CARPENTER® TECHNOLOGY

DATASHEET

VACUMET® 1.4418 STAINLESS

Applicable specifications: DIN X4CrNiMo 16-5-1

Associated specifications: EN 1.4418

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Chromium**	16.00 %	**Nickel**	5.00 %
Manganese	Max 1.50 %	**Molybdenum**	1.00 %	**Silicon**	Max 0.70 %
Carbon	0.060 %	**Phosphorus**	Max 0.010 %	**Sulfur**	Max 0.010 %

Forms manufactured

Bar

Description

VACUMET 1.4418 Stainless is a double vacuum melted variant of 1.4418 Martensitic Stainless steel. 1.4418 is specially formulated for those applications requiring high mechanical strength combined with improved corrosion resistance relative to traditional martensitic stainless steels such as AISI 410. 1.4418 Stainless steel is weldable and cold formable. The low inclusion content of VACUMET 1.4418 Stainless and its controlled microstructure significantly improves the alloy's toughness, weldability, and formability and makes VACUMET 1.4418 Stainless an ideal choice for high pressure thin-walled applications. VACUMET 1.4418 Stainless is commonly supplied in the full hard condition designated as QT900.

Key Properties:

- High strength
- Corrosion resistance
- High toughness
- Magnetic

Markets:

- Aerospace
- Consumer
- Industrial
- Nuclear
- Transportation

Applications:

- Bolts
- Fittings
- High pressure pump housings
- Thin-walled pressure vessels
- Fuel injector bodies
- Valves

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Corrosion resistance

IMPORTANT NOTE:
The following 4-level rating scale (Excellent, Good, Moderate, Restricted) is intended for comparative purposes only and is derived from experiences with wrought product. Additive manufactured material may perform differently; 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**	Moderate
Sodium Hydroxide	Moderate	**Salt Spray (NaCl)**	Moderate
Sea Water	Restricted	**Sour Oil/Gas**	Restricted
Humidity	Good		

Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	7.68	—
DENSITY	—	0.2832 lb/in^3	7839 kg/m^3
MEAN COEFFICIENT OF THERMAL EXPANSION	68 to 392°F (20 to 200°C)	6.6 x 10^{-6} in/in/°F	10.8 x 10^{-6} cm/cm/°C
THERMAL CONDUCTIVITY	At 68°F (20°C)	103 Btu-in/hr/ft^2/°F	14.9 W/m·K
MODULUS OF ELASTICITY (E)	—	29.0 x 10^3 ksi	200,000 MPa

Typical mechanical properties

CONDITION	ORIENTATION	0.2% YIELD STRENGTH		ULTIMATE TENSILE STRENGTH		ELONGATION IN 4D	REDUCTION OF AREA	CHARPY V-NOTCH		HARDNESS
		ksi	MPa	ksi	MPa	%	%	FT-LBS	J	HRC
QT900 @ 68°F (20°C)	Long	120	827	133	917	23	78	165	224	30
QT900 @ -40°F (-40°C)	Long	—	—	—	—	—	—	125	169	—

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Heat treatment

Annealing	1112 to 1200°F (600 to 650°C)
Cooling	Slow cool
Hardening	1740 to 1920°F (950 to 1050°C), oil quench or polymer quench
Tempering	QT900 properties achieved by tempering 1025 to 1145°F (550 to 620°C), 8 hours, OQ or AC. This alloy may suffer temper embrittlement if tempered at 785 to 1022°F (450 to 550°C), or slow cooled through this temperature range.

Workability

Cold working	The work hardening rate of VIM VAR 1.4418 is relatively low, permitting a good deal of cold reduction.
Hot working	This alloy is easily hot worked in the temperature range of 1650 to 2300°F (900 to 1260°C). The optimum hot working range is 2100 to 2150°F (1150 to 1177°C) for the best combination of hot workability and grain size control. Cool forgings in air to room temperature and anneal.
Machinability	VIM VAR 1.4418 can be machined readily using the same practices employed with other martensitic stainless steels at comparable hardness levels.
Weldability	VIM VAR 1.4418 can be satisfactorily welded by shielded fusion and resistance welding processes. Oxyacetylene welding is not recommended since carbon pickup in the weld may occur. Preheating is not required to prevent cracking during welding. For optimum combination of strength, toughness, and corrosion resistance is obtained by hardening and tempering the welded part.

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Typical feeds and speeds

The feeds and speeds in the following charts are conservative recommendations for initial setup. Higher feeds and speeds may be attainable depending on machining environment.

TURNING — SINGLE-POINT AND BOX TOOLS

DEPTH OF CUT, IN	HIGH-SPEED TOOLS			CARBIDE TOOLS			
	SPEED, FPM	FEED, IPR	TOOL MATERIAL	SPEED, FPM		FEED, IPR	TOOL MATERIAL
				COATED	UNCOATED		
.040	75	.007	T-15, M-42	300	450	.007	CC-7
.150	60	.015	T-15, M-42	250	400	.015	CC-6

TURNING — CUT-OFF AND FORM TOOLS

SPEED, FPM	FEED, IPR							TOOL MATERIAL	
	CUT-OFF TOOL WIDTH, IN			FORM TOOL WIDTH, IN				HIGH-SPEED TOOLS	CARBIDE TOOLS
	1/16	*1/8*	*1/4*	*1/2*	*1*	*1-1/2*	*2*		
55	.001	.0013	.0018	.0018	.0014	.0011	.0009	T-15, M-42	C-6
190	.001	.0013	.0018	.0018	.0014	.0011	.0009	T-15, M-42	C-6

ROUGH REAMING

HIGH-SPEED TOOLS		CARBIDE TOOLS		FEED, IPR, REAMER DIAMETER, IN					
SPEED, FPM	TOOL MATERIAL	SPEED, FPM	TOOL MATERIAL	*1/8*	*1/4*	*1/2*	*1*	*1-1/2*	*2*
40	M-1, M-2, M-7	—	—	.003	.005	.008	.010	.012	.015
—	—	55	C-2	.004	.006	.009	.015	.018	.020

DRILLING — HIGH-SPEED TOOLS

SPEED, FPM	FEED, IPR								TOOL MATERIAL
	NOMINAL HOLE DIAMETER, IN								
	1/16	*1/8*	*1/4*	*1/2*	*3/4*	*1*	*1-1/2*	*2*	
45	—	.002	.004	.007	.008	.010	.012	.015	M-1, M-7, M-10

TAPPING — HIGH-SPEED TOOLS

SPEED, FPM	TOOL MATERIAL
10 (thread pitch 7 or less)	M-1, M-7, M-10
15 (thread pitch 8-15)	M-1, M-7, M-10

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MILLING — END PERIPHERAL

DEPTH OF CUT, IN	HIGH-SPEED TOOLS						CARBIDE TOOLS					
	SPEED, FPM	FEED, IN PER TOOTH				TOOL MATERIAL	SPEED, FPM	FEED, IN PER TOOTH				TOOL MATERIAL
		CUTTER DIAMETER, IN						CUTTER DIAMETER, IN				
		1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2	
.020	85	.0005	.001	.002	.003	M-2, M-3, M-7	270	.0005	.001	.003	.005	C-2
.060	65	.001	.002	.003	.004	M-2, M-3, M-7	210	.001	.002	.004	.006	C-2

BROACHING — HIGH-SPEED TOOLS

SPEED, FPM	CHIP LOAD, IN PER TOOTH	TOOL MATERIAL
10	.002	T-15, M-42

For additional information, please contact your nearest sales office:

info@cartech.com | 610 208 2000

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