

SOUR SERVICE GRADES



BEST H₂S
CORROSION
RESISTANCE



HIGHEST
PROVEN
PERFORMANCE



COST
EFFECTIVE



RELIABLE, COST-EFFECTIVE SOLUTIONS FOR SOUR ENVIRONMENTS

- LARGE OFFER COVERING ALL SOUR SERVICE ENVIRONMENTS

- INTEGRATED SUPPLY, WITH CONNECTION EXPERTISE AND QUALIFICATION

- MATERIAL SELECTION SUPPORT AND FIT-FOR-PURPOSE TESTING

A COMPREHENSIVE PORTFOLIO OF SOUR SERVICE GRADES



Vallourec
Material



SMYS



Refers to product
application domain
and performances

Sour Service is one of the toughest challenges in hydrocarbon production. Whatever the level of difficulty, from conventional to high pressure and high temperature (HPHT), deepwater and unconventional wells, our extended portfolio has a tubular offer in high-strength sour service grades to meet the need in this high-stakes challenge. Available in the full range of outside diameters from 2 3/8" to 18 5/8" with wall thickness up to 2.5", our portfolio includes:

SOUR SERVICES

STANDARD OFFER

First generation of Sour Service grades from 80 up to 110ksi, such as **VM110SS**, provided with Quality Control as per NACE Method A at 1bar H₂S, 2.7pH and at a higher applied stress or with a wider application domain than API grades.

COST EFFECTIVE

Range of grades specially designed to be a cost-effective solution for mild sour environments validated by extensive quality control testing. They offer faster delivery, such as **VM95S**, and lower TCO such as **VM110MS**.

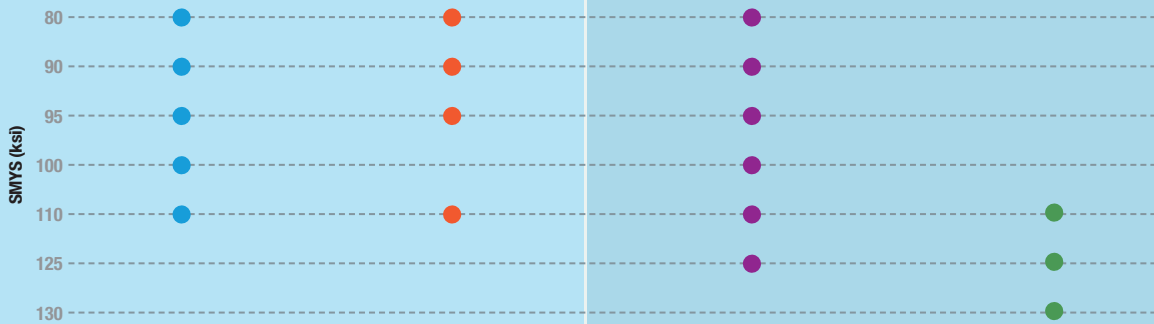
CRITICAL SOUR SERVICES

ENHANCED FRACTURE MECHANICS

Range of grades specially designed to address fracture mechanics and well design requirements including IRP, Riser, proven NACE Method D and CTOD. Grades available from 80 to 125 ksi such as **VM 95 IRP**, **VM 110 RSS** and **VM 125 SS-D**.

HIGH END

State-of-the-art sour service materials with the most robust microstructure, thanks to enhanced chemistry and pipe processing. Grades available from 110ksi to 130ksi including next generation such as **VM110XS**.

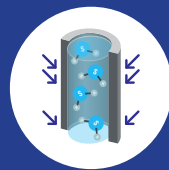


All our Sour Service grades proven by NACE Method A can also be provided with Quality Control as per NACE Method D.

All Sour Service grades are offered combined with the High Collapse and eXtreme Collapse performances.



- High Collapse grades, are a cost-effective solution offering collapse ratings up to 50% higher than API, commonly used to ensure single external diameter and internal drift along the whole string, while reducing the weight of the string and costs.



- eXtreme Collapse grades, are a premium solution designed to cover the most challenging well loads and to offer an alternative to heavy and complex well designs, offering collapse ratings up to 15% higher than High Collapse products.

