

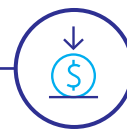
13CR & SUPER 13CR GRADES



BEST
CORROSION
RESISTANCE



HIGHEST
PROVEN
PERFORMANCE



COST
EFFECTIVE



RELIABLE, COST-EFFECTIVE SOLUTIONS FOR SWEET CO₂ ENVIRONMENTS

- LARGE OFFER COVERING ALL SWEET CORROSIVE ENVIRONMENTS

- INTEGRATED SUPPLY, WITH CONNECTION EXPERTISE AND QUALIFICATION

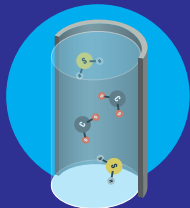
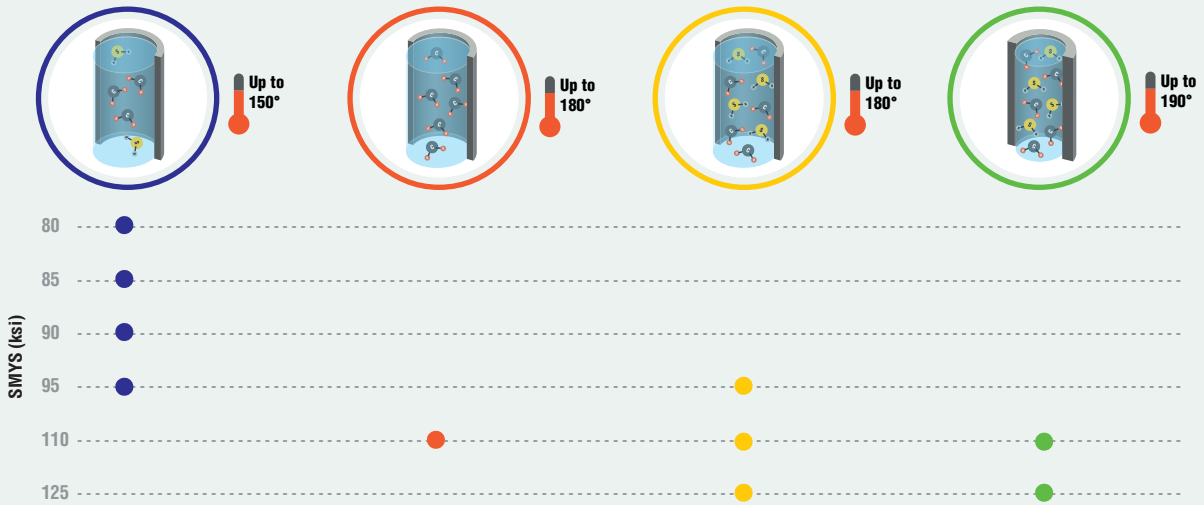
- MATERIAL SELECTION SUPPORT AND FIT-FOR-PURPOSE TESTING

A FULL PORTFOLIO OF CORROSION RESISTANT GRADES



Our extended portfolio covers operational scenarios from conventional to very challenging and extreme well conditions, supporting you on selecting the right material for your well environment. Our portfolio, available in the full range of outside diameter up to 10 3/4", includes :

- 13% Chromium (13CR),** strictly compliant with the latest edition of API 5CT and ISO 11960 standards, offering enhanced corrosion resistance thanks to a more controlled chemistry than standard API L80 13Cr. Suitable for temperatures up to 150°C.
- 13% Chromium Modified (13CRM),** in accordance with group 1 material category 13-5-2 of API 5CRA and ISO 13680. Its enhanced chemistry (containing 13% Cr, 4% Ni and 1% Mo) provides enhanced usage temperature (up to 180°C) and mechanical resistance.
- Super 13% Chromium (13CRSS),** in accordance with group 1 material category 13-5-2 of API 5CRA and ISO 13680, and S41426. This richer alloy provides enhanced resistance at low temperature with H₂S, and at temperatures up to 180°C.
- Enhanced Super 13% Chromium (13ECRSS),** strictly compliant with group 1 material category 13-5-2 of API 5CRA and ISO 13680, allows for resistance up to 190°C, and enhanced corrosion performance at very low pH levels with H₂S.



3% Chromium:

Thanks to its Chromium content, this grade presents a reduced corrosion rate in sweet environments with temperatures up to 90°C, thus extending the lifetime of the string and reducing workover frequency of carbon steel completions.



Operational efficiency:

All Chromium grades are available with dope-free technology CLEANWELL® developed VAM®. This environmentally friendly coating contributes to reducing galling sensitivity, thus presenting significantly lower back-out rates, near zero rejects and overall running time reduction of 50%.

13CR AND SUPER 13CR:

COMPETITIVE SOLUTIONS FOR SWEET CO₂ ENVIRONMENTS

Corrosion on flow-wetted tubulars is becoming increasingly challenging with the exploitation of O&G fields with high acidic content combined with high temperature levels.

