NO. 1 JR® (TYPE 4)

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Chromium**	12.00 to 14.00 %	**Aluminum**	3.0 %
Titanium (Maximum)	0.70 %	**Carbon (Maximum)**	0.15 %		

Forms manufactured

Bar-Rounds	**Strip**	**Wire**	**Wire-Shapes**

Description

No. 1 JR is an oxidation-resistant steel that offers excellent electrical resistance as well as resistance to scale. Because of its high specific electrical resistance and low temperature coefficient of resistance, this alloy has been used primarily as an electrical resistance material.

Three types of No. 1 JR are available with varying aluminum contents that provide different resistivities for greater adaptability to resistor design. Types 1, 2, and 4 have nominal aluminum contents of 4.0, 3.5, and 3.0%, respectively. The alloy is stabilized with titanium to tie up carbon for protection against intergranular corrosion after heat treatment or welding.

No. 1 JR has also been used as a magnetic core material in applications where resistance to oxidation and corrosion are required.

Key Properties:

- Oxidation-resistant steel
- Excellent electrical resistance
- Scale resistance

Markets:

- Automotive

Applications:

- Magnetic cores

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Corrosion resistance

IMPORTANT NOTE:
The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors that affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish, and dissimilar metal contact.

Nitric Acid	Moderate	**Sulfuric Acid**	Restricted
Phosphoric Acid	Restricted	**Acetic Acid**	Restricted
Sodium Hydroxide	Moderate	**Salt Spray (NaCl)**	Moderate
Sea Water	Restricted	**Humidity**	Good

Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	7.30	7.30
DENSITY	—	0.2650 lb/in^3	7335 kg/m^3
MEAN SPECIFIC HEAT	32 to 212°F	0.1100 Btu/lb/°F	460.55 J/kg·K
MEAN COEFFICIENT OF THERMAL EXPANSION ANNEALED	77 to 200°F (35 to 93°C)	6.40 x 10^{-6} length/length/°F	11.50 x 10^{-6} length/length/°C
	77 to 400°F (35 to 204°C)	6.60 x 10^{-6} length/length/°F	11.90 x 10^{-6} length/length/°C
	77 to 600°F (35 to 316°C)	6.70 x 10^{-6} length/length/°F	12.10 x 10^{-6} length/length/°C
	77 to 800°F (35 to 427°C)	6.90 x 10^{-6} length/length/°F	12.40 x 10^{-6} length/length/°C
	77 to 1000°F (35 to 538°C)	7.10 x 10^{-6} length/length/°F	12.80 x 10^{-6} length/length/°C
THERMAL CONDUCTIVITY	—	120.0 Btu-in/hr/ft^2/°F	17.3 W/m·K
ELASTIC MODULUS	—	29.0 x 10^3 ksi	200 MPa
ELECTRICAL RESISTIVITY	68°F (20°C)	656.0 ohm-cir-mil/ft	109.0 microohm·cm
MEAN TEMPERATURE COEFFICIENT OF ELECTRICAL RESISTIVITY	68 to 200°F (20 to 93°C)	0.680 x 10^{-4} ohm/ohm/°F	1.010 x 10^{-4} per °C
	68 to 400°F (20 to 204°C)	0.700 x 10^{-4} ohm/ohm/°F	1.260 x 10^{-4} per °C
	68 to 600°F (20 to 316°C)	0.850 x 10^{-4} ohm/ohm/°F	1.530 x 10^{-4} per °C
	68 to 800°F (20 to 427°C)	0.910 x 10^{-4} ohm/ohm/°F	1.640 x 10^{-4} per °C
	68 to 1000°F (20 to 538°C)	1.04 x 10^{-4} ohm/ohm/°F	1.870 x 10^{-4} per °C
	68 to 1200°F (20 to 649°C)	1.21 x 10^{-4} ohm/ohm/°F	2.180 x 10^{-4} per °C
	68 to 1400°F (20 to 760°C)	1.34 x 10^{-4} ohm/ohm/°F	2.410 x 10^{-4} per °C

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Magnetic properties

COERCIVE FORCE FROM 10 KILOGAUSS	
HOT ROLLED, Oe	**HOT ROLLED AND ANNEALED, Oe[1]**
2.4	1.3

1 H_2 annealed at 1550°F for 2 hours and cooled at 150°F/hr.

Typical mechanical properties

ANNEALED AT VARIOUS TEMPERATURES				
TEMPERATURE	**ULTIMATE TENSILE STRENGTH**		**REDUCTION OF AREA**	**ELONGATION IN 2 IN (50.8 MM)**
	ksi	**kg/mm³**	**%**	**%**
70°F (21°C)	86.0	80.0	57.0	25.0
200°F (93°C)	80.0	56.0	51.0	26.0
400°F (204°C)	75.0	53.0	49.5	24.5
600°F (316°C)	72.5	51.0	45.0	21.5
800°F (427°C)	67.0	47.0	54.5	22.0
1000°F (538°C)	47.5	33.4	66.5	44.5
1200°F (649°C)	20.5	14.4	82.5	61.0
1400°F (760°C)	13.5	9.5	93.0	77.5

Heat treatment

Annealing	For best formability, heat uniformly to 1350/1500°F (732/816°C), cool in air-Brinell approximately 180-Rockwell approximately B 90. For magnetic applications, hydrogen anneal the finish machined part at 1500/1600°F (816/871°C) for 2 hours.
Hardening	Does not respond to hardening by thermal treatment.

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Workability

Forging	Heat to 1950/2050°F (1066/1121°C) and soak uniformly; forge; cool forgings in air.
Blanking and forming	No. 1 JR can be blanked readily in the annealed condition. Annealed strip can be edge wound for making spiral resistors.
Weldability	The alloy can be spot or resistance welded provided precautions are taken to avoid overheating. It also can be brazed using commercial fluxes, but it is imperative that the joining surfaces are clean and free of oxides and all traces of flux are removed after the joining operation.

For additional information, please contact your nearest sales office:
electrification@cartech.com | 610 208 2000

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