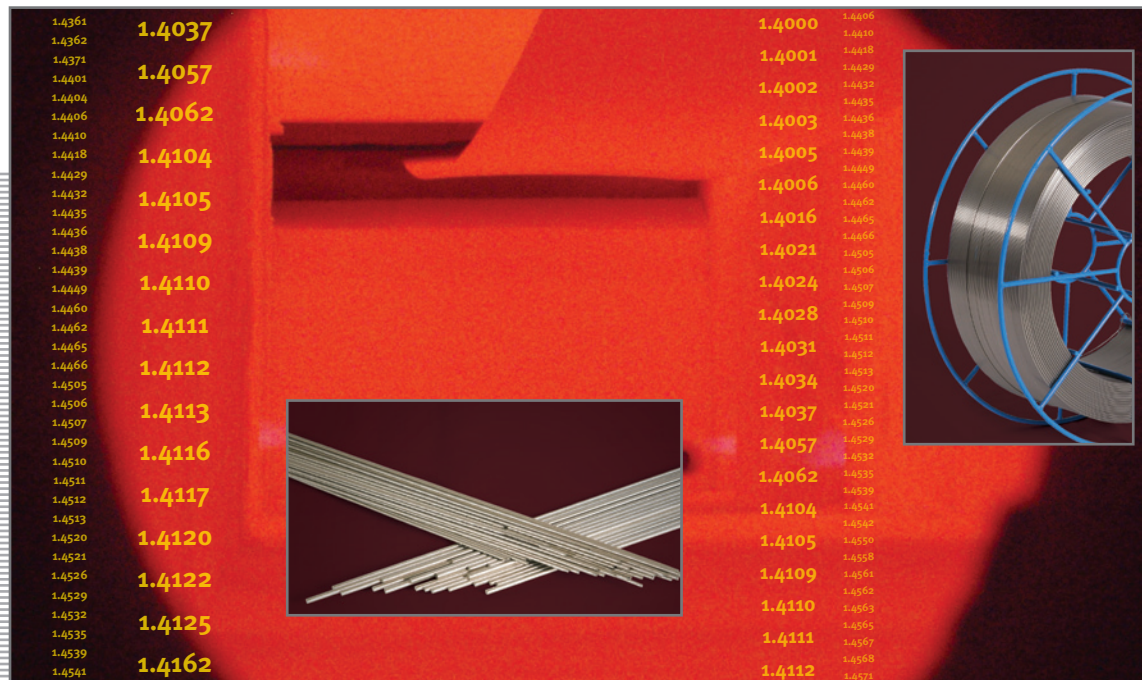


## Stainless Steels: Tables of Fabrication Parameters

Welding processes and filler materials – heat treatments – typical end uses



**Table 1. Guidelines on polishability, welding processes, filler material and typical end uses of stainless steels**

Material number	Steel structure	EN 10088, Part 1, 2, 3	Weldability	Polishability	Suitability of specific welding processes				Preheating approx. (°C)	Filler material
					GMAW (MIG), GTAW (TIG)	SMAW (MMA)	Resistance welding	Autogenous welding		
1.4000	F	1, 2, 3		●	●	●	●	■	200	1.4009, 1.4302, 1.4502, 1.4551, 1.4018, 1.4316, 1.4351
1.4001	M				●	●	●	■	200	1.4009, 1.4302, 1.4502, 1.4551
1.4002	F	1, 2		●	●	●	●		250	1.4009, 1.4551, 1.4302, 1.4502, 1.4018, 1.4409
1.4003	F	1, 2, 3		■	●	●	●	●		1.4316, 1.4326, 1.4370
1.4005	M	1, 3	◆							
1.4006	M	1, 2, 3		●	●	●	●	■	250	1.4009, 1.4502, 1.4302, 1.4551, 1.4018, 1.4316, 1.4370, 1.4519
1.4016	F	1, 2, 3		●	●	●	●	■	200	1.4316, 1.4502, 1.4302, 1.4551, 1.4332, 1.4370, 1.4430, 1.4510
1.4021	M	1, 2, 3	■	●	●	●			350	1.4316, 1.4302, 1.4502, 1.4551, 1.4332, 1.4370, 1.4430, 1.4511
1.4024	M	1, 2, 3	■		●	●			350	1.4302, 1.4316, 1.4502, 1.4551, 1.4009, 1.4018
1.4028	M	1, 2, 3	◆	●		●				2.4806
1.4031	M	1, 2, 3	◆	●		●				2.4806
1.4034	M	1, 2, 3	◆	●		●				1.4302, 1.4316, 1.4502, 1.4551
1.4037	M		◆							2.4806
1.4057	M	1, 3	■		●	●			200	1.4302, 1.4502, 1.4551, 2.4806, 1.4115, 1.4316, 1.4370
1.4062	D			●	●	●				1.4362, 1.4462
1.4104	M	1, 3	◆							
1.4105	F	1, 3	◆							
1.4109	M	1, 3	◆							
1.4110	M	1, 2, 3	◆							
1.4111	M		◆							
1.4112	M	1, 3	◆							
1.4113	F	1, 2, 3		●	●	●				1.4302, 1.4316, 1.4502, 1.4551
1.4116	M	1, 2, 3	◆	●						
