Industeel

ArcelorMittal

CromElso™ 22

Chromium-Molybdenum Steel

Special low alloy (2¼Cr1Mo) steel for high temperature hydrogen service

CromElso™ 22 is a low alloyed Cr-Mo steel designed for pressure equipment such as hydrotreating reactors operating at elevated hydrogen pressure and temperature. **CromElso™ 22** is manufactured via the electric arc furnace with dephosphorisation, ladle refining and vacuum degassing to provide reproducible, clean and homogeneous steel. The use of special steelmaking practice with extralow phosphorus levels gives **CromElso™ 22** improved resistance to temper embrittlement, as well as providing excellent low temperature impact toughness properties.
CromElso™ 22 is particularly suitable for pressure equipment in high temperature hydrogen service (e.g. hydrotreating reactors, exchangers). This steel is available in plate form in thickness up to 250 mm, and can also be provided in single- or multi-piece heads and cores.

Properties

Standards

CromElso™ 22 is compliant with:

- ASTM/ASME A/SA-387 gr22 cl2 (UNS K21590)
- EN 10028-2 10CrMo9-10 (1.7380)

For other standard compliancy, please consult.
Multiple certifications are possible on request.

Tensile properties

Guaranteed transverse tensile properties at room temperature. *(Measured on every plates):*

Standard	Plate thickness (mm)	Yield Strength (MPa)	Ultimate Tensile Strength (MPa)	Minimum Elongation (%)
EN 10028-2 10CrMo9-10	< 60	310	480-630	18
	60-150	260	460-620	17
	150-250	250	450-600	17
A/SA-387 gr22 cl.2		310	515-690	18

Yield Strength (YS/$Rp_{0.2}$) guaranteed ≤ 620MPa.

Chemical composition

Ladle analysis – Expressed in weight percent (wt%) as per above standards

C	Mn	Si	Cr	Mo	Ni
≤ 0.15	0.30-0.60	≤ 0.30	2.0-2.5	0.90-1.10	≤ 0.30

Ultra clean steel : we guarantee J-factor ≤ 80, P ≤ 0.007 wt%, P+Sn ≤ 0.012 wt%
H_2 ≤ 2ppm or even ≤ 1ppm depending on production route, C ≤ 0.14wt% possible for thickness ≤ 120mm

Specific guarantees

CromElso™ 22 is delivered in heat treated condition with tempering done at 710°C minimum, with mechanical properties guaranteed for maximum PWHT 690°C – 38Hrs.

We guarantee actual tensile properties as per ASME II Part D: 90% UTS (Table U) and 100% YS (Table Y).
Tensile test done at design temperature (min and max PWHT).

Brinell hardness (BHN) ≤ 225 in as-delivered condition (Q+T). BHN ≤ 200 following PWHT.

Welding

Consumables used for the welding of **CromElso™ 22** shall comply with the following standards.

	SMAW	GMAW	FCAW	SAW (Wire + Flux)
AWS	SFA5.5 E 9018 B3 H4 R	SFA 5.28 ER 90S-Si	SFA 5.29 E 91T1-B3M-H8	SFA5.23 F11AZ-EB3R-B3
EN	EN ISO 3590-A ECrMo2 B 4 2 H5	EN ISO 21952-A G CrMo2Si	EN ISO 17643-A T CrMo2 P M21 1 H8	EN ISO 24596-B S S CrMo2 AR + EN ISO 14174 S A AR 1 76 AC H5

Please contact your favorite filler materials supplier for corresponding references.

Delivery conditions

Plates

CromElso™ 22 can be be produced in thicknesses from 5 mm and up to 250 mm (3/16" up to 10").
Maximum plate weight: 20 tons per unit for continuous casting route and up to 80+ tons for ingot route.

Prefabrication

By special agreement, prefabricated pieces can be delivered according to drawings. The following operations can be performed: beveling, bending, rolling of shell to radius, cutting to shape, fabrication of stiffeners and annular plates, pre-welding. *(Non exhaustive list, please consult)*

XCarb®

On request, **CromElso™ 22** plates can be delivered with **XCarb®** certificate that guarantees steels with a low carbon footprint, made through the electric arc furnace using recycled scrap and renewable electricity. Product carbon footprint is third-party verified.

Applications

This material may be used in all applications requiring service conditions under high temperature and or high pressure of hydrogen.
CromElso™ 22 is suitable for pressure equipment such as reactors or exchangers operating under hot hydrogen service (within the limits of API RP 941):

- Hydrodesulfuration (HDS) unit
- Hydrotreatment (HDT) unit
- Hydrocracking (HDC) unit

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Your contact

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Technical Literature

A non-exhaustive list of publications is provided below. These papers can be provided on request, only within the framework of discussions linked to projects that may consider the use of **CromElso™ 22** for the fabrication of pressure equipment:

- *Effect of Pre-Strain on Mechanical Properties of Pressure Vessel Grades – Assessment of Stress Relieving / Post Weld Heat Treatments Efficiency to Regenerate Properties. (ESOPE 2013)*
- *Effect of Temper and Hydrogen Embrittlement on Mechanical Properties of 2,25Cr-1Mo Steel Grades – Application to Minimum Pressurizing Temperature (MPT) Issues (IJPVP 2013)*
- *Hydrogen in Cr-Mo(-V) Pressure Vessel Steels (MPC HPV 2009)*
- *Effect of Hydrogen on mechanical behavior for 2,25Cr1Mo grades (standard and Vanadium added) (NACE Corrosion 2008)*
- *Specific problems in refining – high temperature, high pressure and hydrogen – case of 2,25Cr1Mo and 2,25Cr1MoV steels (IIW SSC IX-C Creep 2008)*
- *Overview of Hydrogen Related Problems in Pressure Vessel Steels (DEMAT 2008)*
- *Hydrogen Induced Disbonding: from laboratory tests to actual service conditions (NACE Corrosion 2005)*
- *Numerical simulation of heat treatments of CrMo steels (PVP 2005)*
- *Optimization of ISR and PWHT of CrMo(V) Steels (ESOPE 2004)*
- *Comparison Of Hydrogen Solubility And Diffusivity In CrMo And CrMoV Steels – Hydrogen Induced Disbonding (NACE Corrosion 2012)*
- *Myth on Tempering Temperature and PWHT Temperature of Cr-Mo Steels (AMPP 2018)*
- *Consideration on Tempering and PWHT Temperatures of C-Mn and Low Alloy Steels Used for the Fabrication of Pressure Vessels – Smart Tuning of Heat Treatment Parameters (PVP 2018)*

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