

••• A-11 PM Cold Work Steel

(AISI A11)

WM A-11 powder metal tool steel is a versatile tool and die steel which provides extremely high wear resistance in combination with relatively high impact toughness. A large volume of hard vanadium carbides provides the high wear resistance. The good impact toughness is a result of the fine grain size, small carbides, and superior cleanliness of the powder metallurgy (PM) microstructure. **WM A-11** offers substantially better wear resistance than the high-carbon, high-chromium die steels such as D2 and D7.



Chemical Composition

Carbon	2.45
Manganese	0.50
Silicon	0.90
Chromium	5.25
Molybdenum	1.30
Vanadium	9.75

Physical Properties

Density	– 0.268 lb/in ³
Specific gravity	– 7.41
Coefficient of Thermal Expansion	
70 - 200°F	5.96 x 10 ⁻⁶ in/in/°F
70 - 500°F	6.18
70 - 800°F	6.54
70 - 1100°F	6.82
Critical Temperature:	
Ac1:	1540°F

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Preheating

1500-1550°F, equalize.

Austenitizing (high heat)

Heat rapidly from the preheat, typically by transferring to a second furnace.

For Optimum Wear Resistance:

Soak for 5 to 15 minutes.

Furnace or Salt Bath: 2150°F

For Balance of Wear Resistance and Toughness:

Soak for 15 to 30 minutes.

Furnace or Salt Bath: 2050°F

For Maximum Toughness and minimum distortion in cooling:

Soak for 30 to 60 minutes.

Furnace: 1975°F

Salt Bath: 1950°F

Quenching

Sections less than 3" thick may be air cooled to maximum hardness. Sections 3" thick or more must be quenched at a faster rate, using one of the methods below, to attain maximum hardness.

For pressurized gas, the furnace should have a minimum quench pressure of 4 bars. *The quench rate to below 1000°F is critical to obtain the desired properties.*

For oil, quench until black, about 900°F then cool in still air to 150-125°F.

For salt maintained at 1000-1100°F equalize in the salt, then cool in still air to 150-125°F.

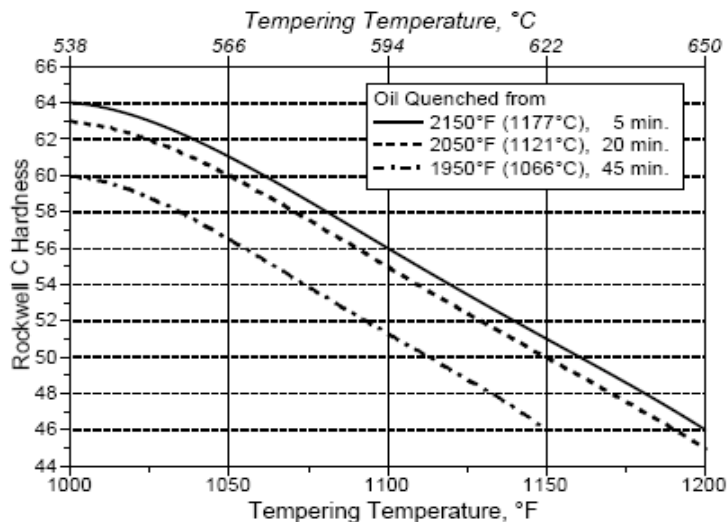
Tempering

Temper immediately after quenching.

The typical tempering range is 1000-1100°F. Do not temper below 1000°F. Hold at temperature for 2 hours then air cool to ambient temperature. Double tempering is required. Triple tempering is required when austenitized at 2100°F.

HEAT TREATMENT RESPONSE

As Oil Quenched from	HRC
1950°F (1066°C), 45 minutes	65
2050°F (1121°C), 20 minutes	65
2100°F (1149°C), 15 minutes	64
2150°F (1177°C), 5 minutes	63



Annealing

Annealing must be performed after hot working and before rehardening.

Heat at a rate not exceeding 400°F per hour to 1600-1650°F, and hold at temperature for 1 hour per inch of maximum thickness; 2 hours minimum. Then cool slowly with the furnace at a rate not exceeding 30°F per hour to 1000°F. Continue cooling to ambient temperature in the furnace or in air. The resultant hardness should be a maximum of 277 HBW.

This information is intended to provide general data on our products and their uses and is based on our knowledge at the time of publication. No information should be construed as a guarantee of specific properties of the products described or suitability for a particular application. Walter Metals reserves the right to make changes in practices which may render some information outdated or obsolete. Walter Metals should be consulted for current information & capabilities.

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