A COMPREHENSIVE OFFER OF CARBON STEELS: COMPETITIVE SOLUTIONS FOR ALL APPLICATIONS

Sour Service resistance is becoming challenging with the increased exploitation of O&G fields in the presence of hydrogen sulphide (H₂S) gas combined with increasing mechanical constraints.

When facing a reservoir with significant H₂S content, well equipment requires a specific metallurgy to resist Sulphide Stress Cracking (SSC). Every casing string, even when not expected to have contact with H₂S, must be Sour Service resistant as it is designed as a second barrier in case of tubular leak. In the case of unconventional wells, the risks are far greater due to contact between tubing and the reservoir fluids.

Vallourec has a long track record of developing and delivering the highest performance proprietary carbon Sour Service grades in the market as a competitive and highly effective response to sour environments, reducing costs and extending the lifespan of the well.

CONVENTIONAL ONSHORE AND OFFSHORE

All types of sour environments

Your challenges

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

Our solution

- VM S: cost effective and short lead time
- VM SS: adapted to severe sour environments
- VM 110 MS: cost effective in mild sour environment
- VM IRP: as per Canadian IRP standard
- VM 110 XS: adapted to extreme sour environment

HPHT/DEEP WATER

High mechanical requirements in sour environment

Your challenges

- Material normative qualification
- Well integrity
- Temperature, pressure & clearance

Our solution

- VM RSS for riser application
- VM SS-D: increased fracture mechanic performances
- VM 130 MS: highest SMYS (130ksi) in mild sour service environment
- VM 110 XS: for ultra critical services

MATERIAL SELECTION

CO₂ ≤ 2 psi or No-flow-wet pipes

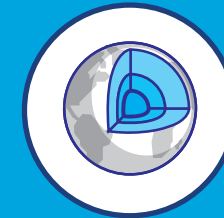
H ₂ S ≤ 0.05 psi	Carbon Steel	API	J - K - N - R - P - Q types
		High Collapse High Strength	VM HC - VM CY VM CYHC
H ₂ S > 0.05 psi	Sour Service Carbon Steel	eXtreme Collapse High Strength	VM CYXC
		API	L - T - C types
H ₂ S > 0.05 psi	Sour Service Carbon Steel	Sour Service	VM S - VM SS - VM 110 MS
		Enhanced Sour Service	VM IRP - VM RSS VM SS-D - VM ESS VM XS - VM 130 MS

ADVANCED MATERIALS FOR HIGH PRESSURE AND SOUR ENVIRONMENT THROUGHOUT YOUR WELL LIFE

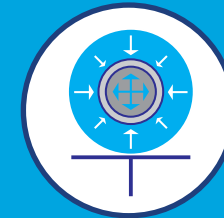
Corrosive environments affect a material's performance and string integrity. Sour Service environments, with their presence of H₂S corrosive gases, lead to different corrosion risks that need to be assessed during the casing material selection process.

IN ORDER TO DETERMINE THE RIGHT MATERIAL FOR A GIVEN SOUR SERVICE ENVIRONMENT, THE FOLLOWING PARAMETERS ARE ANALYZED

OPERATOR CHALLENGES

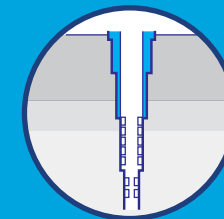


- The expected stresses, including all load cases, which will define the required resistance in terms of internal and external pressures of the casing string.



- The specific environment, which is related to the well conditions such as temperature, presence of acid gases like H₂S and CO₂ affecting the pH, well pressures and reservoir water composition.

THE RIGHT MATERIAL FOR YOUR APPLICATION



- The materials need mechanical and corrosion properties for an optimized well architecture. The higher the mechanical properties of a material, the greater its susceptibility to hydrogen embrittlement and Sulfide Stress Cracking.



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



- Many different parameters impact on a material's corrosion performance in sour environment such as temperature, pH level and H₂S content among others. In addition, the fugacity, also known as "effective partial pressure", allows to better estimate the severity of sour environment.