1.4117	M					●				2.4806
1.4120	M		■	●	●	●			350	1.4302, 1.4551
1.4122	M	1, 2, 3	■		●	●			350	1.4302, 1.4430, 1.4551, 1.4575, 1.4576
1.4125	M	1, 3	◆							
1.4162	D				●	●	●			1.4162
1.4301	A	1, 2, 3		●	●	●	●	■		1.4316, 1.4551, 1.4302, 1.4301
1.4303	A	1, 2, 3		●	●	●	●	■		1.4316, 1.4302, 1.4551
1.4305	A	1, 2, 3	◆							1.4316
1.4306	A	1, 2, 3		●	●	●	●	■		1.4316, 1.4551
1.4307	A	1, 2, 3		●	●	●	●	●		1.4307, 1.4316, 1.4551
1.4310	A	1, 2, 3	◆ <sub>2H</sub>	●	●	●	●	●		1.4302, 1.4316
1.4311	A	1, 2, 3			●	●	●			1.4316, 1.4455, 1.4551
1.4313	M	1, 2, 3			●	●	●	●	350	1.4351, 1.4313
1.4318	A	1, 2		●	●	●	●			1.4316, 1.4455
1.4335	A	1, 2			●	●	●	●		1.4466

»

**Introduction**

The present publication provides an overview of the stainless steel grades referred to in EN 10088 Parts 1, 2 and 3. It also includes some additional grades, which are relevant without, however, being included in the current 2005 version of the European standard. It focuses on the suitability of particular welding processes, lists possible welding filler materials, gives examples of typical end uses or properties and provides information how to heat treat a specific stainless steel grade.

Information on chemical composition, mechanical and physical properties can be taken from another Euro Inox source, Stainless Steel: Tables of Technical Properties, downloadable as a PDF file ([www.euro-inox.org/pdf/map/Tables\\_TechnicalProperties\\_EN.pdf](http://www.euro-inox.org/pdf/map/Tables_TechnicalProperties_EN.pdf); English only) or as an interactive database accessible online ([www.euro-inox.org/technical\\_tables/](http://www.euro-inox.org/technical_tables/) in 11 languages).

