ULTRALUME® ALUMINIZED TYPE 1 PRESS HARDENABLE BORON STEEL

ULTRALUME® PHS is offered for applications less than 1500 MPa where design strength, design flexibility, and crash management are paramount. Hot-stamping technology is used for A- and B-pillar reinforcements, roof rails, side-wall members, bumpers, beams and other crash management components. The hot-stamping process addresses the forming and springback issues experienced in conventional cold forming in higher strength steels.
Product Description

ULTRALUME® Press Hardenable Steel (PHS) is an Aluminized Type 1, heat-treatable, boron (B) steel intended for automotive steel applications where high strength, design flexibility and collision protection are paramount. Blanks produced from ULTRALUME PHS are heated in a furnace at 900 – 950 °C to bring the steel into the austenitic temperature range. The blank is then transferred to a hot forming press where the hot steel is formed into complex shapes. The steel cools rapidly inside the water-cooled dies and undergoes a phase transformation from austenite to a high strength phase – martensite. This rapid cooling, or quenching, increases the tensile strength of the steel from approximately 600 up to 1500 MPa. Since the steel is held in the dies during cooling, thermo-distortion and springback are avoided.

<table>
<thead>
<tr>
<th>Composition</th>
<th>(wt %)</th>
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</thead>
<tbody>
<tr>
<td>Carbon (C)</td>
<td>0.22</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>1.20</td>
</tr>
<tr>
<td>Silicon (Si)</td>
<td>0.25</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>0.20</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>0.003</td>
</tr>
</tbody>
</table>

AVAILABLE FORMS

ULTRALUME PHS is available in gauges from 0.039 – 0.118 in. (1 – 3.0 mm) and widths up to 60 in. (1524 mm). For specific gauge and width capability, please contact your AK Steel sales representative.
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Tables

TABLE 1 – TYPICAL MECHANICAL PROPERTIES BEFORE HOT FORMING

<table>
<thead>
<tr>
<th>Typical</th>
<th>YS, ksi. (MPa)</th>
<th>UTS, ksi. (MPa)</th>
<th>Min. Elongation (%)</th>
<th>n-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal</td>
<td>56 (386)</td>
<td>90 (632)</td>
<td>26</td>
<td>0.15</td>
</tr>
<tr>
<td>Transverse</td>
<td>66 (465)</td>
<td>93 (650)</td>
<td>22</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Properties based on ASTM Testing.

ULTRALUME PHS is continuously hot dip coated on both sides of the steel. The aluminum coating bath contains approximately 91% aluminum (Al) and 9% silicon (Si). The metallic coating is metallurgically bonded to the steel substrate and protects the steel surface against decarburization and oxidation during hot-stamping. As a result, the shot blasting operation required for hot-stamped, uncoated steel parts is eliminated.

FIGURE 1
Photomicrograph showing the as-coated Aluminized Type 1 metallic layer on top of the steel substrate. The coating consists of an aluminum-silicon layer on top of a thin iron-aluminum alloy layer. The substrate microstructure consists of ferrite and pearlite, prior to hot-stamping. The ultimate tensile strength of the as-coated steel is approximately 600 MPa.

FIGURE 2
Photomicrograph showing ULTRALUME PHS after heat-treatment at 900 °C followed by hot-stamping. The coating layer has fully alloyed with the substrate. The steel substrate has transformed from ferrite and pearlite to martensite, dramatically increasing the ultimate tensile strength.
Weldability

Typical automotive welding processes such as resistance spot welding and Gas Metal Arc (GMA) welding can be used for joining of hot-stamped ULTRALUME PHS. The composition, combined with the high strength and martensitic microstructure of the steel after hot-stamping, requires weld process development and joint evaluation. For additional information, contact your AK Steel technical representative.

ADDITIONAL PRESS HARDENABLE STEEL PRODUCTS

• Uncoated Full Hard PHS – Available
• Uncoated Annealed PHS – Available

FIGURE 3

Hot-formed parts produced from ULTRALUME PHS in a water-cooled hydraulic-press line. The blanks are heated to 900 °C then quickly hot processed into complex shapes as depicted in these examples.
AK Steel is a leading producer of flat-rolled carbon, stainless and electrical steel products, primarily for the automotive, infrastructure and manufacturing, electrical power generation and distribution markets. Through its subsidiaries, the company also provides customer solutions through carbon and stainless steel tubing products, die design and tooling, and hot and cold stamping. Headquartered in West Chester, Ohio (Greater Cincinnati), the company employs approximately 9,200 men and women at manufacturing operations across seven states (Alabama, Indiana, Kentucky, Michigan, Ohio, Pennsylvania and West Virginia), as well as Canada and Mexico. Additional information about AK Steel is available at www.aksteel.com.

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