Under such conditions and in presence of CO₂, carbon steel is known to suffer from mass loss corrosion, leading to high cost of material replacement and workover operations.

Thanks to their Chromium contents above 12%, Martensitic (MSS) and Super Martensitic Stainless Steels (SMSS) develop a passive layer of Chromium oxide that protects the material from the corrosive environment.

As a result, these grades remain passive and unharmed under conditions when carbon steel are subjected to severe general and localized corrosion, allowing the use of one single string for the whole well life and thus providing the most cost - effective solution.

Vallourec has a long track record of developing and delivering the highest performance proprietary MSS and SMSS grades in the market as a competitive and highly effective response to sweet corrosion, reducing costs and extending the lifespan of the well.

CONVENTIONAL ONSHORE AND OFFSHORE WELLS:

All types of corrosive environments with a maximum service temperature of 150°C

Your challenges

- Reduce total cost of ownership
- Fit-for-purpose material selection
- Large developments

Our solution

- 3CR: onshore and shallow water
- 13CR: adapted to most onshore and offshore environments
- 13CRM: increase SMYS of 110ksi for higher internal pressures demands

HP/HT WELLS:

High mechanical requirements and high temperature exposure

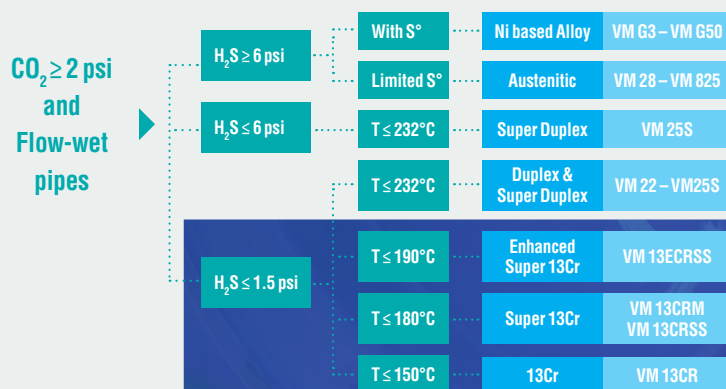
Your challenges

- Material normative qualification
- Well integrity
- Temperature and pressure

Our solution

- 13CRM: a cost-effective alternative to Super 13CR for non-sour environments
- 13CRSS: Increased mechanical resistance and higher corrosion resistance during shut-in phase at low temperatures when in presence of H₂S
- 13ECRSS: increased corrosion resistance at low and high temperature

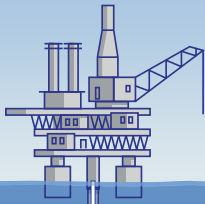
MATERIAL SELECTION



Application domain of MSS and SMSS

INNOVATION AND KNOW-HOW TO GUARANTEE YOUR WELL INTEGRITY

Corrosive environments affect a material's performance and string integrity. Sweet environments, when in presence of CO₂ and H₂S corrosive gases, lead to different corrosion risks that need to be assessed during material selection of flow-wetted tubulars:



LOW TEMPERATURE CORROSION RISK:

During shut-in phase, the top of the well is subjected to low temperature levels.

Under such conditions and when in the presence of H₂S, Sulphide Stress Cracking (SSC) phenomenon is considered to be catastrophic and represents a major concern for operators during well design and material selection, since it can lead to tubular string failure within days or even hours. H₂S resistant material therefore becomes a must.

HIGH TEMPERATURE CORROSION RISK:

During production, the tubing string is in contact with formation fluid at high temperatures. Under such conditions, the two main corrosion mechanisms to be assessed are:

- CO₂ corrosion: CO₂ drives the acidity and corrosive levels of the environment, since the formation of carbonic acid leads to the occurrence of general mass loss and localized attacks.
- Stress Corrosion Cracking (SCC): cracking of metal that occurs under the unfavorable combination of corrosive environments, high temperature and mechanical loads.

MATERIAL SELECTION EXPERTISE: SELECTING THE RIGHT MATERIAL FOR YOUR APPLICATION

Many different parameters impact on a material's corrosion performance, such as temperature, presence of corrosive gases, chloride content, pH level, among others.

Since materials performance mappings are not able to take all these parameters into consideration, Vallourec puts at your disposal a team of experts to support you in your Material Selection process.

Our testing expertise allow us to evaluate our material performance in your well conditions, according to NACE standard test, or following the latest, most state-of-the-art testing techniques.

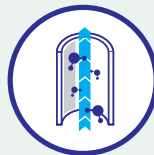
PROVIDING VALUABLE ASSISTANCE IN OPTIMIZING YOUR OPERATIONS

Our team of experts is there to guide you at every stage of your project, from well design stage to decommissioning at end of well life, through eventual failure analysis during well production. Whatever your project, we take up all your challenges with an innovative range of proprietary grades and standard materials combined with a full range of services and assistance to mitigate risks and ensure well integrity in inhospitable environments.