Examples of typical applications; properties (where appropriate)	material number
Structural parts exposed to water or steam, process equipment in the oil and gas industry, welded parts	1.4000
Industrial fittings and building fixtures for interior applications, cutlery	1.4001
Petroleum processing plants, e.g. cracking installations, water turbines; adequate resistance to H <sub>2</sub> O, water vapour and H <sub>2</sub> S	1.4002
Rail and road vehicles, agricultural equipment, tubes in mining, sugar industry, hoppers, conveyors, silos, containers, non-decorative applications in building interiors; good wear resistance	1.4003
Free-machining grade for nuts, bolts, screws etc.; otherwise similar to 1.4006	1.4005
Structural parts exposed to water or steam, valve and pump components, cracking installations, gun barrels; used in contact with H <sub>2</sub> and H <sub>2</sub> S	1.4006
Cutlery, tableware, kitchen and food service equipment, interior cladding, domestic appliances, automotive trim; excellent polishability and good drawability; resistant to intergranular corrosion only in the as-delivered condition	1.4016
Knives, surgical instruments, brake discs, press plates; high wear resistance; resistant to H <sub>2</sub> O and water vapour	1.4021
Structural parts, shafts, bolts, valve stems, piston rods, turbine blades	1.4024
Springs, piston rods, bolts, knife blades, surgical instruments; resistant to H <sub>2</sub> O and water vapour when hardened	1.4028
Springs, piston rods, bolts, knife blades surgical instruments; resistant to H <sub>2</sub> O and water vapour when hardened	1.4031
Cutting tools, knives and scissors, ball bearings and skates, brake discs, press plates; hardenable; resistant to H <sub>2</sub> S	1.4034
Cutlery, ball bearings, wearing rails; resistant to H <sub>2</sub> S and water vapour	1.4037
High-strength structural parts in the food industry, production of acetic acid and soap; resistant to H <sub>2</sub> O, water vapour, dilute acids (with restrictions)	1.4057
Water industry, hydropower plants; good resistance to intergranular, fatigue and erosion corrosion	1.4062
Parts exposed to H <sub>2</sub> O or steam, bolts, spindles, arbors; improved machinability, limited corrosion resistance	1.4104
Automatic lathe components, pole armatures	1.4105
Cutting tools; highly hardenable	1.4109
Butchers knives, surgical instruments; similar to 1.4034, however harder and more abrasion resistant	1.4110
Razor blades, surgical instruments, circular knives in the meat industry, bearings; exceptional cutting hardness	1.4111
Wear-resistant parts, perforated discs, professional knives, surgical instruments, ball bearings; limited corrosion resistance	1.4112
Automotive trim; higher corrosion resistance than 1.4016, resistant to intergranular corrosion in the as-delivered condition	1.4113
Professional meat knives, penknife blades and surgical instruments; also for partially hardened parts, resistant to H <sub>2</sub> O and water vapour	1.4116
Surgical tongs and scissors; parts to be hardened partially only	1.4117
Turbine shafts and blades, valve cones for temperatures of up to 500 °C; beater knives in the cellulose industry; resistant to H <sub>2</sub> O and water vapour (better than 1.4021)	1.4120
Arbors, shafts, spindles, bolts, fittings, components for temperatures of up to 600 °C; resistant to H <sub>2</sub> O and dilute acids (with restrictions)	1.4122
Small ball bearings; highly hardenable, wear-resistant	1.4125
Pulp and paper industry, desalination, tanks and pipes in chemical tankers, storage tanks, biogas digesters, pressure vessels, heat exchangers, water heaters	1.4162
Kitchen and tableware, domestic appliances, architecture, food industry, automotive; outstanding welding, deep drawing and polishing properties; resistant to intergranular corrosion up to 6 mm thickness	1.4301
Chemical industry, precision deep drawn parts, bolts; resistant to intergranular corrosion up to 6 mm thickness, highly formable	1.4303
Turned parts; improved machinability, lower corrosion resistance than 1.4301	1.4305
Equipment exposed to organic and fruit acid in the food and chemical industries; suitable for heavy cold-forming and multiple drawing, good corrosion resistance, resistance to intergranular corrosion up to 350 °C, good resistance to HNO <sub>3</sub> of higher concentration and temperature	1.4306
Similar to 1.4301; resistant to intergranular corrosion	1.4307
Press plates, conveyor chains, mixer blades and other parts exposed to high mechanical loads, leaf springs for temperatures of up to 300 °C, shoe inserts; adequate corrosion resistance, high strength	1.4310
Pressure vessels in the chemical, dairy and brewing industries, pumps and fittings; good general corrosion resistance	1.4311
Pumps, compressors, rotor wheels in power plants and reactors; high strength; resistant to H <sub>2</sub> O and water vapour, heat treatable	1.4313
Rail carriages, buses and other lightweight designs; spring steel resistant to intergranular corrosion after welding; adequate corrosion resistance	1.4318
Good resistance to chloridic environments and acids, high mechanical strength	1.4335
	»

