AN INNOVATIVE FAMILY OF FORMABLE TUBE PRODUCTS

- FORMTUBE®
- FORMTUBE® AI
- FORMTUBE® SS
- FORMTUBE® 340
- FORMTUBE® PHS
- FORMTUBE® 700 / 800 / 1000
- NEXTUBE® 1000 / 1200
FORMTUBE®

Designed for improved formability at a lower cost for Pressure Tube (PT) applications. Cost effective alternative for J356 standards for low pressure applications.

<table>
<thead>
<tr>
<th>TUBE MECHANICAL PROPERTIES (minimums)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YIELD STRENGTH</strong></td>
</tr>
<tr>
<td>172 MPa</td>
</tr>
</tbody>
</table>

**ADVANTAGES**
- Typical elongation of 46%
- Available as cold rolled or aluminum coated product
- Available in Diameter to Thickness ratios up to 100:1
- Lower cost alternative to annealed tube

**APPLICATIONS**
- Fuel filler neck
- Radiator tubes
- Fluid line tubing
- Vent tubes
- Exhaust tubes

**SIZES**
- 19 – 168 mm diameters
- 0.8 – 3.0 mm thickness
FORMTUBE® AI

A highly formable, aluminum coated, carbon tubing available in extremely high Diameter to thickness (D/t) ratios, specifically designed for use in demanding exhaust applications that require tight 1XD bends. Proven to improve customer quality and reduce production costs. Meets ASTM A787.

**TUBE MECHANICAL PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>YIELD STRENGTH</th>
<th>TENSILE STRENGTH</th>
<th>ELONGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>220 MPa</td>
<td>296 MPa</td>
<td>44%</td>
</tr>
</tbody>
</table>

**ADVANTAGES**

- High corrosion resistance in carbon tube
- Excellent heat reflectivity at temps less than 430 °C
- Material effective up to 680 °C
- Available in Diameter to Thickness ratios up to 100:1

**APPLICATIONS**

- Auto and truck exhaust components
- Coolant fluid transfer components

**SIZES**

- 19 – 168 mm diameters
- 0.8 – 3.0 mm thickness
Ferritic stainless steel tubing developed with superior formability. Available in 409 and 439 grades, both bare and aluminized coated options.

TUBE MECHANICAL PROPERTIES (typical – 127 mm diameter)

<table>
<thead>
<tr>
<th>STAINLESS</th>
<th>YIELD STRENGTH</th>
<th>TENSILE STRENGTH</th>
<th>ELONGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>409</td>
<td>340 MPa</td>
<td>420 MPa</td>
<td>31%</td>
</tr>
<tr>
<td>439</td>
<td>370 MPa</td>
<td>475 MPa</td>
<td>29%</td>
</tr>
</tbody>
</table>

ADVANTAGES

- Equiaxed grain structure improves forming and reduces customer scrap
- Uniform mechanical properties for repeated forming
- Minimal tube cold work allows maximum customer forming
- Aluminum coated product available for increased corrosion resistance
- Available in Diameter to Thickness ratios up to 100:1

APPLICATIONS

- Automotive, truck and ATV/UTV exhaust tubes
- Hot and cold end exhaust components
- Resonators, catalytic converters, headers, tips included

SIZES

- 32 – 168 mm diameters
- 0.8 – 3.0 mm thickness
FORMTUBE® 340

Excellent replacement for HSLA 340/HSLA 50 grade tubing. Formulated to provide superior formability and weldability.

TUBE MECHANICAL PROPERTIES (typical – 60 mm diameter)

<table>
<thead>
<tr>
<th>YIELD STRENGTH</th>
<th>TENSILE STRENGTH</th>
<th>ELONGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>372 MPa</td>
<td>441 MPa</td>
<td>32%</td>
</tr>
</tbody>
</table>

ADVANTAGES
- Higher elongation compared to HSLA 340/HSLA 50 grades
- Lower cost alternate to HSLA grades
- Available in Diameter to Thickness ratios up to 100:1

APPLICATIONS
- Any HSLA 340 or HSLA 50 grade structural application
- Cross car beams, load beams, cross members and other structural components

SIZES
- 19 – 168 mm diameters
- 0.8 – 3.0 mm thickness
FORMTUBE® Press Hardenable Steel (PHS)

Available in 1500 MPa and 2000 MPa grades (after customer hot-forming). Designed specifically for tubular hot-forming applications.

