

# AN INNOVATIVE FAMILY OF FORMABLE TUBE PRODUCTS

**FORMTUBE®**

**FORMTUBE® AL**

**FORMTUBE® SS**

**FORMTUBE® PHS**

**FORMTUBE® 700 / 800 / 1000**

**NEXTUBE® 1000 / 1200**



# FORMABLE TUBE PRODUCTS

## FORMTUBE® – Product Description

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

### TUBE MECHANICAL PROPERTIES (minimums)

Yield Strength	Tensile Strength	Elongation
172 MPa	276 MPa	35%

### ADVANTAGES

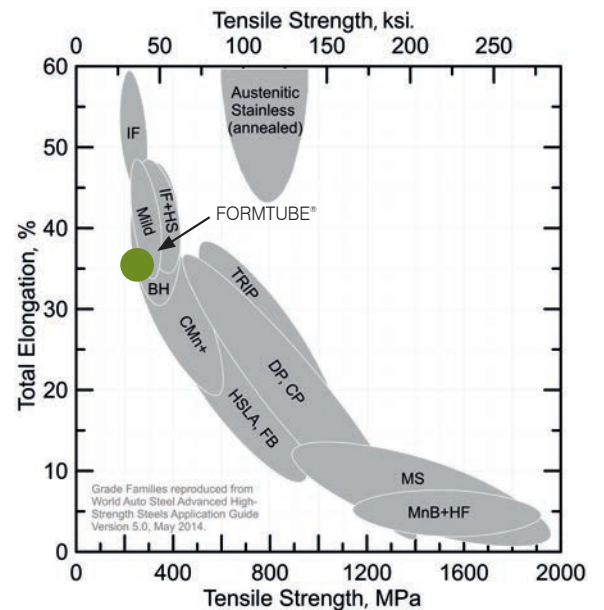
- Typical elongation of 46%
- Available as cold-rolled or aluminum-coated product
- Available in diameter-to-thickness (D/t) ratios up to 100:1
- Lower-cost alternative to annealed tube

### APPLICATIONS

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

### SIZES

- 19 – 168 mm diameters
- 0.8 – 3.0 mm thickness



# FORMABLE TUBE PRODUCTS

## FORMTUBE® AL – Product Description

A highly-formable, aluminum-coated, carbon tubing available in extremely high 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 (typical – 76 mm diameter)

Yield Strength	Tensile Strength	Elongation
220 MPa	296 MPa	44%

### ADVANTAGES

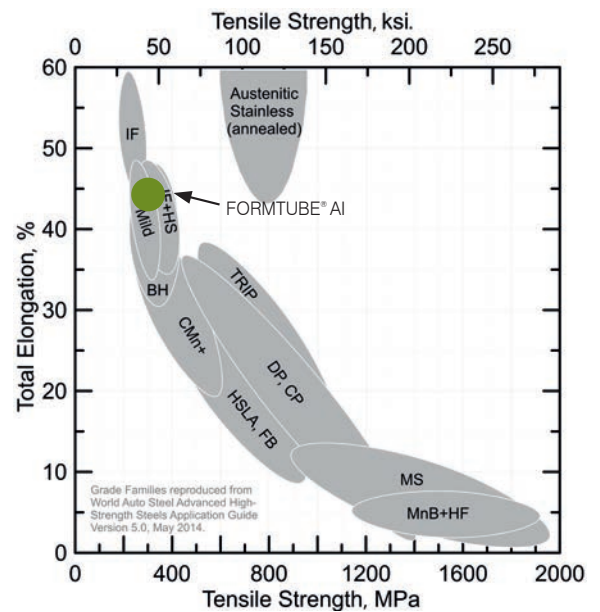
- High corrosion resistance in carbon tube
- Excellent heat reflectivity at temps less than 430 °C
- Material effective up to 680 °C
- Available in Diameter/t ratios up to 100:1

### APPLICATIONS

- Auto and truck exhaust components
- Coolant fluid transfer components

### SIZES

- 19 – 168 mm diameters
- 0.8 – 3.0 mm thickness



## FORMABLE TUBE PRODUCTS

### FORMTUBE® SS – Product Description

Ferritic stainless steel tubing developed with superior formability. Available in 409, 439, 441, 15 Cr-Cb™ and 18 Cr-Cb™. The 409 and 439 grades are available in aluminum coated versions.

