

# Materials



## Cast

### GG: Grey cast iron with lamellar graphite

Designation	DIN EN	USA	Main alloying constituents in %										Hardness	Yield strength Rp0.2 (20°C)		
			C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other				
GG 20	0.6020	ASTM A48 (30B)	3.4	2.0	0.35					0.5			Rest		150-230 HB	200 N/mm <sup>2</sup>
GG 25	0.6025	ASTM A48 (40B)	2.0-4.0	1.8-2.1	0.6-0.8								Rest	P < 0.1 S < 0.08	180-250 HB	250 N/mm <sup>2</sup>

For general applications without any corrosion or abrasion requirement.

### GGG: Spheroidal cast iron with spheroidal graphite

Designation	DIN EN	USA	Main alloying constituents in %										Hardness	Yield strength Rp0.2 (20°C)		
			C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other				
GGG 40	0.7040	ASTM A536 (60-40-18)	3.8	2.5	<0.1								Rest		120-180 HB	250 N/mm <sup>2</sup>
GGG 50	0.7050	ASTM A536 (60-45-12)	3.4	2.7	<0.1				1.8				Rest		170-240 HB	320 N/mm <sup>2</sup>

For general applications without any corrosion or abrasion requirement.

### Hard Iron HG 25.3

Designation	DIN EN	USA	Main alloying constituents in %										Hardness	Yield strength Rp0.2 (20°C)		
			C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other				
HG25.3	G-X 150 Cr25	ASTM A532 (III A 25% Cr)	1.4-1.6	0.5-0.7	0.5-0.7	24-26	<3.0	<0.5			<0.2		Rest		55-60 HRC (Hardened)	No longer ductile

Extremely abrasion resistant material. For wastewater and slurries containing lots of sand. Resistant against weak acids and weak lyes.



## Stainless steels

Steel castings with at least 13% chromium content are designated as non-rusting stainless steels or Inox.

The alloy content, primarily chromium, nickel and molybdenum, form a thin passive layer on the surface which is responsible for the corrosion protection. The surface refreshes itself constantly through the presence of oxygen (air, water). The main component of stainless steel is always iron.

### Stainless steel 1.4409 (Austenitic)

			Main alloying constituents in %											
Designation	DIN EN	USA	C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other	Hardness	Yield strength Rp0.2 (20°C)
1.4409	GX2CrNiMo 19-11-2	AISI 316 L	<0.03	<1.5	<2.0	18-20	2.0-2.5	9-12		<0.2	Rest		130-200 HB	140-195 N/mm <sup>2</sup>

Equivalent designations: A4, V4A, Inox, Nirosta  
Resistant against weak acids and weak alkalis. Increased resistance against intercrystalline corrosion. Resistant against fluids with low chloride content. Moderately wear-resistant.

### Duplex stainless steel 1.4593 (Austenitic-Ferritic)

			Main alloying constituents in %											
Designation	DIN EN	USA	C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other	Hardness	Yield strength Rp0.2 (20°C)
1.4593	GX3CrNiMo-CuN24-6-2-3	AISI 329 ASTM A 890	<0.04	<1.5	<1.5	23-26	2.0-3.0	5-8	2.75-3.5	0.1-0.2	Rest		200-260 HB	450 N/mm <sup>2</sup>

Equivalent designation: CD4MCu  
Resistant to a number of mixed acids and mixed alkalis. Increased resistance to stress corrosion cracking, especially from fluids containing chlorides. Moderate to good resistance to wear.

### Highly corrosion-resistant stainless steel 1.4588 (Austenitic)

			Main alloying constituents in %											
Designation	DIN EN	USA	C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other	Hardness	Yield strength Rp0.2 (20°C)
1.4588	GX2NiCrMo-CuN25-20-6	ASTM A 743 (CK-3MCuN)	<0.025	<1.0	<2.0	19-21	6.0-7.0	24-26	0.5-1.5	0.1-0.25	Rest		Not specified	210 N/mm <sup>2</sup>

Resistant to a number of acids and alkalis. High resistance to stress corrosion cracking, especially from fluids containing chlorides. Moderately wear-resistant.



## Nickel-based alloys

In contrast to stainless steels, nickel-based alloys have nickel as their main component. Iron is only present in small amounts. The element, nickel provides these materials with very high resistance to corrosion. Through the addition of other alloying elements, especially copper, chromium, molybdenum, and tungsten, specific properties can be achieved.

### Hastelloy C-2000 / Hastelloy B3 (Nickel-based)

Designation	DIN EN	USA	Main alloying constituents in %										Hardness	Yield strength Rp0.2 (20°C)	
			C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other			
Hastelloy C-2000	2.4675 NiCr23Mo-16Cu		<0.01	<0.08	<0.5	22-24	15-17	51-62	1.3-1.9			<3.0	Al <0.5 Co <2.0	205 HB	280-330 N/mm <sup>2</sup>
Hastelloy B3	2.4600 NiMo29Cr		<0.01	<0.1	<3.0	0.5-3.0	26-32	48-72	<0.5			1.0-6	Al <0.5 Co <3.0 W <3.0 V <0.2 Ti <0.2 Nb <0.4	140-200 HB	300 N/mm <sup>2</sup>

Hastelloy is suited for a variety of highly corrosive acids, depending on temperature and concentration. Hastelloy alloys are moderately wear-resistant.

Hastelloy is a registered brand name. Inconel is a competing product with similar properties.

### Monel 411 (Nickel-based)

Designation	DIN EN	USA	Main alloying constituents in %										Hardness	Yield strength Rp0.2 (20°C)	
			C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other			
Monell 411	2.4365 G-NiCu30Nb	ASTM A 494 (M-30-C)	<0.15	0.5-1.5	0.5-1.5			62-68	26-33			1.0-2.5	Al <0.5 Co <1.0 Nb 1.0-1.5 P <0.01 S <0.01	>120 HB	220 N/mm <sup>2</sup>

Very often used with sea water and brines to a maximum of 120°C. Highly resistant to hydrofluoric acid (HF) over a wide temperature and concentration range. Moderate to poor wear resistance.

### Nickel 210 (Nickel-based)

Designation	DIN EN	USA	Main alloying constituents in %										Hardness	Yield strength Rp0.2 (20°C)	
			C	Si	Mn	Cr	Mo	Ni	Cu	N	Fe	Other			
Nickel 210	2.4170.01 G-Ni95	ASTM A 494 (CZ-100)	<1.0	<2.0	<1.5			>95	<1.2			<1.0	S <0.01	80 HB	120 N/mm <sup>2</sup>

Most important use is for sodium hydroxide (NaOH) and other alkalis. Moderately wear-resistant.