**Structure**

- F ferritic
- M martensitic
- D duplex
- A austenitic
- PH precipitation-hardening

**Rating**

- good, preferred
- conditional, with restrictions
- ◆ poor, with specialised processes only

**Data source** [Stahlschlüssel - Key to Steel \(www.stahlschlüssel.de\)](http://www.stahlschlüssel.de)  
 Data sheets of producers of stainless steels and welding filler materials  
 Converging information from both sources

STAINLESS STEELS: TABLES OF FABRICATION PARAMETERS

Material number	Steel structure	EN 10088, Part 1, 2, 3	Weldability	Polishability	Suitability of specific welding processes				Preheating approx. (°C)	Filler material
					GMAW (MIG), GTAW (TIG)	SMAW (MMA)	Resistance welding	Autogenous welding		
1.4361	A	1, 2, 3			●					1.4361
1.4362	D	1, 2, 3			●	●	●			1.4362, 1.4462
1.4371	A	1, 2								1.4316, 1.4430, 1.4462
1.4401	A	1, 2, 3		●	●	●	●	■		1.4430, 1.4576, 1.4403
1.4404	A	1, 2, 3		●	●	●	●	■		1.4430, 1.4455, 1.4576
1.4406	A	1, 2, 3			●	●	●	■		1.4430, 1.4455
1.4410	D	1, 2, 3			●	●	●			1.4410
1.4418	M	1, 2, 3			●	●	●	●	350	1.4430, 1.4462
1.4429	A	1, 2, 3			●	●	●			1.4455, 1.4430, 1.3954, 1.4440, 1.4453
1.4432	A	1, 2, 3		●	●	●	●			1.4430
1.4435	A	1, 2, 3		●	●	●	●			1.4430, 1.4576, 1.4440
1.4436	A	1, 2, 3			●	●	●			1.4430, 1.4576, 1.4403, 1.4436, 1.4453, 1.4440
1.4438	A	1, 2, 3			●	●	●	■		1.4440, 1.4438, 1.4453
1.4439	A	1, 2, 3		●	●	●	●			1.4440, 1.4439, 1.4453, 1.4519, 2.4831, 2.4656
1.4449	A	1			●	●	●	●		1.4453
1.4460	D	1, 3	■		●	●	●	●		1.4330, 1.4337, 1.4430, 1.4462
1.4462	D	1, 2, 3		●	●	●	●			1.4462, 1.4501
1.4465	A				●	●	●	●	150	1.4465, 2.4653
1.4466	A	1, 2, 3								
1.4505	A				●	●	●			1.4507, 1.4519, 1.4539
1.4506	A				●	●	●			1.4507, 1.4519, 1.4539
1.4507	D	1, 2, 3								
1.4509	F	1, 2, 3		●	●	●	●			1.4316, 1.4370, 1.4511
1.4510	F	1, 2		◆	●	●	●		200	1.4316, 1.4502, 1.4551, 1.4302, 1.4015, 1.4016, 1.4511
1.4511	F	1, 2, 3			●	●	●	■	200	1.4016, 1.4316, 1.4502, 1.4551, 1.4302
1.4512	F	1, 2		◆	●	●	●		200	1.4316, 1.4370, 1.4505, 1.4502, 1.4511
1.4513	F	1, 2								1.4430
1.4520	F	1, 2, 3		◆	●	●	●			1.4316, 1.4502
1.4521	F	1, 2		◆	●	●	●			1.4430
1.4526	F	1, 2, 3								1.4430
1.4529	A	1, 2, 3			●	●	●	●		2.4621, 2.4831, 1.4529, 1.4539, 1.4831
1.4532	A				●	●			250	1.4540
1.4535	M		◆							
1.4539	A	1, 2, 3		●	●	●	●			1.4539, 1.4430, 1.4831, 1.4519, 2.4831, 2.4656
1.4541	A	1, 2, 3		◆	●	●	●	■		1.4316, 1.4551, 1.4576, 1.4541
1.4542	PH	1, 2, 3			●	●	●	●		1.4542
1.4550	A	1, 2, 3		■	●	●	●	■		1.4316, 1.4551, 1.4576
1.4558	A	1			●	●	●	●		2.4648, 2.4806
1.4561	A			◆	●	●	●			1.4445, 1.4455
1.4562	A				●	●	●	●		1.4562, 2.4609, 2.4607
1.4563	A	1, 2, 3			●	●	●			2.4621, 2.4653, 2.4656
1.4565	A	1, 2, 3		●	●	●				2.4609, 2.4657
1.4567	A	1, 3								1.4316, 1.4430
1.4568	PH	1, 2, 3	◆	●						1.4316
1.4571	A	1, 2, 3		◆	●	●	●	■		1.4430, 1.4576
1.4575	F				●					1.4462, 1.4332
1.4577	A				●	●	●	■		1.4587, 1.4465
1.4580	A	1, 2, 3			●	●	●	■		1.4430, 1.4576
1.4582	D		■		●	●				1.4430
1.4583	A				●	●	●			1.4430, 1.4576, 1.4440, 1.4453, 1.4583
1.4586	A				●	●	●	■		1.4539, 2.4653
1.4589	F	1, 2		◆	●	●	●			1.4316, 1.4370
1.4618	A									1.4370, 1.4316, 1.4551
1.4621	F									1.4430

