



# LINDQUIST STEELS, INC.

## TOOL STEEL SPECIALISTS

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## TECHNICAL BULLETIN

### LSI 9 PM



Color Code: White/Brown

Typical Chemistry		Physical Properties	
Carbon	1.80	Specific Gravity	7.41
Manganese	0.50	Density	0.267 lb/in <sup>3</sup>
Silicon	0.90	Typical Heat Treated Hardness	56-58 HRC
Chromium	5.25	Modulus of Elasticity	32 x 10 <sup>6</sup> psi
Molybdenum	1.35	Machinability	35-40% of 1% Carbon Steel
Vanadium	9.00		

## DESCRIPTION

Lindquist Steels, Inc. 9 Powdered Metal is an advanced powdered metal tool steel designed to be used in applications where a high wear value is required. Our 9 Powdered Metal (PM) does not have the hardness of our 10 PM/A11 material or the compressive strength of D2 or M2, but it does offer improved resistance to cracking. The most common applications for our 9 PM material have been for plastic extrusion feedscrews, punches, machine blades, and roll form dies.

Many of the benefits realized in the use of powdered metals, such as LSI 9 PM, are a direct result of the refined microstructure (smaller, more uniformly distributed carbide particles and a finer grain size) and the lack of segregation in the powder metallurgy product. These advantages include ease of grinding, improved response to heat treatment, greater wear resistance, and increased toughness of the finished tool.

### Typical Chemistry

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Molybdenum	1.35
Vanadium	9.00

### Physical Properties

Density: 0.267 lb./in<sup>3</sup>  
Specific Gravity: 7.41  
Modulus of Elasticity: 32 x 10<sup>6</sup> psi  
Machinability: 35-40% of 1% Carbon Steel  
Typical Heat Treated Hardness: 56-58 HRC

## HEAT TREATMENT

\*Important Note: Always consult with your Heat Treating professional to ensure optimal results

### ANNEALING

The material must be annealed after hot working and before re-hardening. Heat at 400° F per hour to 1600-1650° F and hold for 1 hour per inch of the maximum thickness. Cool slowly in the furnace at a rate of 30° F per hour to 1000° F. Continue the cooling process at room temperature (77° F).

### HARDENING

Hardening should occur in a modern protective vacuum furnace atmosphere. Pre-heat the furnace to 1500-1550° F.

- For increased wear resistance increase the furnace temperature to 2050° F and hold for at least 20 minutes.
- To achieve the best balance of wear resistance and toughness run the furnace at 1950-2000° F and hold for at least 25 minutes.
- Quenching should be performed at a minimum pressure of 4 bars.

### TEMPERING

The material must be tempered immediately after the quenching process. The recommended tempering temperature is 1000-1100° F. It is not recommended to temper below 1000° F. Hold the tempering temperature for at least 2 hours and then cool at room temperature (77° F). A double temper is required with this material and a third temper is recommended if the material was austenitized at 2050° F.

### GRINDING

During the grinding process localized heating can alter the temper of the material. Caution needs to be given to avoid this. Contact your grinding wheel supplier for advice on the appropriate grinding wheel of choice.

### SURFACE TREATMENTS

LSI 9 PM is a very good substrate material for various surface treatments such as PVD and CVD coatings. The material also lends itself well to nitriding.

For further information regarding LSI 9 PM please contact the Lindquist Steels branch nearest your location by logging on to [www.lindquiststeels.com](http://www.lindquiststeels.com)

Disclaimer: The information and data presented on this technical bulletin is for informational purposes only. The values listed are typical values only. Variations in chemistry, mechanical, physical properties, as well as heat treatment parameters may vary. The information contained herein should not be construed as a warranty.

[www.lindquiststeels.com](http://www.lindquiststeels.com)

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