#### TUBE MECHANICAL PROPERTIES (typical – 127 mm diameter)

Stainless	Yield Strength	Tensile Strength	Elongation
409	340 MPa	420 MPa	31%
439	370 MPa	475 MPa	29%
441	470 MPa	520 MPa	24%

#### ADVANTAGES

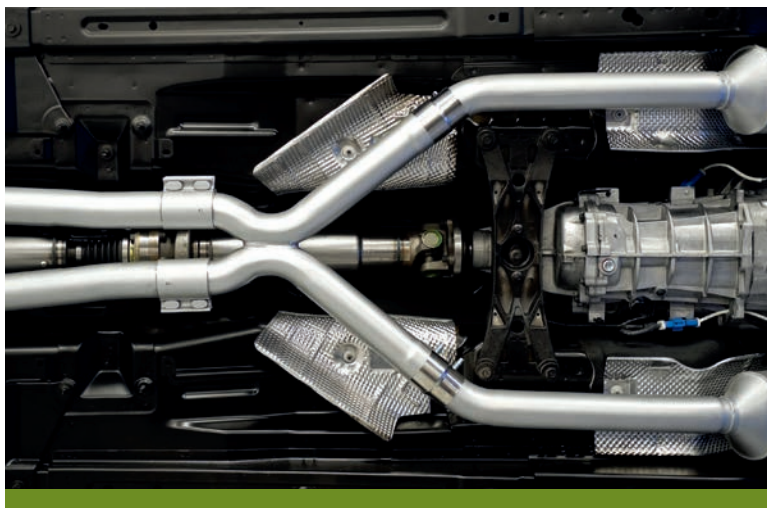
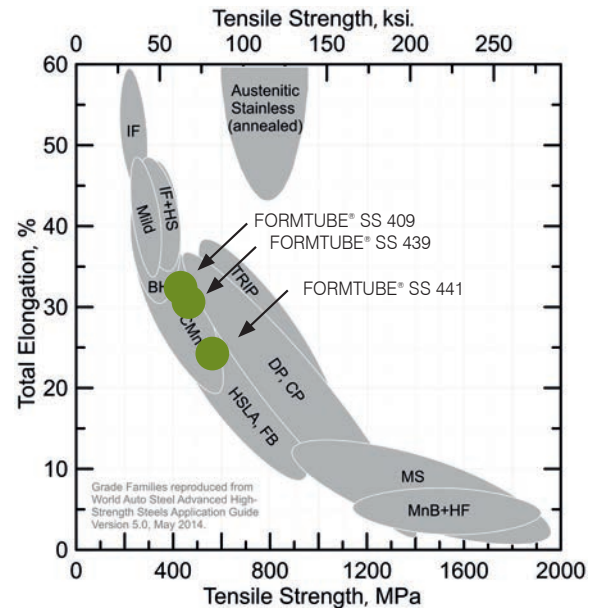
- Equiaxed grain structure improves forming and reduces customer scrap
- Uniform mechanical properties for repeated forming
- Minimal tube cold work allows maximum customer forming
- Aluminum-coated product available in 409 and 439 grades for increased corrosion resistance
- Available in D/t ratios up to 100:1

#### APPLICATIONS

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

#### SIZES

- 32 – 168 mm diameters
- 0.8 – 3.0 mm thickness



# FORMABLE TUBE PRODUCTS

## FORMTUBE® PHS – Product Description

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

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

	Yield Strength	Tensile Strength	Elongation
PHS 1500	470 MPa	630 MPa	23%

### ADVANTAGES

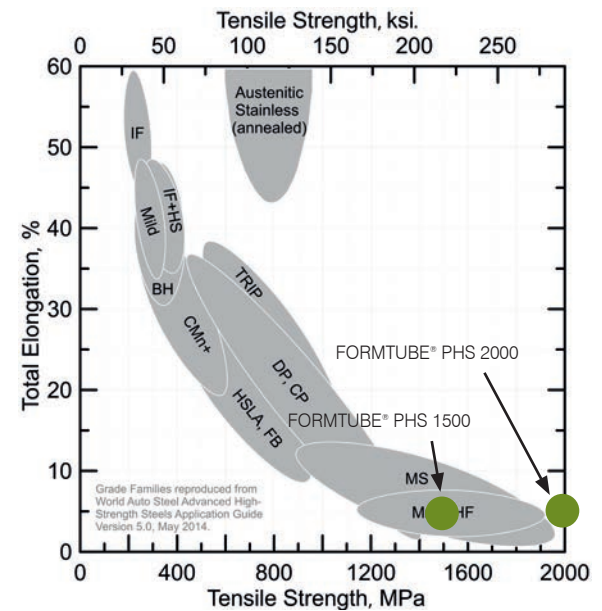
- Bare or Aluminum-coated product available
- Available in round or complex custom shapes
- Smooth cut ID and OD surface for precise mandrel bending
- Available in D/t ratios up to 100:1

### APPLICATIONS

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

### SIZES

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



\* Note: Properties after hot-forming



## FORMABLE TUBE PRODUCTS

### FORMTUBE® 700 / 800 / 1000 – Product Description

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)

	Yield Strength	Tensile Strength	Elongation
DP 800	620 MPa	841 MPa	17%
DP 1000	896 MPa	1068 MPa	10%
TRIP 700	558 MPa	724 MPa	30%

Note: Typical bake hardening effect on Yield Strength – 7% increase.

