] Kallen, W.: Die Herstellung hochwertiger Gussstücke aus austenitischem Gusseisen mit Kugelgraphit (The manufacture of high quality castings from spheroidal graphite austenitic cast iron). Giesserei 56 (1969) No. 6, pp 135–139

[5] **Nickel, O.:** Einfluss der Zusammensetzung auf die mechanischen Eigenschaften von austenitischem Gusseisen mit Kugelgraphit und 20 % Nickel (Influence of the composition of spheroidal graphite austenitic cast iron with 20 % nickel on its mechanical properties). Giesserei 56 (1969) No. 25, pp 752–755

[6] **Summary of Experimental Data.** Ni-Resist Type D-4A. International Nickel Deutschland GmbH, Düsseldorf

[7] **Church, N. L.; Fiene, M. J.:** Depaul, R. A.: Austenitisches Gusseisen mit Kugelgraphit zur Verwendung bei hohen Temperaturen (Spheroidal graphite austenitic cast iron for use at high temperatures). Giess.-Prax. (1973) No. 21, pp 377–384

[8] **Grant, J. W.; Morrison, J. C.:** Herstellung von Gussstücken aus austenitischem Gusseisen mit Lamellen- und Kugelgraphit (Manufacture of castings from flake graphite or spheroidal graphite austenitic cast iron). Giesserei 60 (1973) No. 4, pp 89–95

[9] **Dietrich, H.:** Nichtmagnetisierbare Gusseisenwerkstoffe und ihre Prüfung. I/II. (Non-magnetizable cast irons and testing of them). Giesserei, techn.-wiss. Beih., 15 (1963) No. 1, pp 45–58; No. 2, pp 59–73

[10] Publication No. 29 of International Nickel Deutschland GmbH, Düsseldorf

[11] **Nickel, O.:** Eigenschaften der austenitischen Gusseisenwerkstoffe (Properties of austenitic cast irons). Konstruieren und Giessen (1976) No. 3, pp 9–19 VDI Verlag, Düsseldorf

[12] AD Instruction sheet W 3/3. Gusseisenwerkstoffe. Austenitisches Gusseisen mit Lamellengraphit (Cast irons. Flake graphite austenitic cast irons). 4th edition, 1970

[13] AD Instruction sheet W 10, sheet 1. Werkstoffe für tiefe Temperaturen. Eisenwerkstoffe. (Materials for low temperatures. Ferrous materials). Draft 12. 1963

[14] VdTÜV Material sheet 368.9.1972. Austenitisches Gusseisen mit Kugelgraphit GGG-NiCr 20 2 (0.7660) (Spheroidal graphite austenitic cast iron)

[15] VdTÜV Material sheet 367.9.1972. Austenitisches Gusseisen mit Kugelgraphit GGG-NiMn 23 4 (0.7673) (Spheroidal graphite austenitic cast iron)

[16] **Kämmer, K.:** Austenitisches Gusseisen (Spanabhebende Bearbeitung) (Austenitic cast iron (machining)). Konstruieren und Giessen (1975) No. 6, pp 34–39

[17] **Nickel, O.:** Schweissen von austenitischem Gusseisen (Welding of austenitic cast iron). Konstruieren und Giessen (1978) No. 1, pp 20–27

[18] **Stephenson, N.; Strassburg, F. W.:** Untersuchungen zur Verbesserung der Schweisseignung von austenitischem Gusseisen GGG-NiCr 20 2 (Studies on improving the weldability of austenitic cast iron GGG-NiCr 20 2). Schweissen und Schneiden (1978) No. 2, pp 48–53

Table 5. **Code designations for austenitic cast irons in Germany and abroad**

Graphite structure	DIN 1694 symbol	ISO 2892 – 1973	ASTM A 436–71 A 439–71 A 571–71	British Standard B,S 3468 : 1974	Commercial name
Flake graphite	GGL-NiMn 13 7	L-NiMn 13 7	–	L-NiMn 13 7	–
	GGL-NiCuCr 15 6 2	L-NiCuCr 15 6 2	Type 1	L-NiCuCr 15 6 2	Ni-Resist 1
	GGL-NiCuCr 15 6 3	L-NiCuCr 15 6 3	Type 1b	L-NiCuCr 15 6 3	Ni-Resist 1b
	GGL-NiCr 20 2	L-NiCr 20 2	Type 2	L-NiCr 20 2	Ni-Resist 2
	GGL-NiCr 20 3	L-NiCr 20 3	Type 2b	L-NiCr 20 3	Ni-Resist 2b
	GGL-NiSiCr 20 5 3	L-NiSiCr 20 5 3	–	L-NiSiCr 20 5 3	Nicrosilal
	GGL-NiCr 30 3	L-NiCr 30 3	Type 3	L-NiCr 30 3	Ni-Resist 3
	GGL-NiSiCr 30 5 5	L-NiSiCr 30 5 5	Type 4	L-NiSiCr 30 5 5	Ni-Resist 4
Spheroidal graphite	GGG-NiMn 13 7	S-NiMn 13 7	–	S-NiMn 13 7	–
	GGG-NiCr 20 2	S-NiCr 20 2	Type D-2	S-NiCr 20 2	Ni-Resist D-2
	GGG-NiCrNb 20 2	–	–	–	Ni-Resist D-2W
	GGG-NiCr 20 3	S-NiCr 20 3	Type D-2B	S-NiCr 20 3	Ni-Resist D-2B
	GGG-NiSiCr 20 5 2	S-NiSiCr 20 5 2	–	S-NiSiCr 20 5 2	Nicrosilal Spheronic
	GGG-Ni 22	S-Ni 22	Type D-2C	S-Ni 22	Ni-Resist D-2C
	GGG-NiMn 23 4	S-NiMn 23 4	Type D-2M	S-NiMn 23 4	Ni-Resist D-2M
	GGG-NiCr 30 1	S-NiCr 30 1	Type D-3A	S-NiCr 30 1	Ni-Resist D-3A
	GGG-NiCr 30 3	S-NiCr 30 3	Type D-3	S-NiCr 30 3	Ni-Resist D-3
	GGG-NiSiCr 30 5 2	–	–	–	Ni-Resist D-4A
	GGG-NiSiCr 30 5 5	S-NiSiCr 30 5 5	Type D-4	S-NiSiCr 30 5 5	Ni-Resist D-4
	GGG-Ni 35	S-Ni 35	Type D-5	S-Ni 35	Ni-Resist D-5
	GGG-NiCr 35 3	S-NiCr 35 3	Type D-5B	S-NiCr 35 3	Ni-Resist D-5B
	GGG-NiSiCr 35 5 2	–	–	–	Ni-Resist D-5S