ASP®2012 is a powder metallurgical tool steel with a unique analysis that offers outstanding ductility and a good wear resistance up to 62/63 HRC.

DELIVERY HARDNESS

Typical soft annealed hardness is 230 HB.

APPLICATIONS

ASP®2012 is particularly suitable when chipping, cracks and adhesive wear are the main failures mechanism during production of Advanced High Strength Steels, soft material and thick sheet pieces.

ASP®2012 is the best in class for very high demanding application such as:

- Blanking and forming
- Deep drawing
- Fine blanking
- Powder compaction
- Plastic injection moulds, broaches to improve H11/H13 wear resistance, especially in case of large series with reinforced moulding materials (fibers).
- Machine components and rolls.
- Warm- and hot-work applications : extrusion dies, forging dies and punches, Press hardening tools

HEAT TREATMENT

- Soft annealing in a protective atmosphere at 850-900°C for 3 hours, followed by slow cooling at 10°C/h down to 700°C, then air cooling.
- Stress-relieving at 600-700°C for approximately 2 hours, slow cooling down to 500°C.
- Hardening in a protective atmosphere with pre-heating in 2 steps at 450-500°C and 850-900°C and austenitising at a temperature suitable for chosen working hardness. Cooling down to 40-50°C.
- In case of big dimensions (>150 mm crosssection) a third preheating step is recommended.
- ASP®2012 offers a variety of heat treatment possibilities depending on the application and the targeted hardness (55 to 63 HRC). The hardening temperatures range from 1025 and 1150°C, whereas the tempering one is 525 to 560°C.

In order to better stabilize the tools, we recommend to perform 3 tempers at the chosen tempering temperature.

GUIDELINES FOR HARDENING

<table>
<thead>
<tr>
<th>Segment</th>
<th>Application</th>
<th>Hardness HRC</th>
<th>Current grades</th>
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</thead>
<tbody>
<tr>
<td>Cold work</td>
<td>Blanking, Punching of HSS/UHSS, Fine blanking, Coining punch</td>
<td>58/63</td>
<td>D2, M2, PM23 types, X10CrMoV8, X70CrMoV5</td>
</tr>
<tr>
<td>Plastic injection</td>
<td>Long series of small and medium parts for automotive industry</td>
<td>54/60</td>
<td>H11, H13, X50CrMoV5</td>
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<tr>
<td>Press hardening</td>
<td>Inserts in the forming tool to enhance the wear resistance</td>
<td>54/59</td>
<td>X50CrMoV5, X20CrMoV7</td>
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</tbody>
</table>

PHYSICAL PROPERTIES

- Density g/cm³ (1) 7.8 7.7 7.6
- Modulus of elasticity GPa (1) 220 195 175
- Coefficient of thermal expansion from 20°C, per m/°C (2) - 12.3x10^-6 12.7x10^-6
- Thermal conductivity W/m°C (2) 26 30 30
- Specific heat J/kg °C (2) 420 510 600

ASP®2012 can be worked as follows:

- Machinability (grinding, turning, milling) : machinability is very good, far better compared to D2 and Cr 8% type or PM23. Machinability is similar to H11/H13.
- Polishability: due to the good cleanliness level and the very even distribution of the small primary carbides, ASP®2012 is suitable for high quality surface requirements after polishing.
- Electrical discharge machining: the low content of non metallic inclusion and the homogeneous microstructure of ASP®2012 gives after EDM process a better surface finish.
- Grinding: the grindability is good, much better compared to conventional cold work tool steels
- Welding: A special procedure has to be followed including preheating and filler materials with analysis close to the base metal. Laser welding for moulds maintenance is easy.

SURFACE TREATMENT

The steel grade is a perfect substrate material for PVD coating. If nitriding is requested, a small diffusion zone is recommended but avoid the too brittle white layer.

WEAR RESISTANCE

Wear resistance is the time needed for removal of one-gram material from a test piece.

RELATIVE ABRASIVE WEAR RESISTANCE COMPARISON

- H13 (52HRC)
- X50CrMoV5 (58HRC)
- X70CrMoV7 (62HRC)
- ASP®2012 (62HRC)
TEMPERING RESISTANCE

The effect of time at tempering temperature on hardness

Comparator Properties

<table>
<thead>
<tr>
<th>Grade</th>
<th>Abrasive wear resistance</th>
<th>Adhesive wear resistance</th>
<th>Chipping/cracking resistance</th>
<th>Compressive strenght</th>
<th>Polishability</th>
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<tbody>
<tr>
<td>ASP®2012</td>
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<td>X160CDV12 / D2</td>
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<td>X70CrMoV5.2</td>
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<td>X50CrMoV5.2</td>
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<tr>
<td>H11 / H13</td>
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