#### ADVANTAGES

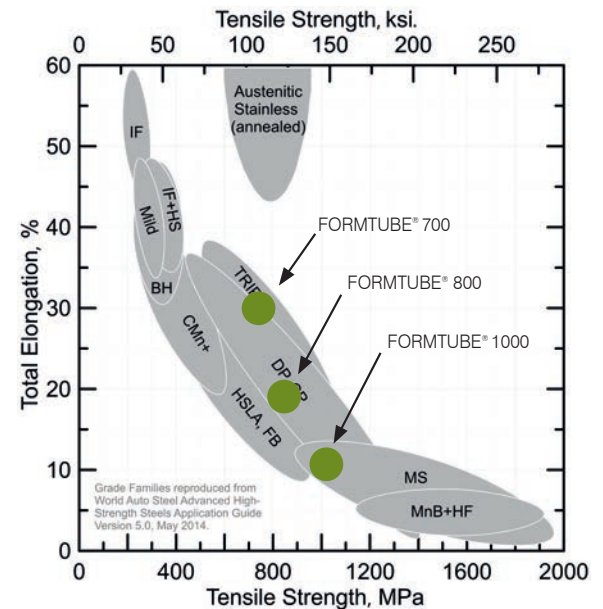
- Uniform tube properties for consistent forming
- High D/t ratios up to 100:1
- Consistently smooth cut ID and OD cutting for efficient bending and forming
- Lightweight alternative to current mild carbon or HSLA grades

#### 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



# FORMABLE TUBE PRODUCTS

## NEXTUBE® 1000 / 1200 Product Description

Available in tensile strengths of 1000 / 1200 MPa. Offers superior formability coupled with high tensile strengths. Excellent for lightweighting.

### TUBE MECHANICAL PROPERTIES (typical)

	Yield Strength	Tensile Strength	Elongation
1000	834 MPa	1006 MPa	17%
1200	1054 MPa	1234 MPa	14%

Note: Typical bake hardening effect – 3% to 10% increase in Yield Strength.

### ADVANTAGES

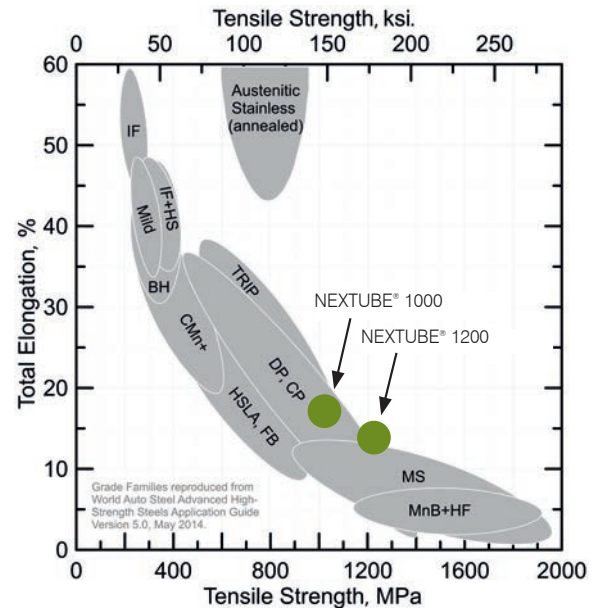
- Uniform tube properties for consistent forming
- High D/t ratios up to 80:1
- Wall thicknesses down from 1.0 mm
- Consistently smooth ID and OD cutting for efficient bending and forming
- Lightweight alternative to current mild carbon, HSLA or Gen 2 AHSS applications

### 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



## FORMABLE TUBE PRODUCTS

### WORLD-CLASS RESEARCH AND INNOVATION CENTER

Cleveland-Cliffs Research and Innovation Center in Middletown, Ohio is a 135,000 square foot facility located between Dayton and Cincinnati.

The Research and Innovation Center underscores our focus on driving leading-edge products and processes as an innovator in carbon, stainless and electrical steels.

Cleveland-Cliffs 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 electrical 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 center also features a number of Cleveland-Cliffs' steel products throughout the facility.

### ABOUT CLEVELAND-CLIFFS TUBULAR COMPONENTS

We have grown to become the premier Electric Resistance Welded (ERW) tube producer in North America. Our two Midwest plants, located in the heart of U.S. manufacturing, are fully certified to IATF 16949 and ISO 14001. We welcome the opportunity to supply our customers' mechanical carbon, stainless and AHSS tubing needs.

Our facilities are located in Walbridge, Ohio and Columbus, Indiana. With a commitment to meet our customers' needs, Cleveland-Cliffs offers innovative solutions, with a wide range of steel, diameter, gauge and shape capabilities. All this while being an industry leader in safety.



### 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.

#### CLEVELAND-CLIFFS INC.

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