



VAM® connections
& OCTG grades

OCTG product selection guide



VAM® products and services have continuously set the pace for Oil & Gas industry innovation, cost effectiveness and performance evolution.

In 1965, Vallourec invented VAM®, a key breakthrough innovation for tubing and casing.

The increasing complexity of accessing available hydrocarbon reserves to meet the world growing energy need is driving development of ever more advanced solutions. Improving efficiency also requires cutting edge technologies and solutions.

To respond to the specific challenges of the oil and gas market, Vallourec manufactures and sells tubes and connections designed for oil and gas well equipment: casing, tubing, VAM® premium connections, proprietary and API grades and accessories, also called Oil Country Tubular Goods (OCTG).

Each year VAM® designs new connections, extend product lines and qualify new sizes to the most stringent specifications to meet our customer needs. VAM® Research & Development teams can customize connection designs to new sizes or specific requirements. This range of products is constantly evolving to offer even better performance and to adapt to new user requirements.

Without compromising quality or safety, we provide value, reliability, and technically effective solutions for over 50 years.

THREADED & COUPLED



Big, Strong, Reliable



Semi premium reference



Easy Running



Advanced technology (ISO:2011/API2013 CAL IV)



High Torque standard (ISO:2002 CAL IV)



Extreme High Pressure Connection



Extreme High Torque



Performance Heavy Wall



Workover riser, high number of make and breaks, external seal



Steam well standard



Standard premium



Fatigue enhanced VAM TOP® for drilling, production, workover



High torque standard (ISO:2002 CAL IV)



High compression standard (ISO:2002 CAL IV)



Connections for all high fatigue applications

INTEGRAL JOINT



Extreme High Torque Flush



Extreme torque semi-flush Shale Gas



Flush premium



High Torque workstring



Heavy wall flush



Large OD Flush high performance



Standard premium Shale Gas



Semi-Flush high performance



Advanced semi-flush Shale Gas

DOPEFREE



Standard dopefree

Premium dopefree

CLEANWELL® DRY is the VAM® Family dopefree solution:

- It is a fully DRY and non sticky multi functional coating directly applied in Vallourec mills on the surface of threads.
- Coating replaces both storage and running compounds, which allow optimizing rig preparation by reducing the occurrence of protector removal, thread cleaning and pipe handling.



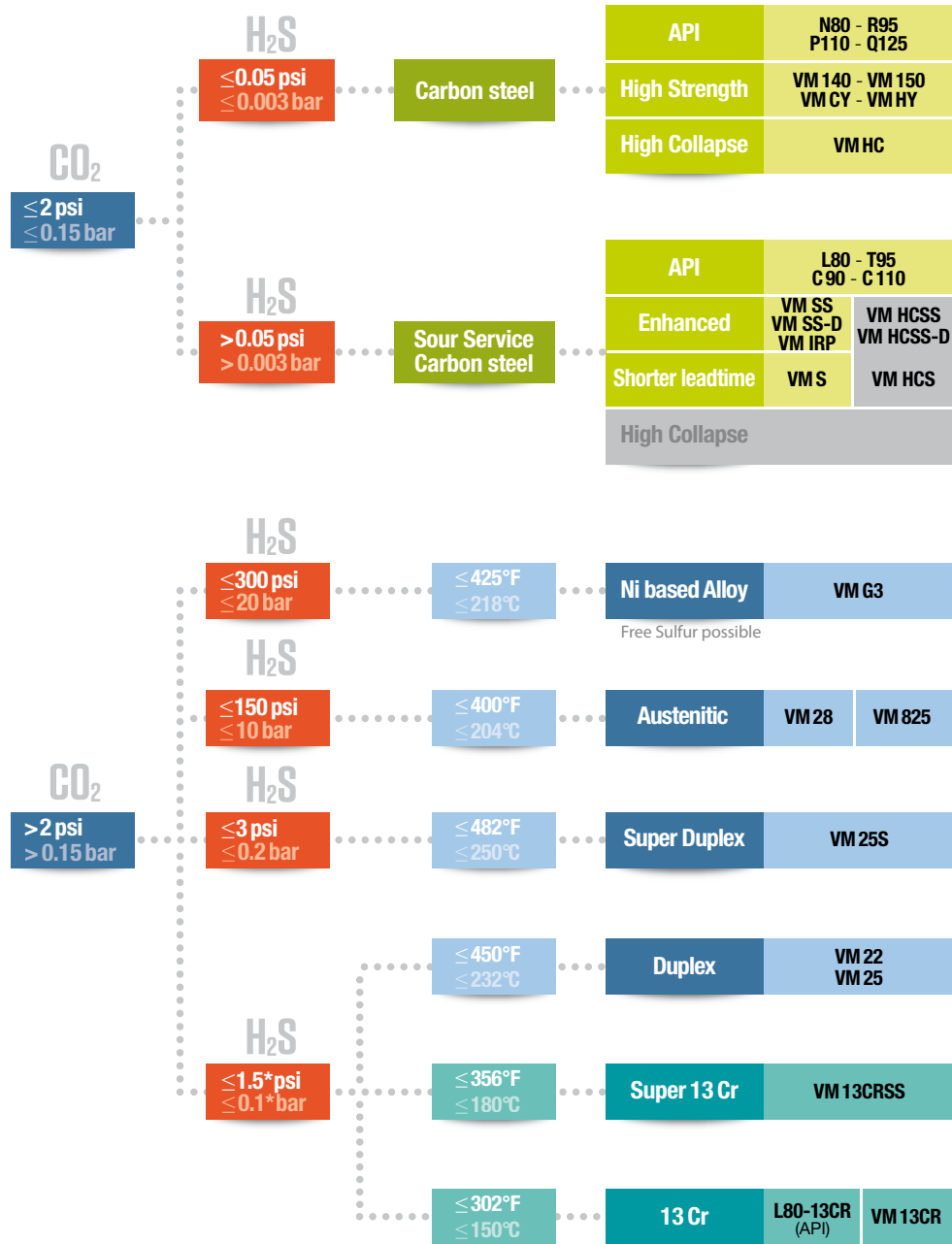
CLEANWELL® DRY brings a wide range of benefits:

