UDDEHOLM VANADIS® 4 EXTRA

SuperClean³ Powder Metallurgical Tool Steel

General Heat Treatment Recommendations

	Vacuum	Salt Bath** / Fluidized Bed	Atmosphere Furnace Muffle Furnace / Packed
	** Salt Bath heat treatment can be performed but is not recommended for details with blind holes or threaded holes that will not be rework after heat treatment.		
Preheating Temperature	1. Bring up to 1200℉, equalize 2. Heat up to 1550℉, equalize	1. 1100 – 1200℉, equalize 2. 1500 – 1550℉, equalize	1. Bring up to 1200℉, equalize 2. Heat up to 1550℉, equalize
Hardening Temperature* **(Austenitizing)**	1725 – 2100℉ (Normally 1870℉) Holding time after the tool or part has fully heated through at the hardening temperature: minimum 30 minutes, maximum 1 hour. Alternatively hold 20 minutes for first 1" and then 15 minutes for each additional inch of wall thickness.		
	*For hardening temperatures at and over 2010℉ soak ing time should decrease to 15 minutes. *For best ductility use the lower hardening temperature for the desired hardness range.		
Quenching*	**Alt. 1** Inert gas, positive pressure **Alt. 2** Back-filled pressurized gas to 1050℉, then equalize center and surface. Continue to 600℉ and equalize. Then cool in circulating air.	**Alt. 1** Quench in Salt 930-1020℉ **Alt. 2** Circulated high speed inert gas	**Alt. 1** Circulated inert gas **Alt. 2** Circulated air
	*Cooling rate must be adequate to avoid any transformation products, with decreased properties as a result. However, also consider the risk of excessive distortion from very fast cooling.		
Tempering **(minimum two times)** **Temper immediately after quenching when the complete tool reaches 150℉**	Tempering Temperatures (℉)	Hardening Temperatures 1870℉	 1940℉	 2010℉
	980	60-62 HRC	61-63 HRC	62-64 HRC
	1020	58-60 HRC	59-61 HRC	61-63 HRC
	1050	56-58 HRC	57-59 HRC	59-61 HRC
	Tempering Times: 1 hour per inch of wall thickness, or hold at temperature a minimum of 2 hours.		
Stress Temper performed on hardened tools after EDM	Temperature: Shall be 50℉ (25℃) below the highest tempering temperature. Time: Soak 2 hours once tool comes to temperature. Cool in still air.		
Dimensional Stability	Average size change as a result of hardening and tempering may not exceed 0.003 inch/inch/maximum dimension if the tool has been stress relieved before finish machining. If Stress relieving is not performed as recommended, dimensional stability maybe inconsistent and cannot be guaranteed.		

UDDEHOLM VANADIS® 4 EXTRA

High Toughness, Strength and Wear Resistance in a P/M Tool Steel

- Excellent toughness for superior edge retention
- Excellent machinability
- Excellent choice for cutting and forming high strength work materials
- Readily coatable

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Uddeholm Powder Metallurgy Tool Steel Special Heat Treatment Guidelines

For Optimum Wear Resistance

P/M Steel Grades	VANADIS 4 EXTRA	VANADIS 6	VANADIS 10	ELMAX
Hardening Temp. ℉ (℃)	2100 (1150)	2100 (1150)	2010 (1100)	2010 (1100)
Tempering Temp. ℉ (℃)	3x1000 (3x540)	3x1040 (3x560)	3x1000 (3x540)	3x980 (3x525)
Hardness, HRC	63-65	63-65	63-65	58-60

For Optimum Ductility

P/M Steel Grades	VANADIS 4 EXTRA	VANADIS 6	VANADIS 10	ELMAX
Hardening Temp. ℉ (℃)	1725 (940)	1830 (1000	1800 (980)	1920 (1050)
Tempering Temp. ℉ (℃)	2x1020 (2x550)	2x480 (2x250)	2x480 (2x250)	2x480 (2x250)
Hardness, HRC	54-56	60-62	59-61	54-56

Note:
The choice of heat treatment has to be based on the specific requirements of the individual application.

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