

	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 reworked after heat treatment.			
Preheating Temperature	1. Bring up to 1200°F, equalize 2. Heat up to 1550°F, equalize (optional)	1. 1100 – 1200°F, equalize 2. 1500 – 1550°F, equalize	1. Bring up to 1200°F, equalize 2. Heat up to 1550°F, equalize	
Hardening Temperature (Austenitizing)	Austenitizing Range: 1870-2050°F. Typically 1870°F.  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 temperatures above 2000°F hold a maximum of 15 minutes once the tool or part is fully heated through.			
Quenching **	Alt. 1 Inert gas, positive pressure Alt. 2 Back-filled pressurized gas to 1050°F, then equalize center and surface. Continue to 600°F and equalize. Then cool in circulating air.	Alt. 1 Martempering bath 930-1020°F Alt. 2 Forced air circulation	Alt. 1 Circulated inert gas  Alt. 2 Circulated air	
	** Cooling rate must be adequate to avoid any transformation, with decreased properties as a result. However, also consider the risk of excessive distortion from very fast cooling.			
Tempering  (minimum two times)	Tempering Temperatures	Hardening Temperature	Hardening Temperature	Hardening Temperature
	480°F † 980°F 1020°F	1870°F 61-63 HRC 60-62 HRC –	2010°F ‡ – 63-65 HRC –	2050°F ‡ – – 60-62 HRC
Temper immediately after quenching when the complete tool reaches 150°F	Tempering Times: One hour per inch of wall thickness, or hold at temperature a minimum of two hours. † Not recommended when surface treating tools or when maximum dimensional stability is required. ‡ Minimum two tempers required except when using a hardening temperature of 2010°F or 2050°F, then temper a minimum of three times			
Stress Temper performed on hardened tools after EDM	Temperature: Shall be 50°F (25°C) 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® 10 – A High Wear Resistance Powder Metal Tool Steel

- Excellent wear resistance
- Excellent hardenability and stability for ease of heat treatment
- Good toughness for long running applications

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose. It is your responsibility to confirm you have the latest revision of this document (verify on our website) and that you forward to your Heat Treatment service provider. Failure to do so may result in inferior material properties. Rev. Apr 27, 2010

For more information, please contact us at 1-800-638-2520 or find us on the web at [www.bucorp.com](http://www.bucorp.com).

### Bohler-Uddeholm Powder Metallurgy Tool Steel Special Heat Treatment Guidelines

<b>For Optimal Wear Resistance</b>					
P/M Steel Grade	Uddeholm Vanadis 4 Extra	Uddeholm Vanadis 6	Uddeholm Vanadis 10	Uddeholm Vanadis 23	Uddeholm Elmax
Hardening Temperature	2100°F 1150°C	2100°F 1150°C	2100°F 1150°C	2160°F 1180°C	2010°F 1100°C
Tempering Temperature	3x1000°F 3x540°C	3x1040°F 3x560°C	3x1000°F 3x540°C	3x1040°F 3x560°C	3x980°F 3x525°C
Hardness	63-65 HRC	63-65 HRC	63-65 HRC	65-67 HRC	58-60 HRC

<b>For Optimal Ductility *</b>					
P/M Steel Grade	Uddeholm Vanadis 4 Extra	Uddeholm Vanadis 6	Uddeholm Vanadis 10	Uddeholm Vanadis 23	Uddeholm Elmax
Hardening Temperature	1725°F 940°C	1830°F 1000°C	1800°F 980°C	1920°F 1050°C	1920°F 1050°C
Tempering Temperature	2x1020°F 2x550°C	2x480°F 2x250°C	2x480°F 2x250°C	2x1040°F 2x560°C	2x480°F 2x250°C
Hardness	54-56 HRC	60-62 HRC	59-61 HRC	58-60 HRC	54-56 HRC

\* Low temperature tempers are not recommended when surface treating tools or when maximum dimensional stability is required.

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

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose. It is your responsibility to confirm you have the latest revision of this document (verify on our website) and that you forward to your Heat Treatment service provider. Failure to do so may result in inferior material properties. Rev. Apr 27, 2010

For more information, please contact us at 1-800-638-2520 or find us on the web at [www.bucorp.com](http://www.bucorp.com).