- No discharge to the environment
- Anti-corrosion properties equivalent to storage dope
- Not sticky and easy thread inspection
- Prevent Rig thread cleaning, minimize yard and rig handling
- Prevent plugging formation pores

Box and Pin threads with CLEANWELL® DRY

Vallourec material selection guide

Vallourec offers a full range of standard API and proprietary grades covering all the needs of the OCTG industry. From standard applications to the most severe environments, Vallourec is your worldwide guarantee for quality and reliability. This material selection chart helps you choosing the appropriate material for your application depending on H₂S and CO₂ partial pressures, and temperature range in your well.



* p_{H₂S} limit will change depending on other parameters (ex: Chloride content, pH etc.)

Special applications				
1% - 3% Cr	Arctic	Enhanced API	Expandables	Riser

The right VAM® connection for your application

The connection selection table below helps you choosing the VAM® connection that best fits your needs.

The color code is the following:

- Dedicated**
- Capable / Appropriate**
- Not applicable**

For more details, please contact your VAM® representative or visit our website: www.vallourec.com/OCTG

<i>Premium connections - Gas tight performance</i>											
STANDARD CLEARANCE									MAX CLEARANCE		
THREADED AND COUPLED (T&C)									INTEGRAL JOINT		
VAM® 21™	VAM® 21 HT™	VAM® TOP™	VAM® TOP HC™	VAM® TOP HT™	VAM® HTTC™	VAM® HP™	VAM® HWST™	VAM® SLU-IT™	VAM® FUL™	VAM® HTF-NR™	
3 1/2" 14"	5" 9 5/8"	2 3/8" 4 1/2"	5" 16"	5" 7 3/4"	5" 7 5/8"	4 1/2" 9 5/8"	7 5/8" 10 3/4"	5" 14"	4 1/2" 16"	2 3/8" 11 7/8"	4 1/2" 9 5/8"

Applications	Sub application	Technical requirements	VAM® 21™	VAM® 21 HT™	VAM® TOP™	VAM® TOP HC™	VAM® TOP HT™	VAM® HTTC™	VAM® HP™	VAM® HWST™	VAM® SLU-IT™	VAM® FUL™	VAM® HTF-NR™	
Main application	Tubing	Production	Regular											
		High Compression (>60% CYS)												
		ISO13679:2002 CAL IV												
		API5C5:2014 CAL IV												
	High Deviation	High bending												
	Liner	Production	Regular											
		High Compression (>60% CYS)												
		ISO13679:2002 CAL IV												
		API5C5:2014 CAL IV												
	High Deviation & Rotating Liner	High Torque												
	Casing	Production casing	Regular											
		Production Tie-back	High Compression (>60% CYS)											
			ISO13679:2002 CAL IV											
			API5C5:2014 CAL IV											
		Rotating casing	High Torque											
Intermediate Casing		Premium Gas tight												
HP/HT & deep wells	Production Tubing	ISO13679:2002 CAL IV												
		API5C5:2014 CAL IV												
	Production Liner	High Compression + ISO CAL IV												
	Contingency Drilling Liner	Clearance + ISO CAL III												
	Rotating Liner and Casing	High Torque + ISO CAL IV												
	Production casing	Heavy Wall												
	Production Tie-back	Heavy Wall + HEP(1)+ISO CAL IV												
	Intermediate Casing	High Compression + HEP(1) + ISO CAL IV												
	High torque applications	ERD												
		Drilling with Tubing	High Torque											
Drilling with Casing / Liner		High Torque												
Special applications	Unconventionals	Shale Oil & Gas												
		Tight gas												
		Heavy oil												
	Workstring, Test string													
	Injection Wells	Water Injection (e.g. w / GRE liner)												
		Steam Injection / Heavy oil												
Riser	Salt Dome & Squeezing clay	HEP ⁽¹⁾												
	Expandable													
	Production	Inner												
		Outer / Single barrier												
	Drilling (Surface BOP) riser													
	Workover / Landing string													

