

HEAT TREATMENT RECOMMENDATION



GRADE: Z-TUFF PM **METHOD:** STANDARD VACUUM

APPLICATION: HEAVY DUTY COLD WORK

PROPERTIES: OPTIMUM TOUGHNESS

HARDNESS RANGE: HRC 58-62

RACKING	Parts should be placed in basket with adequate spacing to allow even heating and good exposure to quench gas. Long thin parts should be held in vertical position to maintain flatness/straightness.
HEATING	<p>Use of multiple preheat steps required</p> <ul style="list-style-type: none"> ▪ Ramp furnace to 1150±25°F and equalize temperature. <ul style="list-style-type: none"> - <i>Use convective heating if possible</i> ▪ Ramp furnace to 1550±25°F and equalize temperature. ▪ Ramp furnace to 1750±25°F and equalize temperature. Advance to high heat
HARDENING	<p>Must maintain critical control during high heat segment</p> <ul style="list-style-type: none"> ▪ Ramp furnace to 1900±10°F and equalize temperature. ▪ Soak: 20-25 minutes
QUENCHING	<p>Accelerated cooling required</p> <ul style="list-style-type: none"> ▪ Back fill to positive pressure (4 bar minimum, 6 bar ideal), and fan quench. <ul style="list-style-type: none"> - <i>Cool at maximum possible rate until load temperature < 1300°F</i> - <i>Interrupt quench (or reduce rate) at 1000/1100°F if needed to minimize distortion</i> ▪ Continue continuous cooling of load to room temperature (<120°F) <ul style="list-style-type: none"> - <i>Parts should be tempered within 8 hours</i>
TEMPERING	<p>Double temper mandatory. Third stress relief temper strongly advised.</p> <p>Select tempering temperature based on hardness: HRC 60-62 = 970±5°F 59-61 = 985±5°F* 58-60 = 1000±5°F 57-59 = 1015±5°F</p> <ul style="list-style-type: none"> ▪ 1st temper: Heat parts to selected temperature and equalize. Soak 3-4 hours. Cool parts completely to room temperature (<120°F) <ul style="list-style-type: none"> - <i>can use vacuum/inert gas or air (depending on finish)</i> - <i>use convective heating and fan cooling</i> ▪ 2nd temper: Repeat first temper cycle. Soak 2 hours ▪ 3rd temper/stress relieve: Heat parts to 925/950°F, equalize, and soak 1-2 hours. <ul style="list-style-type: none"> - <i>stress relieve can be performed in same manner after hard finishing and/or EDM operations (vacuum methods preferred on finished tools)</i> <p style="color: red;">* <i>Ideal process for optimum combination of wear, toughness, and strength.</i></p>