Examples of typical applications; properties (where appropriate)	material number
High corrosion resistance in concentrated hot nitric and sulphuric acid	1.4361
Chemical industry, biogas digesters, load-bearing building components; high strength and corrosion resistance	1.4362
Frames and structural profiles for rail carriages and trailers, cryogenic tanks, pressure vessels, pipes and distillation columns	1.4371
Equipment for the chemical, food-processing and textile industries, drinking, cooling and waste water systems, linings of swimming pools and water reservoirs, tanks for aggressive media; improved corrosion resistance, especially against non-oxidising acids; high resistance to localised corrosion and intergranular corrosion at up to 300 °C in continuous operation and up to 6 mm	1.4401
Similar to 1.4401; resistant to intergranular corrosion at thicknesses above 6 mm	1.4404
Equipment in the chemical, food processing and textile industries, pressure vessels	1.4406
Pulp and paper industry, desalination, flue gas cleaning, tanks and pipes in the chemical industry, seawater systems, pressure vessels, heat exchangers, rotors, impellers and shafts; very high corrosion resistance	1.4410
Mechanical engineering, arbors, components for pumps and centrifuges; resistant to H <sub>2</sub> O and dilute acids, heat treatable, high strength	1.4418
Similar to 1.4406; good corrosion resistance in non-oxidising acids, resistant to intergranular corrosion at continuous operation at temperatures of up to 350 °C	1.4429
Drinking, cooling and waste water, external cladding in chloride-containing atmosphere	1.4432
Welded parts of high corrosion resistance; production of urea and synthetic fibres, cellulose industry, textile finishing; properties similar to those of 1.4429	1.4435
Similar to 1.4435, however for temperatures of up to 350 °C	1.4436
Containers and process equipment in the cellulose and textile industries	1.4438
Chemical industry, seawater desalination, flue gas cleaning; high corrosion resistance at elevated temperatures and higher chlorine concentrations at temperatures of up to 400 °C in continuous service	1.4439
Process equipment in the textile, pulp and paper and chemical industries, turbine components; waste-gas heat exchangers	1.4449
Parts for high corrosive and mechanical stress: ship building, welded compressor impellers for aggressive gases, good corrosion resistance in oxidising environments	1.4460
Oil and gas, pulp and paper industries, seawater desalination, biofuel, bridges; high strength and resistance to pitting corrosion and stress corrosion cracking; resistant to intergranular corrosion also when welded	1.4462
High resistance against sulphuric acid, also in reducing environments	1.4465
Urea production	1.4466
Chemical industry; good resistance to phosphoric and sulphuric acid	1.4505
Chemical industry; good resistance to phosphoric and sulphuric acid	1.4506
Oil and gas industry, pulp and paper industries, sulphuric and phosphoric acid plants, pollution control equipment (scrubbers), geothermal tubes	1.4507
Automotive exhausts, catalytic converters, heat exchangers, burners, lift and door frames, structures of catering equipment, domestic appliances; scale resisting up to 950 °C	1.4509
Washing machine drums, mufflers, hot water boilers; welded in the dairy, food and brewing industries; good welding properties, corrosion resistant to H <sub>2</sub> O and water vapour, weak acids and alkaline solutions	1.4510
Welded parts in the dairy, food and brewing industries exposed to weak acids	1.4511
Automotive exhaust parts, wheelhouses and body panels of buses, trams and trains, containers; limited corrosion resistance, scale-resisting up to 800 °C	1.4512
Mufflers in automotive exhaust systems	1.4513
Domestic appliances, esp. washing machine drums; good resistance to H <sub>2</sub> O and water vapour, weak acids and alkaline solutions	1.4520