AN END-TO-END SERVICE OFFERING

- **A one-stop, full-service provider** from steelmaking to pipe running in your well
- **Fit-for-purpose qualification matrix** design and testing in our facilities in France and Brazil
- **State of the art testing techniques**, to better represent your operating conditions and select the most cost-effective material
- **Advanced corrosion modelling** and in-situ pH simulation using dedicated softwares
- **Fast-Screening tests** for a quick material assessment and recommendation
- **Pipe finishing** including full-length mill threading
- **Supply Chain Management**
- **Stock Management** in nine facilities around the world, in France, Germany, UK, USA, Canada, Mexico, Brazil and Indonesia.
- **Extensive VAM® licensee network** globally for field repairs and accessories
- **VAM® Field Service International** inspection and running services for reduced down-time and smoother operations

BENEFITS OF 13CR AND SUPER 13CR



BEST CORROSION RESISTANCE

Our proprietary 13Cr and Super 13Cr grades offer the highest corrosion resistance for oil & gas fields under high temperature in sweet environments.



HIGHEST PROVEN PERFORMANCES

Decades of know-how and process control are backed-up by hundreds of corrosion test results.



COST EFFECTIVE

As an alternative to more costly Duplex and Super Duplex grades, our 13Cr and Super 13Cr offer a long-life, cost-efficient solution.

FOR MORE INFORMATION ON
SECTIONAL PROPERTIES VISIT
EXPERTISE.VALLOUREC.COM

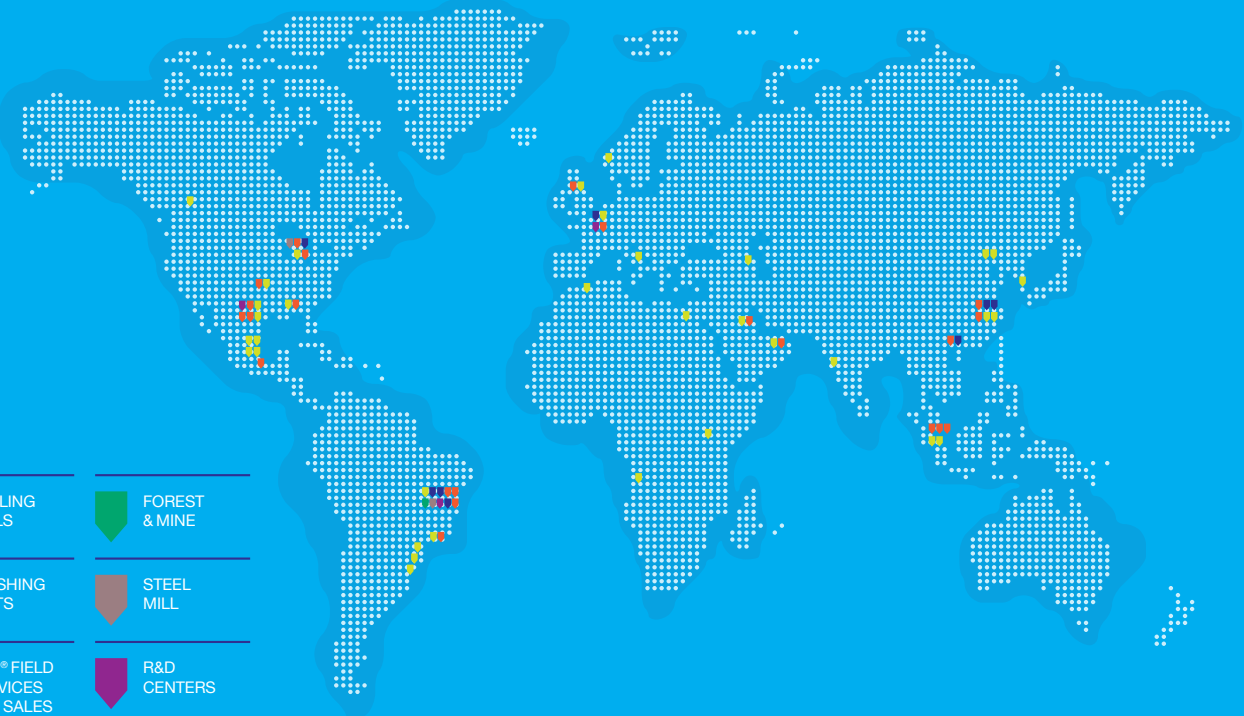


“Vallourec’s material qualification for specific well environments allowed us to improve our material selection, replacing CRA duplex material with the more cost-effective S13Cr solution, a highly advantageous move for the business.”

Badr El Din Petroleum Company
(BAPETCO) Egypt



YOUR PARTNER, SETTING THE PACE FOR INNOVATION AND PERFORMANCE EVOLUTION



NEED MORE INFORMATION?

Information is available online on solutions.vallourec.com or by scanning the following QR code.



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