

**HEAT TREAT  
 PROCEDURE CARD**

**F-4.9V2**



**ISO 9002:1994  
 QS-9000:1998  
 FM 63339**

**NOTE I.D. #**

**EXPLANATION**

- #1 A stress relief, at 1200°F for two [2] hours at temperature, is required between rough and semi-finish machining. This will allow distortion to be predicted and controlled within the machine stock recommendations (outlined in Note #2) during hardening/tempering.
- #2 Given that the recommended stress relief is performed between rough and semi-finish machining, distortion during hardening and tempering should not exceed the following machine stock recommendations for each grade:

MACHINE STOCK RECOMMENDATION [INCHES/INCH/SIDE]	GRADE OF STEEL
0.0015"	VANADIS 4, VANADIS 10, VANADIS 23
	STAVAX ESR, OPTIMAX, ELMAX
	ORVAR SUPREME, QRO 90 SUPREME
0.0020"	RIGOR (A-2), SVERKER 21 (D-2), COMPAX (S-7)
	ORVAR 2 MICRODIZED (H-13)
0.0025"	ARNE (0-1)

Example:

A block of ORVAR Supreme measuring 12" in length in the finished condition requires a minimum of 0.018" per side stock allowance or 12.036" total length prior to heat treatment.

If sufficient machine stock is not allowed or sufficient stress relief, acceptable distortion may exceed machine stock tolerances. Additionally, quench rate and ultimately tool properties may have to be sacrificed to control distortion within the allowed machine stock.

- #3 If any EDM recast layer is present on the tool going into hardening and tempering operations, the risk of quench cracking is significantly increased.
- #4 If welding is performed in the annealed state and a soft annealing is not performed prior to hardening and tempering operations, the risk of quench cracking is significantly increased.
- #5 If significant material removal will be accomplished by the EDM process (especially via wire EDM) after hardening and tempering operations, a high temperature temper may be required to prevent cracking during and after the EDM process. High temperature tempering can result in degradation of tool properties (i.e. hardness, toughness, corrosion resistance, etc.) For some grades.
- #6 It is critical that the tempering temperature for tool is not exceeded during a coating operation. If the tempering temperature is exceeded, a permanent loss of hardness, strength and/or dimensional tolerance may occur.  
 If a coating with an elevated application temperature is planned, the tempering temperature, which is used, must exceed the coating application temperature by 50°F. High temperature tempering can result in degradation of tool properties (i.e., hardness, toughness, corrosion resistance, etc.) For some grades.