High Powered Small Caliber Rifles
Bench Rest Rifles
Hunting Rifles
Tactical Rifles
Sport Rifles

Elastic Modulus
(tension) 29.0 X 10^6 psi (200 GPa)
(torsion) 10.5 X 10^6 psi (72.3 GPa)
Density 0.28 lbs./in^3 (7.75 g/cm^3)
Specific Heat
From 32-212°F (0-100°C) 0.11 0.039
Thermal Conductivity
200°F (93°C) 14.4 25.1 0.0599
1000°F (538°C) 16.5 28.5 0.0682
Coefficient of Thermal Expansion
21 to 212°F (-6) to 100°C 5.5X10^-6 9.9X10^-6
32 to 600°F 0 to 315°C 5.6X10^-6 10.1X10^-6
32 to 1000°F 0 to 100°C 6.4X10^-6 11.5X10^-6
32 to 1200°F 0 to 315°C 6.5X10^-6 11.7X10^-6

CRUCIBLE 416R Stainless
Precision Rifle Barrel Stock

Carbon 0.12%
Manganese 0.40%
Silicon 0.40%
Chromium 12.50%
Molybdenum 0.40%
Sulfur 0.13%

Physical Properties

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Corrosion Resistance

The corrosion resistance of Crucible 416R was evaluated in a variety of corrosion tests normally used for this type of stainless. The corrosion resistance is comparable to that of standard AISI Type 416.

NOTE: Crucible 416R forms an oxide scale at approximately 1250°F (677°C). This temperature may vary with atmosphere and application.

Passivation

It is recommended that Crucible 416R finished-machined parts be passivated for optimum corrosion resistance.

Recommended passivation parameters are shown below:

Acid Concentration (by volume of concentrated nitric acid): 40-60%
Sodium Dichromate (by weight): 2.0%
Immersion Time (in minutes) 15-30
Bath Temperature: 110-140°F (43-60°C)

Typical 120°F (49°C)

Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values.
Thermal Treatments

Crucible 416R is supplied pre-hardened and stress relieved after straightening, so normally there is no need for further heat treatment, except possibly a further stress relief after machining, when required.

Stress Relieving

Stress Relieve after machining at 950-1000°F (510-540°C). Hold 2-4 hrs. Air cool. (Higher temperatures may be used if desired.)

For reannealing or rehardening, follow these guidelines:

Annealing

Crucible 416R may be annealed for maximum softness at 1550°F (843°C), followed by a furnace cool. For better machinability, a subcritical anneal at 1300°F (704°C) is recommended.

Annealed hardness: Approximately 170 BHN

Hardening

Preheat: 1400-1450°F (760-788°C). Equalize

Austenitize: 1750-1850°F (954-1010°C). For maximum corrosion resistance and strength, austenitize high in the range.

Hold time at temperature: 30 - 60 minutes.

Quench: Oil or salt quench to below 125°F (50°C).

As-quenched hardness: BHN 375/415 (HRC 40/45)

Tempering: Temper 4 hrs. at the appropriate temperature for the desired properties shown in the following graph. (Graph based on data for 1” Rd. austenitized at 1800°F (982°C), oil quench, tempered 4 hrs. at temperature).

Machining

The machining of all high-chromium steels is characterized by the tendency of the chip to gall or build up on the cutting edges and radii of the tool. However, the special composition and the precision heat treatment of Crucible 416R tend to minimize the galling and build-up. The chips produced are short and brittle, resulting in relatively easy chip control.

Turning - Single Point and Box Tools

<table>
<thead>
<tr>
<th>Depth of Cut (inches)</th>
<th>CPM High Speed Steel Tooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool Material</td>
<td>Speed (fpm)</td>
</tr>
<tr>
<td>.040 T15, Rex 76</td>
<td>100</td>
</tr>
<tr>
<td>.150 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>.300 T15, Rex 76</td>
<td>60</td>
</tr>
</tbody>
</table>

Turning - Cut-off and Form Tooling

<table>
<thead>
<tr>
<th>Cutoff Tool Width (inches)</th>
<th>CPM High Speed Steel Tooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool Material</td>
<td>Speed (fpm)</td>
</tr>
<tr>
<td>.062 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>.125 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>.250 T15, Rex 76</td>
<td>80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Form Tool Width (inches)</th>
<th>CPM High Speed Steel Tooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool Material</td>
<td>Speed (fpm)</td>
</tr>
<tr>
<td>.500 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>.750 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>1.00 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>1.50 T15, Rex 76</td>
<td>80</td>
</tr>
<tr>
<td>2.00 T15, Rex 76</td>
<td>80</td>
</tr>
</tbody>
</table>

When using carbide tooling you can increase the speed to 250 fpm with the same feed rates.

Gun Drilling

<table>
<thead>
<tr>
<th>Hole Diameter (inches)</th>
<th>Carbide Tool Material</th>
<th>Speed (fpm)</th>
<th>Feed (ipr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.078 - .156 C2</td>
<td>250</td>
<td>.00015 - .00025</td>
<td></td>
</tr>
<tr>
<td>.156 - .250 C2</td>
<td>250</td>
<td>.0003 - .0005</td>
<td></td>
</tr>
<tr>
<td>.250 - .500 C2</td>
<td>250</td>
<td>.0005 - .0008</td>
<td></td>
</tr>
<tr>
<td>.500 - .750 C2</td>
<td>250</td>
<td>.0008 - .0010</td>
<td></td>
</tr>
<tr>
<td>.750 - 1.00 C2</td>
<td>250</td>
<td>.0010 - .0015</td>
<td></td>
</tr>
<tr>
<td>1.00 - 2.00 C2</td>
<td>250</td>
<td>.0015 - .0020</td>
<td></td>
</tr>
</tbody>
</table>

Welding

Welding is not recommended for Crucible 416R.