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## Stainless Steel 409 Grade Data Sheet

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### Grade 409

Grade 409 is a titanium-stabilised ferritic stainless steel. Although regarded as a general-purpose chromium stainless steel the almost exclusive application for Grade 409 is automotive exhaust systems. Its applications are those where appearance is a secondary consideration to mechanical properties and corrosion resistance, particularly at high temperatures, and where some weldability is required.

The generic grade 409 has now been replaced in some ASTM specifications (notably the flat rolled specification ASTM A240M) by several “sub-grades”, designated S40910, S40920 and S40930. These have various degrees of stabilisation with titanium, niobium or both titanium and niobium. Any of these may be certified as S40900 (Grade 409). By contrast only standard Grade 409 is listed in ASTM A268M covering tube.

### Corrosion Resistance

Grade 409 resists atmospheric and exhaust gas corrosion. A light surface rust will form in most atmospheres; this rust retards further corrosion but makes the surface undesirable for decorative applications. The corrosion resistance is about the same as that of 3CR12 and the 12% chromium martensitic grades such as 410, and inferior to the 17% chromium grade 430.

### Heat Resistance

Generally, 409 is classified as resistant to scaling in intermittent service up to 815°C and up to 675°C in continuous service, but these temperatures are dependent upon the exact service environment.

### Heat Treatment

#### Annealing

Heat to 790-900°C and air cool. This grade cannot be hardened by thermal treatment.

#### Welding

Readily welded but a pre-heat of 150-260°C is recommended. Grade 409 or Grade 430 electrode or filler rods can be used, but AS 1554.6 pre-qualifies welding of 409 with Grade 309 rods or electrodes. These austenitic fillers result in a more ductile weld.

Post-weld annealing at 760-815°C improves weld ductility.

Post-weld annealing is not required when welding thin sections. Automotive exhaust tubing is typically welded without filler metal (autogenously).

All welding must be carried out with minimum heat input to reduce grain growth effects.

### Typical Applications

Automotive exhaust systems, including catalytic converters and mufflers.

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### Specified Properties

The properties for Grade 409 are specified for annealed tubing in ASTM A268M. Compositions of other grades are for coil and sheet in ASTM A240M. Similar but not necessarily identical properties are specified for other products in their respective specifications.

### Composition Specification (%)

Grade		C	Mn	Si	P	S	Cr	Ni	N	Ti	Nb
409 S40900	min.	-	-	-	-	-	10.5	-	-	6x%C	-
	max.	0.08	1.00	1.00	0.045	0.030	11.7	0.50	-	0.75	-
S40910	min.	-	-	-	-	-	10.5	-	-	6x%C	-
	max.	0.03	1.00	1.00	0.040	0.020	11.7	0.50	0.030	0.50	0.17
S40920	min.	-	-	-	-	-	10.5	-	-	0.15 & 8 x (C+N)	-
	max.	0.03	1.00	1.00	0.040	0.020	11.7	0.50	0.030	0.50	0.10
S40930	min.	-	-	-	-	-	10.5	-	-	Ti + Nb = (0.08+8) x (C+N)	
	max.	0.03	1.00	1.00	0.040	0.020	11.7	0.50	0.030	0.75	

### Mechanical Property Specification

Grade	Tensile Strength (MPa) min.	Yield Strength 0.2% Proof (MPa) min.	Elongation (% in 50mm) min.	Hardness	
				Rockwell B (HR B) max.	Brinell (HB) max.
409	380	170	20	95	207

These same tensile, yield and elongation limits also apply to the other grades in ASTM A240M. Hardness limits are 88HRB and 179HB maximum for these other grades in flat rolled product.

### Physical Properties (Typical values in the annealed condition)

Grade	Density (kg/m <sup>3</sup> )	Elastic Modulus (GPa)	Mean Coefficient of Thermal Expansion			Thermal Conductivity		Specific Heat 0-100°C (J/kg.K)	Electrical Resistivity (nΩ.m)
			0-100°C (µm/m/°C)	0-315°C (µm/m/°C)	0-538°C (µm/m/°C)	at 100°C (W/m.K)	at 500°C (W/m.K)		
409	7700	208	11.0	11.7	12.4	25.8	27.5	460	600

### Grade Specification Comparison

Grade	UNS No	Euronorm		Swedish SS	Japanese JIS
		No	Name		
409	S40900	1.4512	X6CrTi12 / X2CrTi12	-	SUH 409

There no known standardised international alternatives to the ASTM S40910, S40920 and S40930 grades.

These comparisons are approximate only. The list is intended as a comparison of functionally similar materials **not** as a schedule of contractual equivalents. If exact equivalents are needed original specifications must be consulted.

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### Possible Alternative Grades

Grade	Why it might be chosen instead of 409
3CR12	Similar corrosion resistance, better weldability and more readily available than 409, particularly in heavy sections. (409 may have better drawability than 3CR12.)
304	Better corrosion resistance and heat resistance but at higher cost.
321	Higher heat resistance than 409 or 304.
Aluminised steel	Lower cost than stainless steel grade 409, but also a lower resistance to exhaust gases.

#### **Limitation of Liability**

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