Boilers, water heaters, heat exchangers, storage tanks, plumbing tubes, cold heading parts, nuts, bolts; better resistance to localised corrosion than non-Mo-containing 17 % Cr grades	1.4521
Automotive trim, deep-drawn parts	1.4526
Marine technology, heat exchangers at up to 400 °C, fasteners in tunnel and interior swimming pool environments; high resistance to sulphuric and phosphoric acid, also with chloride impurities; good resistance to pitting and crevice corrosion and stress corrosion cracking	1.4529
Refiner disc segments, inlet housing in the paper industry; high resistance against cavitation and wear	1.4532
Knife blades, cutters, valve pins, ball bearings; high cutting hardness and corrosion resistance	1.4535
Flue gas desulphurisation, parts exposed to condensates of combustion gases, buildings fasteners in aggressive atmosphere; high resistance to H <sub>2</sub> SO <sub>4</sub> and H <sub>3</sub> PO <sub>4</sub> , pitting corrosion and stress corrosion cracking; resistant to intergranular corrosion in continuous service up to 400 °C	1.4539
Food and chemical industries; mufflers and exhaust emission control equipment low-temperature equipment; good corrosion resistance, resistant to intergranular corrosion	1.4541
Bolts and spindles in fittings compressor parts; high strength, resistant to H <sub>2</sub> O and dilute acids	1.4542
Power and chemical industries; resistant to intergranular corrosions in continuous service at up to 400 °C	1.4550
Heat exchangers and steam generators, NH <sub>3</sub> production; good resistance to stress corrosion cracking; outstanding corrosion resistance in liquids or/and up to 500 °C and to stress corrosion cracking	1.4558
Steel chimneys, equipment with alternating phases of high-temperature operation and downtimes involving wet-corrosive conditions; resistant to exhaust gases in the temperature range of 400–500 °C	1.4561
Chemical industry, sour gas applications; high resistance to intergranular corrosion, pitting corrosion and stress corrosion cracking; resistant to sulphuric acid of even higher concentration	1.4562
Heat exchangers in contact with sulphuric and phosphoric acid contaminated by chlorides and fluorides, pipes in the oil and gas industry; good resistance to pitting corrosion, crevice corrosion and stress corrosion cracking	1.4563
Flue gas desulphurisation, seawater treatment, transportation of mineral oil and natural gas; outstanding corrosion resistance	1.4565
Automotive, chemical, food and beverage industries, kitchen utensils, electronic equipment, ship building; cold-heading grade for bolts	1.4567
Hinges, hose clips, springs, valve parts, pressure vessels	1.4568
Chemical, petrochemical and coal chemical industries, cellulose production, textile finishing, water and food technology; good corrosion resistance, resistant to intergranular corrosion	1.4571
Chemical and petrochemical industry, pulp and paper industry, sea water desalination	1.4575
Chemical, textile and cellulose industries; good corrosion resistance in chloride-containing environments	1.4577
Chemical industry, especially resin, paint and rubber production; similar to 1.4571	1.4580
Similar to 1.4460; for operating conditions of up to 300 °C, high corrosion and mechanical resistance	1.4582
Welded parts for the textile and petrochemical industries, paint and rubber production	1.4583
Production of dyes, plastic and petroleum products	1.4586
Rail carriages, conveyor chains; good corrosion resistance to H <sub>2</sub> O and water vapour, weak acids and alkaline solutions, oxidising acids	1.4589
Chemical, food industry, dairy equipment, industrial and food storage vessels, general metalwork	1.4618
Automotive decorative trims, household appliances, elevators, roofing, street furniture	1.4621

