# Industeel

ArcelorMittal

# SuperElso® 690CR

**Quenched and Tempered High Strength Steel for Leg Components of Jack-up Rigs.**

## SuperElso® 690 CR: Quenched and Tempered High Strength Steel for Leg Components of Jack-up Rigs.

**SuperElso® 690 CR** is a **high-strength quenched and tempered steel** (minimum yield 690 MPa / 100 ksi) specifically developed **for jack-up rig leg structures** used in offshore drilling platforms.

It is produced via **Electric Arc Furnace (EAF)** melting with **ladle refining, dephosphorisation, and vacuum degassing,** ensuring **clean, homogeneous steel and reproducible mechanical properties** through thicknesses up to 250 mm.

Now available under the **XCarb® Recycled and Renewably Produced** label, SuperElso® 690 CR combines **extreme strength** and **superior impact toughness** (> 50 J at –60 °C) with **a substantially reduced carbon footprint** thanks to recycled scrap and renewable electricity.

**Its very low carbon content enables ease of cutting, forming, and welding**, minimizing fabrication cost and risk – an ideal material **for racks, chords, and welded leg sections.**

## Properties

### Classification and standards

- **DNV-GL:** VL FO690 (215 mm), VL EO690 / E690 (254 mm)
- **ABS**: AB FQ70 Z35 (210 mm)
- **ASTM:** A514 / A517 A–Q (11 in)

### Chemical composition

**Ladle analysis** – Expressed in weight percent (wt%)

| C | Mn | Si | P | S | Ni | Mo | Cr | Al |
|---|---|---|---|---|---|---|---|---|
| ≤0.15 | ≤1.2 | 0.15-0.45 | ≤0.010 | ≤0.002 | ≤4.0 | ≤0.7 | ≤0.7 | ≤0.05 |

Optimized alloy design ensures both **high strength and excellent toughness** across the plate thickness, while maintaining **HAZ hardness ≤ 400 HV5**, as recommended by DNV.

## Mechanical properties

| Property | Yield Strength (MPa) 1/2 thick | Tensile Strength (MPa) 1/4 thick | Elongation A (%) | Charpy V (-60°C, 1/4 thick) (J) | Charpy V (-37°C, 1/4 thick) (J) |
|---|---|---|---|---|---|
| Guaranteed | ≥690 | 480-640 | ≥16 | ≥35 | ≥46 avg/32min 65-120 |
| Typical | 770 | 480-640 | ~20 | ≥35 | ≥46 avg/32min 80-130 |

SuperElso® 690 CR provides **high safety margins** for impact and CTOD performance, even in thick welded joints.

## Processing and welding

- **Heat treatment :** Water quenching + tempering ≈ 600 °C. PWHT not recommended (may degrade toughness).
- **Preheat / Interpass :** 120 °C (+25 / −0 °C) / ≤ 170 °C.
- **Post-heat :** ≈ 250 °C (± 10 °C / 2 h).

These optimized parameters maintain **stable underbead hardness** and minimize hydrogen-assisted cracking.

Compatible with SAW, FCAW, SMAW; Industeel-validated consumables include **Oerlikon Tenacito 80 CI, Fluxofil 42, Böhler FOX EV 85**, and others.

## Hydrogen and cathodic protection

SuperElso® 690 CR exhibits **excellent resistance to hydrogen-induced cracking and cathodic protection environments**, performing comparably to normalized steels in NACE $H_2S$-saturated conditions.
Slow strain-rate testing confirms its robustness under synthetic seawater at −1000 mV/SCE.

## Applications

Specially designed **for jack-up rig legs,** SuperElso® 690 CR is used for :
racks, chords, windows, welded leg sections up to 24 m, and rack chocks for locking systems.

**Its high yield strength, excellent weldability, and proven reliability in arctic or deep-sea conditions** make it a reference material for next-generation offshore rigs.

## Sustainability

## XCarb® Recycled and Renewably Produced

SuperElso® 690 CR is now part of the **XCarb® Recycled and Renewably Produced** range.
Manufactured from u**p to 96 % recycled steel using renewable electricity which use is ensured through Guarantees of Origin (GoOs)**, it offers a **carbon footprint around 2.4 t $CO_2$ eq/t of plate (cradle-to-gate)**, third-party reviewed (ISO 14040/14044 – Worldsteel LCI methodology).

This makes SuperElso® 690 CR **a low-carbon high-strength solution** for offshore structures supporting the **energy transition and sustainable drilling operations.**

XCarb®
Recycled and renewably produced

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