**CAPABILITIES**

Ellwood Specialty Steel is a fully integrated producer of a wide range of specialty tool steels. Our ExELL grades are made with the advanced ASEA-SKF steel making capabilities which include an ultra high powered electric arc furnace with subsequent state of the art ladle refining and vacuum degassing equipment for the most complete and modern ladle metallurgy technology.

Our steel making expertise and capability is further enhanced from a long forging history with optimum forging and heat treating practices to develop very special material characteristics of product uniformity, cleanliness, machinability, polishability, strength, toughness, hardenability and other steel properties. All this from production facilities certified to ISO 9002.

**QUALITY ASSURANCE**

Ellwood Specialty Steel is committed to providing products and services which will consistently meet or exceed all quality and performance expectations. We will provide customer and technical service that will ensure complete satisfaction.

Being a very flexible provider, Ellwood Specialty Steel will establish product programs to fully support industry or customer requirements. Our extensive stock programs are supported by very short mill lead times of custom forged products. Customized stock programs are and can be available for specific customer needs.

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. Ellwood Specialty steel reserves the right to make changes in practices which may render some information outdated or obsolete. Ellwood Specialty Steel should be consulted for current information and/or capabilities.

**Applications**

**ExELL H13 SUPERIOR** is used in die casting die applications where a higher level of heat resistance along with good toughness and ductility are required.

**ExELL H13 SUPERIOR** is manufactured to meet the demanding criteria of NADCA #207, Chrysler NP2080, GM DC9999-1, Ford AMTD-DC2010 and other specifications for superior H-13 quality.

**ExELL H13 SUPERIOR** is also used in most other hot work applications such as forging dies and extrusion tooling components as well as plastic molds and in critical cold or hot knife, punch or holder applications where a combination of strength and toughness are required. Typical applications and required hardness levels are:
**CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Coefficient of Thermal Expansion, in/in/F</th>
<th>Thermal Conductivity, BTU in/ft²hr F</th>
<th>Density, lbs/cu.in</th>
<th>Modulus of Elasticity, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-450 F: 0.000070</td>
<td>70 F: 180</td>
<td>70 F: 180</td>
<td>70 F: 29,400,000</td>
</tr>
<tr>
<td>70-1450 F: 0.000077</td>
<td>750 F: 185</td>
<td>750 F: 185</td>
<td>750 F: 29,500,000</td>
</tr>
<tr>
<td></td>
<td>1450 F: 195</td>
<td>1450 F: 195</td>
<td></td>
</tr>
</tbody>
</table>

**HEAT TREATMENT** (General Recommendations)

Critical Temperatures:
- Ac1: 1560 F
- Ac3: 1740 F
- Ms: 570 F

**SURFACE TREATMENTS**

Surfaces of ExELL H-13 SUPERIOR can readily be chrome plated, nitrocarburized or nitrided by all commercial processes. Care must be taken to avoid hydrogen embrittlement in chrome plating. Tempering at 400°F for 4 hours after plating.

Avoid excessive concentrations of nitrogen during various nitriding processes to avoid white layer and excessive network. Generally, case depths greater than 0.010" are not recommended for hot work applications.

**STRESS RELIEVING**

After rough machining of an annealed component, heat the part to 1200°F, equalize and hold 1-2 hours. Furnace cool to 900°F and then air cool to room temperature.

For heat treated parts, the stress relieving temperature should be at least 100-150°F less than the tempering temperature used in heat treatment, so as not to lower the hardness of the part.

**ANNEALING**

With a protective atmosphere or vacuum furnace, heat slowly to 1560°F. Equalize and hold one hour per inch of thickness. Furnace cool 20°F/hr to 1100°F and equalize. Air cool to room temperature. Hardness - 229 HB maximum.

**HARDENING AND QUENCHING**

Protect against decarburization and oxidation during austenitizing.

**Preheating:** Heat to 1200°F and equalize. Continue heating to 1550°F and equalize. Complete heating to hardening temperature.

**Hardening:** Typical austenitizing range is 1850-1920°F. Hardening temperature can be adjusted to develop added heat resistance. A hardening temperature of 1870°F is normally used for most applications while 1900°F can be used for increased heat resistance.

**Quenching:** Quenching should be performed as rapidly as possible without promoting excessive movement or cracking. Typical quenching media include:
- High speed gas with sufficient positive pressure in vacuum furnace
- Circulating air/atmosphere
- Martempering bath or fluidized bed at 575-1020°F, then cool in air
- Warm Oil

Temper as soon as quenching temperature reaches 120-150°F.

Typical tempering temperature responses are:
(Use for approximate guideline only)

<table>
<thead>
<tr>
<th>Tempering Temperature</th>
<th>Hardness HRC Oil Quench</th>
<th>Hardness HRC Air Quench</th>
</tr>
</thead>
<tbody>
<tr>
<td>800°F</td>
<td>49</td>
<td>47</td>
</tr>
<tr>
<td>900°F</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td>1000°F</td>
<td>43</td>
<td>40</td>
</tr>
<tr>
<td>1100°F</td>
<td>40</td>
<td>36</td>
</tr>
<tr>
<td>1200°F</td>
<td>36</td>
<td>32</td>
</tr>
</tbody>
</table>

**TEMPERING**

Temper immediately after quenching to about 150°F. Temper a minimum of two times with intermediate cooling to room temperature.

Choose the tempering temperature to develop required hardness. ExELL H-13 SUPERIOR should be heated to the desired tempering temperature, equalized and held a minimum of two hours. Air cool to room temperature. Check hardness and adjust temperature for additional tempering operation(s). Repeat for added tempers.

**MECHANICAL PROPERTIES**

Typical tensile data vs. hardness at RT:

<table>
<thead>
<tr>
<th>Tensile Strength, psi</th>
<th>52 HRC</th>
<th>46 HRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2% Yield Strength, psi</td>
<td>260,000</td>
<td>205,000</td>
</tr>
<tr>
<td>% RA</td>
<td>220,000</td>
<td>185,000</td>
</tr>
<tr>
<td>% Elongation</td>
<td>46</td>
<td>56</td>
</tr>
</tbody>
</table>

**TOOLMAKING**

For any additional information including welding, machining, grinding or EDM processing, please contact Ellwood Specialty Steel direct at: 800-932-2188