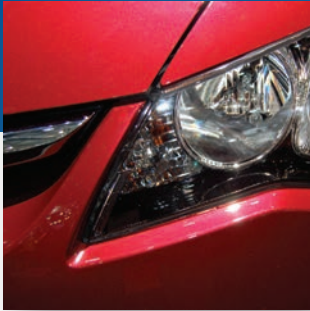


# ULTRALUME<sup>®</sup>

**ALUMINIZED TYPE 1 PRESS  
HARDENABLE BORON STEEL**



- Cost-Effective**
- Higher Strength**
- Weight Reduction**
- Improved Crash Management**



**ULTRALUME<sup>®</sup> PRESS HARDENABLE STEEL (PHS)** is offered for applications 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.

# ULTRALUME<sup>®</sup> PRESS HARDENABLE STEEL

## Product Description

ULTRALUME 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.

Composition		(wt %)
Carbon	(C)	0.22
Manganese	(Mn)	1.20
Silicon	(S)	0.25
Chromium	(Cr)	0.20
Boron	(B)	0.003

### AVAILABLE FORMS

ULTRALUME PHS is available in gauges from 1 – 3.3 mm and widths up to 1524 mm. For specific gauge and width capability, please contact your Cleveland-Cliffs sales representative.



# ULTRALUME® PRESS HARDENABLE STEEL

## Tables

**TABLE 1 – MECHANICAL PROPERTIES BEFORE HOT FORMING**

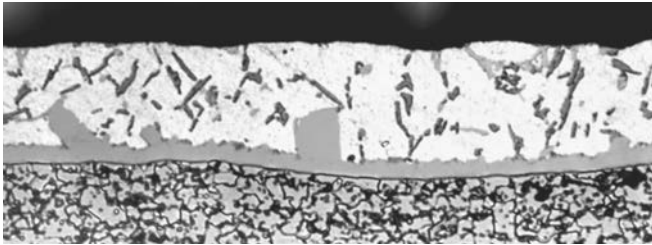
	Yield Strength (MPa)	Tensile Strength (MPa)	Tensile Elongation (%)	n-Value
Longitudinal	370	585	23	0.13

*Typical 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 and 9% silicon. 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.

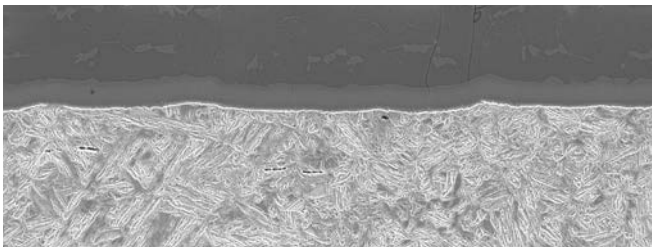
### FIGURE 1

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.



# ULTRALUME® PRESS HARDENABLE STEEL

## 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 Cleveland-Cliffs 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





# ULTRALUME<sup>®</sup> PRESS HARDENABLE STEEL

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## About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada. For more information, visit [www.clevelandcliffs.com](http://www.clevelandcliffs.com).



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