**Table 2. Guidelines on the temperatures for heat treatment of martensitic stainless steels**

Material number	Heat treatment symbol	Annealing		Quenching		Tempering
		Temperature <sup>a)</sup> (°C)	Type of cooling	Temperature <sup>a)</sup> (°C)	Type of cooling	Temperature (°C)
1.4005	A	745-825	air	–	–	–
	QT650	–	–	950-1000	oil, air	680-780
1.4006	A	750-810	–	–	–	–
	QT550	–	–	950-1010	oil, air	700-780
	QT650	–	–	950-1010	oil, air	620-700
1.4021	A	745-825	–	–	–	–
	QT	–	–	950-1050	oil, air	200-350
	QT650	–	–	950-1010	oil, air	700-780
	QT750	–	–	950-1010	oil, air	620-700
1.4024	A	750-810	–	–	–	–
	QT550	–	–	950-1050	oil, air	700-780
	QT650	–	–	950-1050	oil, air	660-700
1.4028	A	730-790	–	–	–	–
	QT	–	–	950-1050	oil, air	200-350
	QT800	–	–	950-1010	oil, air	650-730
1.4031	A	730-790	–	–	–	–
	QT	–	–	1000-1100	oil, air	200-350
1.4034	A	730-790	–	–	–	–
1.4037	A	730-800	furnace	–	–	–
	QT	–	–	980-1030	oil	100-300
1.4057	A <sup>b)</sup>	680-800	furnace, air	–	–	–
	QT800 <sup>c)</sup>	–	–	950-1050	oil, air	750-800 + 650-700 <sup>c)</sup>
	QT900	–	–	950-1050	oil, air	600-650
1.4104	A	750-850	furnace, air	–	–	–
	QT650	–	–	950-1070	oil, air	550-650
1.4109	A	750-800	furnace, air	–	–	–
1.4110	A	750-830	furnace, air	–	–	–
	QT	–	–	1000-1100	oil, air	200-350
1.4112	A	780-840	furnace, air	–	–	–
1.4116	A	770-830	furnace, air	–	–	–
1.4120	A	750-850	furnace	–	–	–
	QT	–	–	950-1000	oil	650-750
1.4122	A	770-830	furnace, air	–	–	–
	QT	–	–	1000-1100	oil, air	200-350
1.4125	A	780-840	furnace, air	–	–	–
1.4313	QT780	–	–	950-1050	oil, air, water	560-640
	QT900	–	–	950-1050	oil, air, water	510-590
1.4418	QT840	–	–	900-1000	oil, air, water	570-650

a) If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

b) Double annealing might be advisable.

c) In the case that the nickel is at the lower side of chemical composition, a single tempering at 620-720 °C may be sufficient.

**Table 3. Guidelines on the temperatures for heat treatment of precipitation hardening stainless steels**

Material number	Heat treatment	Stress relieving		Solution annealing		Precipitation hardening
		Temperature (°C)	Type of cooling	Temperature <sup>a)</sup> (°C)	Type of cooling	Temperature (°C)
1.4542	AT	–	–	1025-1055	air	–
	P850	–	–	1025-1055	air	4 h (610-630)
	P900	–	–	1025-1055	air	1 h (590-610)
	P950	–	–	1025-1055	air	1 h (580-600)
	P1070	–	–	1025-1055	air	1 h (540-560)
	P1300	–	–	1025-1055	air	1 h (470-490)
	SR630	≥ 4 H (600-660) <sup>b)</sup>	–	–	–	–
1.4568	AT	–	–	1030-1050	air	–
	P1450	–	–	10 min (945-965)	<sup>c)</sup>	1 h (500-520)

a) If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

b) After martensitic transformation. Solution annealing at 1025 °C to 1055 °C will be necessary before precipitation hardening.

c) Quick cooling to ≤ 20 °C; cooling within 1 h to –70 °C; holding time 8 h; reheating in air to +20 °C.

