



# CryoSTEEL™

## CMC's Latest Innovation in Rebar - Cryogenic Rebar

CryoSTEEL™ is a specially-engineered concrete reinforcing steel produced by Commercial Metals Company (CMC) for cryogenic applications. CMC's advanced production process for CryoSTEEL™ yields results that exceed minimum specifications and published temperatures of other cryogenic rebar producers while meeting all specification strength and ductility requirements. This additional safety factor provides peace of mind when designing and building tanks, equipment slabs, foundations or other structures exposed to extreme environments and temperatures.

CryoSTEEL™ has been successfully tested down to -265°F (-165°C) by an independent lab to ensure it meets or exceeds all specifications for the majority of cryogenic applications. CMC will individually test CryoSTEEL™ to the required design temperature for your specific project or need.



## BENEFITS OF CryoSTEEL™

- > Domestically produced in the U.S. means shorter lead times. Historically only available from international sources.
- > Exceeds minimum design specifications as a result of the advanced production process.
- > Order exactly the material your job requires and have CMC deliver installation-ready rebar directly to your job site - no more ordering overages.
- > Reduce the frustrations of managing separate purchasing, storage and fabrication processes - simplify your project by partnering with CMC and reduce the extra headaches of cryogenic requirements.

## GRADES AND SPECIFICATIONS

CryoSTEEL™ rebar is produced in imperial units and is available in lengths up to 66 feet.

Available in two specifications to meet a wide range of cryogenic temperature requirements, CryoSTEEL is produced in the following grade, sizes and specifications:

### Grade:

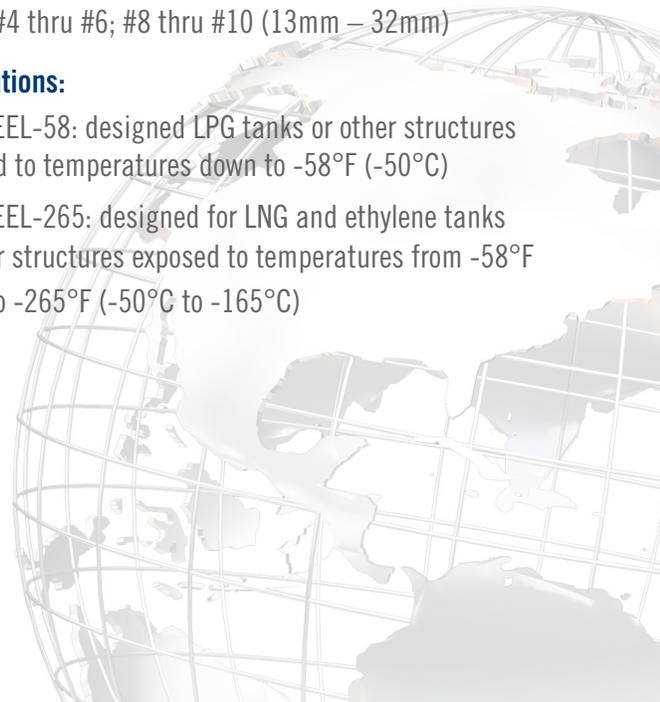
- > ASTM A615, Grade 60 (420 MPa)

### Sizes:

- > Rebar #4 thru #6; #8 thru #10 (13mm – 32mm)

### Specifications:

- > CryoSTEEL-58: designed for LPG tanks or other structures exposed to temperatures down to -58°F (-50°C)
- > CryoSTEEL-265: designed for LNG and ethylene tanks or other structures exposed to temperatures from -58°F down to -265°F (-50°C to -165°C)



# CryoSTEEL™

With over a century of experience in the steel industry, CMC is committed to innovation and industry leading customer service.

## CryoSTEEL™ Testing Criteria

With CryoSTEEL™ you are assured that all specifications are met through rigorous testing with certifications issued for each heat delivered. Testing is performed to ACI 376-11 “Code Requirements for Design & Construction of Concrete Structures for Containment of Refrigerated Liquefied Gases” and BS EN 14620-3:2006 Annex A.3 for reinforcing steel for the “Design and manufacture of site built, vertical, cylindrical, flat-bottomed, steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 deg. C and -165 deg. C. Part 3: Concrete Components.”

## Testing

Tensile tests are carried out under cold conditions (at the design metal temperature) to establish the suitability of the steel.

The design metal temperature is determined from the lowest temperature that the reinforcement bar would be subjected to under abnormal loading conditions. During the test, the specimen temperature is as uniform as possible. The difference between the temperatures at any two points of the specimen or the difference between the temperature at any point and the design temperature does not exceed 5°C. Tensile tests in accordance with EN 10002-1 are conducted on un-notched and notched bar specimens.

## Plastic Elongation

Each un-notched specimen demonstrates a percentage plastic elongation of at least 3%. The percentage plastic elongation is the permanent percentile increase of the original gauge length corresponding to tensile strength.

## Yield Strength

The yield strength of the un-notched specimen found during testing is at least 1.15 times the minimum yield strength used in the design.

## The Notch Sensitivity Ratio (NSR) is calculated by:

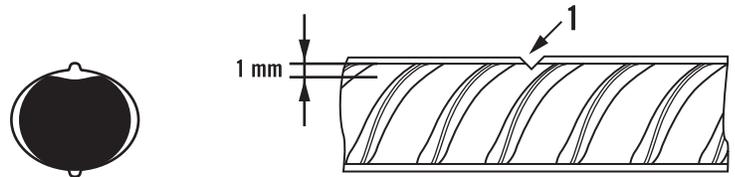
$$\text{NSR} = \frac{\text{Tensile strength of notched bar}}{0.2\% \text{ proof stress of un-notched bar}}$$

or:

$$\text{NSR} = \frac{\text{Tensile strength of notched bar}}{\text{Lower yield stress of un-notched bar}}$$

A NSR value of 1 or greater is required to achieve acceptable toughness.

The test specimen for notched bar tests is notched at the half-length position between the machine grips. A V-notch has an internal angle of 45° and a radius at the base of 0.25 mm. Machining techniques and tolerances are in accordance with EN 10045-1. For longitudinal ribbed bars, the notch is placed across the rib and penetrates 1 mm into the underlying bar.



Key  
1 - V-notch

Figure A — Notch on reinforcement bar

CryoSTEEL™ is produced exclusively at CMC Steel Arizona. For additional information contact our sales team at:

### CMC Steel Arizona

11444 East Germann Rd.

Mesa, AZ 85212

Phone: 888.641.8956 • Email: cryosteel@cmc.com



RECYCLING | MILLS | FABRICATION | WWW.CMC.COM

**COMMITMENT**  
YOU CAN COUNT ON

**A CENTURY OF INDUSTRY EXPERIENCE** Founded in 1915, Commercial Metals Company and its subsidiaries recycle, manufacture and fabricate steel, metal products and related materials through a network of facilities throughout the United States and around the globe. As a publically traded company (NYSE: CMC) on the Fortune 1000 list, our long-standing professionalism and exceptional level of service have been recognized among the best in our industry. We set the standard for being an environmentally responsible, efficient, high quality, and low cost metal recycler, steel manufacturer and fabricator.