<table>
<thead>
<tr>
<th></th>
<th>YIELD STRENGTH</th>
<th>TENSILE STRENGTH</th>
<th>ELONGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHS 1500</td>
<td>470 MPa</td>
<td>630 MPa</td>
<td>23%</td>
</tr>
</tbody>
</table>

**ADVANTAGES**
- Bare or Aluminum coated product available
- Available in round or complex custom shapes
- Smooth cut ID and OD surface for precise mandrel bending
- Available in Diameter to Thickness ratios up to 100:1

**APPLICATIONS**
- Hot-formed structural components
- Impact beams, roof rails, and pillars

**SIZES**
- 19 – 168 mm diameters
- 1.0 – 3.5 mm thickness

TUBE MECHANICAL PROPERTIES (typical – 63.5 mm diameter, before hot-forming)

*Note: Properties after hot-forming*
FORMTUBE® 700 / 800 / 1000

Available in DP 600 / 800 / 1000 and TRIP 600 / 700 grades, in both bare and galvanized coated versions. Offers highest D/t range in the market today. Excellent for lightweighting.

TUBE MECHANICAL PROPERTIES (typical)

<table>
<thead>
<tr>
<th></th>
<th>DP 800</th>
<th>DP 1000</th>
<th>TRIP 700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Strength (MPa)</td>
<td>620</td>
<td>896</td>
<td>558</td>
</tr>
<tr>
<td>Tensile Strength (MPa)</td>
<td>841</td>
<td>1068</td>
<td>724</td>
</tr>
<tr>
<td>Elongation (%)</td>
<td>17</td>
<td>10</td>
<td>30</td>
</tr>
</tbody>
</table>

Note: Typical bake hardening effect 7%.

ADVANTAGES
- Uniform tube properties for consistent forming
- High Diameter to Thickness ratios up to 100:1
- Consistently smooth ID and OD cutting for efficient bending and forming
- Lightweight alternative to current mild carbon or HSLA grades

APPLICATIONS
- Any automotive, truck or power sports structural application
- Excellent for lightweight and/or crash management applications

SIZES
- 19 – 168 mm diameters
- 0.9 – 2.5 mm thickness
Available in tensile strengths of 1000 / 1200 MPa. Offers superior formability coupled with high tensile strengths. Excellent for lightweighting.

<table>
<thead>
<tr>
<th></th>
<th>1000</th>
<th>1200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Strength (MPa)</td>
<td>834</td>
<td>1054</td>
</tr>
<tr>
<td>Tensile Strength (MPa)</td>
<td>1006</td>
<td>1234</td>
</tr>
<tr>
<td>Elongation (%)</td>
<td>17</td>
<td>14</td>
</tr>
</tbody>
</table>

Note: Typical bake hardening effect 3%.

**NEXTUBE® 1000 / 1200**

**ADVANTAGES**
- Uniform tube properties for consistent forming
- High Diameter to Thickness ratios up to 80:1
- Wall thicknesses down to 1.0 mm
- Consistently smooth ID and OD cutting for efficient bending and forming
- Lightweight alternative to current mild carbon, HSLA or Gen 2 AHSS applications

**APPLICATIONS**
- Any automotive, truck or power sports structural application
- Excellent for lightweight and/or crash management applications

**SIZES**
- 19 – 168 mm diameters
- 1.0 – 2.0 mm thickness
AK Steel’s Research and Innovation Center in Middletown, Ohio is a 135,000 square foot facility located between Dayton and Cincinnati, OH.

The Research and Innovation Center underscores our focus on driving leading-edge products and processes as an innovator in carbon, stainless and electrical steels. This Research and Innovation Center is an important part of our strategy to create steel solutions to meet the needs of our customers today and for the future.

AK Steel’s talented team of researchers, scientists and engineers are working to develop innovative products such as:

**Next Generation Advanced High Strength Steels (AHSS)** to help automotive customers design lighter, more fuel-efficient vehicles that maintain superior strength and safety performance.

