Typical Composition wt%

C	Si	Mn	Cr	Mo	V	S
2.45	0.9	0.5	5.2	1.3	9.7	max 0.09

General Description

Bohler K294 MICROCLEAN® is an AISI A11 powder metallurgically produced cold work tool steel with extremely high wear resistance, good toughness, and high compressive strength. This tool steel is resulfurized to aid machinability. The third generation P/M technology refines the sulfur to give unsurpassed mechanical properties for this type of alloy.

Applications

Blanking dies; punches; cutting, pelletizing, and fragmentation knives; extrusion and plastic injection molding screws, nozzles, and barrels; powder compaction tooling; and wear parts.

3rd Generation PM Technology

The latest generation of powder metal technology enables Bohler to manufacture a cleaner and finer powder than any other producer in the world today. The result is a significant increase in ductility and toughness and a more uniform carbide distribution.

Physical Properties	
Density g/cm^3 lbs/in^3	 7.40 0.268
Modulus of Elasticity MPa psi	 220,000 31.9×10^6
Coefficient of Thermal Expansion 20 to 200, 400°C mm/mm/°C 68 to 390, 750°F in/in/°F	 10.7×10^{-6} ; 11.4×10^{-6} 6.0×10^{-6} ; 6.3×10^{-6}
Thermal Conductivity W/m°C (200, 400°C) Btu in/ft^2 h°F (390, 750°F)	 20, 22 139, 153
Specific Heat J/kg°C Btu/lb°F	 460 0.110

Heat Treatment

Soft Annealing: Protect steel from scaling and/or decarburization. Heat through to 1600°F (870 °C). Control cool at 30°F (15°C) per hour to 1000°F (540°C), then furnace or air cool to room temperature.

Hardness after annealing: max. 280 HB

Stress-relieving: After rough machining, it is recommend that a stress relieve is done. The tool should be heated through to 1200°F (650°C), holding for 2 hours. Cool slowly to 930°F (500°C), then air cool.

Hardening:

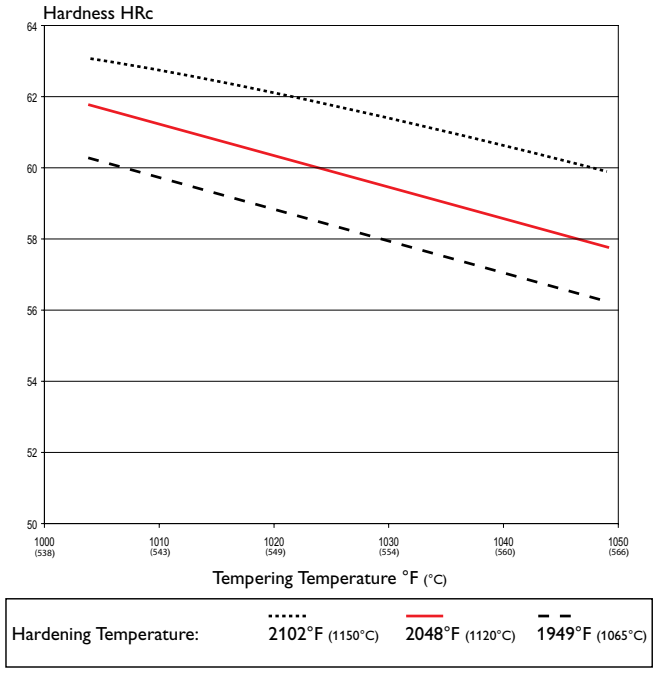
Preheating – recommended preheating steps: First preheat at 1510-1550°F (820-840°C). Equalize surface and center. Second preheat at 1850-1900°F (1010-1040°C). Equalize surface and center. Preheating helps minimize distortion due to uneven heating.

Austenitizing: Hardening range 1950-2100°F (1065-1150°C). Ramp rapidly to 2050°F (1120°C). Holding time after tool or part is heated fully through at the austenitizing temperature: minimum of 30 minutes, maximum 1 hour. Alternatively, hold 20 minutes for the first inch and then 15 minutes for each additional inch of wall thickness.

Quenching: Rapid cooling is important for optimum microstructure and properties, but quench rate must be a balance between risk of distortion and cracking. Pressure gas quench with a target cooling rate of 70-90°F/min (38 to 50°C/min) from the hardening temperature to 1000°F (540°C).

Tempering: Slow heat to tempering temperature immediately after hardening. Time in furnace is one hour per each inch of work piece thickness, but at least 2 hours minimum. Cool in air. Minimum two tempers. With hardening temperatures above 2000°F (1090°C) use a minimum of three tempers. Average size change as a result of hardening and tempering should not exceed 0.003 inch/inch per maximum dimension if the tool has been stress relieved before finish machining.

Temper Response*	
Temperature	**Hardness**
1000°F	61-63 HRC
1020°F	59-61 HRC
1050°F	57-59 HRC
* After 2050°F (1120°C) Austenitizing Temperature	



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