**Table 4. Guidelines on the temperatures for heat treatment of austenitic stainless steels**

Material number	Solution annealing	
	Temperature <sup>a)</sup> (°C)	Type of cooling
1.4301	1000-1100	air, water*
1.4303	1000-1100	air, water*
1.4305	1000-1100	air, water*
1.4306	1000-1100	air, water*
1.4307	1000-1100	air, water*
1.4310	1010-1090	air, water*
1.4311	1000-1100	air, water*
1.4318	1020-1100	air, water*
1.4335	1030-1110	air, water*
1.4361	1100-1160	air, water*
1.4371	1000-1100	air, water*
1.4401	1030-1110	air, water*
1.4404	1030-1110	air, water*
1.4406	1030-1110	air, water*
1.4429	1030-1110	air, water*
1.4432	1030-1110	air, water*
1.4435	1030-1110	air, water*
1.4436	1030-1110	air, water*
1.4438	1070-1150	air, water*
1.4439	1060-1140	air, water*
1.4465	1050-1150	air, water*
1.4466	1070-1150	air, water*
1.4505	1050-1100	air, water*
1.4529	1120-1180	air, water*
1.4539	1060-1140	air, water*
1.4541	1000-1100	air, water*
1.4550	1020-1120	air, water*
1.4558	950-1050	air, water*
1.4561	1020-1100	air, water*
1.4563	1070-1150	air, water*
1.4565	1120-1170	air, water*
1.4567	1000-1100	air, water*
1.4571	1030-1110	air, water*
1.4577	1080-1150	air, water*
1.4580	1030-1110	air, water*
1.4618	1020-1120	air, water*

a) If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

\* Cooling sufficiently rapidly in order to avoid the occurrence of intergranular corrosion as defined in EN 3651-2.

**Table 5. Guidelines on the temperatures for heat treatment of ferritic stainless steels**

Material number	Annealing	
	Temperature <sup>a)</sup> (°C)	Type of cooling
1.4000	750-810	air, water
1.4002	750-810	air, water
1.4003	700-760	air, water
1.4016	770-830	air, water
1.4105	750-850	air, water
1.4113	790-850	air, water
1.4509	870-930	air, water
1.4510	770-830	air, water
1.4511	790-850	air, water
1.4512	770-830	air, water
1.4513	820-880	air, water
1.4520	820-880	air, water
1.4521	820-880	air, water
1.4526	800-860	air, water
1.4589	750-800	air, water

a) If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

**Table 6. Guidelines on the temperature for heat treatment of duplex stainless steels**

Material number	Solution annealing	
	Temperature <sup>a),b)</sup> (°C)	Type of cooling
1.4062	980-1080 <sup>c)</sup>	water, air <sup>d)</sup>
1.4162	950-1050 <sup>c)</sup>	water, air <sup>d)</sup>
1.4362	950-1050	water, air
1.4410	1040-1120	water, air
1.4460	1020-1100	water, air <sup>d)</sup>
1.4462	1020-1100	water, air <sup>d)</sup>

a) If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

b) Solution annealing may be omitted, if after hot working the mechanical properties and the resistance to intergranular corrosion as defined in EN ISO 3651-2 are obtained.

c) Producer's data

d) Cooling sufficiently rapidly in order to avoid precipitation.

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1. Stahlschlüssel - Key to Steel, with kind permission of Verlag Stahlschlüssel Wegst GmbH, Marbach (D), [www.stahlschluessel.de](http://www.stahlschluessel.de);
2. Data sheets of producers of stainless steels and welding filler materials;
3. European standards EN 10088 Parts 1, 2 and 3.

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