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

PROVIDING VALUABLE SUPPORT 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 have the solution to 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
- Fugacity calculation and in-situ pH simulation** using dedicated softwares
- High Advanced Non Destructive** Equipment and Heat Treatment facilities
- 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 CARBON SOUR SERVICE GRADES



- BEST H₂S CORROSION RESISTANCE**
Our proprietary carbon steel grades offer the highest H₂S resistance for oil & gas fields with the lowest temperatures and highest constraints in sour environments.



- HIGHEST PROVEN PERFORMANCE**
Decades of know-how and process control backed-up by thousands of NACE method A & D test results.



- COST EFFECTIVE**
As an alternative to the more costly API C110 grade, our proprietary VM 110 MS grade generates cost savings for mild sour environments.

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

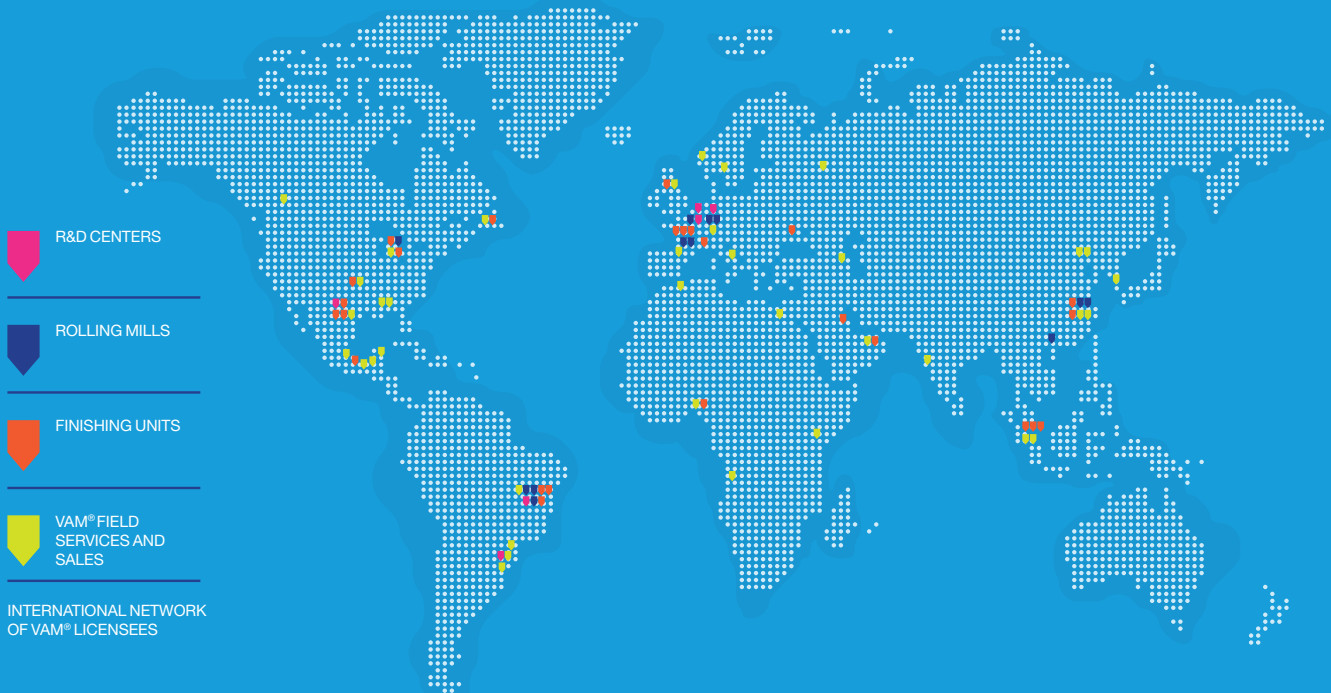


TRIED, TESTED AND VALIDATED

The proprietary VM 130 (HC)MS grade has been qualified in fit-for-purpose conditions and through the arduous I3P process. It was selected for several HPHT 20K projects in the Gulf of Mexico.



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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