**New Stainless Steels** that offer superior corrosion resistance for a wide variety of applications.

**High Efficiency Electrical Steels** that will enable the nation’s electricity grid to become more energy-efficient, and improve performance in motors for hybrid and electric vehicles.

The Research and Innovation Center’s state-of-the-art laboratories and pilot steelmaking facilities include 17 prototype laboratories, 17 analytical laboratories and 22 collaborative spaces for employees, customers and suppliers. The new center also features a number of AK Steel’s steel products throughout the facility.

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**A HERITAGE OF INNOVATION**

As a leader of innovation in the steel industry, in 1910 AK Steel’s predecessor company, The American Rolling Mill Company (ARMCO), established the first steel research organization in North America. AK Steel continues to be on the leading-edge of steel technology for carbon, stainless and electrical steels today.

AK Steel pioneered the development of electrical steels beginning in 1903, followed by the introduction of Ingot Iron, the first commercially produced, high purity iron for the appliance and porcelain enameling industries. In the 1920s, AK Steel revolutionized the steel industry with the introduction of the world’s first continuous hot rolling mill for sheets and coils. The 1930s brought the first continuously galvanized and aluminized strip with in-line annealing and excellent coating adhesion in the United States that launched AK Steel’s advancements in coated steels. This work continued with our patented Aluminized Stainless Steels, which helped transform the automotive exhaust market in the 1990s.

Continuing AK Steel’s history of innovation, our team of researchers, scientists and engineers have recently introduced:

**NEXMET® AHSS**, family of steels, offering significant lightweighting opportunities with high strength, excellent ductility (elongation), and high hole expansion ratio.

**ULTRALUME® PHS**, an Advanced High Strength Steel (AHSS) designed to improve safety and lightweighting of structural components in vehicles.

**DI-MAX® HF-10X**, a non-oriented electrical steel designed for rotating equipment operating at above 60 Hz.

**THERMAK® 17**, designed for demanding hot-end automotive exhaust applications with improved high temperature strength and thermal fatigue performance to enable vehicle lightweighting.
AK Tube LLC, a subsidiary of AK Steel, was founded in 1976 and has grown to have three mills across the Midwest and Mexico. All of the Midwest facilities are certified in ISO 9002, QS 9000, TS/ISA 16949 requirements. In 2016, construction began on a new facility in Querétaro, Mexico and is now TS / ISO 16949 certified. AK Tube welcomes the opportunity to serve customers Electric Resistance Welded (ERW) mechanical carbon and stainless steel tubing needs.

Locations for AK Tube facilities are located in Wallbridge, Ohio, Columbus, Indiana, and Querétaro, Mexico. With the commitment and dedication to meet the needs of the customer, AK Tube offers innovative solutions with a wide breadth of steel, diameter, gauge and shape capabilities, and has the expertise necessary to meet our customers' tubing requirements. The AK Tube team is dedicated to being the leader in safely producing superior products with pride and integrity. The commitment to safety was recently recognized with the Rusy Demeules Safety Award for outstanding safety at the Columbus, Indiana facility. AK Tube aims to provide increased profitability through mutually beneficial relationships with our employees, customers and suppliers.

MAKING TUBING... AND A DIFFERENCE IN THE LIVES OF OTHERS

• Serving our customers better than any other tubemaker
• World-class research and innovation center
• Producing the most diversified product line in the steel industry
• Award winning safety performance
• Recognized for excellence in steelmaking
• Giving back to the communities where we work and live

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800.955.8031
www.aktube.com

AK Tube LLC is a wholly owned subsidiary of AK Steel.

AK Steel is a leading producer of flat-rolled carbon, stainless and electrical steel products, primarily for the automotive, infrastructure and manufacturing, including electrical power, and distributors and converters markets. Through its subsidiaries, the company also provides customer solutions with carbon and stainless steel tubing products, die design and tooling, and hot- and cold-stamped components. Headquartered in West Chester, Ohio (Greater Cincinnati), the company has approximately 9,500 employees at manufacturing operations in the United States, Canada and Mexico, and facilities in Western Europe. Additional information about AK Steel is available at www.aksteel.com.

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