(1) High External Pressure

ANCE		Semi-Premium			Special		Expandable		Riser			Shale		
NT (LJ)		(T&C)	(T&C)	(T&C)	(T&C)	(LJ)	(LJ)	(T&C)	(T&C)	(T&C)	(LJ)	(LJ)	(LJ)	
VAM® HTT™ (Upset)	VAM® BOLT™	DINO VAM®	DWC/C™	BIG OMEGA®	VAM® SW™	VAM® MUST™	VAM® ET WISE™	VAM® ET MOD™	VAM® TTR™	VAM® TOP FE™	VAM® LDR™	VAM® PDW1™ (Upset)	VAM® SG™	VAM® EDGE™
2 7/8" 5 1/2"	11 3/4" 18"	9 5/8" 16"	3 1/2" 13 3/8"	14" 26"	4 1/2" 13 3/8"	7 5/8" 10 3/4"	4 1/2" 11 3/4"	7 5/8"	7" 16"	6 5/8" 14"	7 5/8"	9 5/8" 13 3/8"	4 1/2" 5 1/2"	4 1/2" 5 1/2"

Threaded & coupled

Coupling OD > Pipe OD

Compression ← Tension

Internal Pressure ↑
External Pressure ↓

T&C connection typical envelope
CYS⁽²⁾ = 100% PBYS⁽³⁾

T&C connections generally offer maximum strength but require connection OD larger than pipe OD (standard clearance). Special Clearance (SC) option improves clearance while reducing tensile strength.

Integral Semi-Flush

Connection OD ≈ 102% Pipe OD

Compression ← Tension

Internal Pressure ↑
External Pressure ↓

Integral Semi-Flush connection typical envelope
70% ≤ CYS⁽²⁾ ≤ 82% PBYS⁽³⁾

Integral Semi-Flush connections combine great clearance and high strength.

Integral Flush

Connection OD ≤ pipe OD max (API)

Compression ← Tension

Internal Pressure ↑
External Pressure ↓

Integral Flush connection typical envelope
45% < CYS⁽²⁾ < 70% PBYS⁽³⁾

Integral Flush connections offer maximum clearance while reducing strength.

(2) CYS = Connection Yield Strength - (3) PBYS = Pipe Body Yield Strength

A full range of OCTG grades for all your applications

→ High Collapse and High Strength Steel

Vallourec offers a large range of OCTG **High Collapse** grades, to meet the most challenging collapse conditions of well environment and load case scenarios. Vallourec High Collapse grades cover the full range of sizes and weights from 4 1/2" to 26", grades from 80 ksi to 150 ksi, and offer special drifts on a standard basis without collapse derating. While strictly compliant with API standards, Vallourec High Collapse grades are delivered with guaranteed minimum High Collapse rating. High Collapse performances are also available with Sour Service properties (HCS – HCSS series) and on 13Cr and Super 13Cr materials.

Type	Name	Yield Strength ksi (MPa)	U.T.S. ksi (MPa)	HRC max mean value
HIGH COLLAPSE	VM 80 HC	80 (552)	110 (758)	N/A
	VM 95 HC	95 (655)	125 (862)	N/A
	VM 110 HC	110 (758)	140 (965)	N/A
	VM 125 HC	125 (862)	150 (1034)	N/A
	VM 140 HC	140 (965)	165 (1138)	N/A
	VM 150 HC	150 (1034)	175 (1206)	N/A
	VM 130 CYHC	130 (900)	140 (965)	35.0
	VM 140 CYHC	140 (965)	150 (1034)	36.0
HIGH STRENGTH	VM 125 HYHC	140 (965)	150 (1034)	36.0
	VM 140	140 (965)	165 (1138)	N/A
	VM 150	150 (1034)	175 (1206)	N/A
	VM 125 CY	125 (862)	140 (965)	35.0
	VM 130 CY	130 (900)	140 (965)	35.0
	VM 125 HY	140 (965)	150 (1034)	36.0
	VM 140 CY	140 (965)	150 (1034)	36.0

→ Sour Service Carbon Steel

Vallourec offers a large range of OCTG suitable for **Sour Service** environment where H₂S is present. It covers the requirements and parameters of such severe conditions including high pressures, low temperatures, low pH... More than anywhere else, reliability is paramount and Vallourec provides the required top-of-the-class expertise and know-how.

Type	Name	Yield Strength ksi (MPa)	U.T.S. min ksi (MPa)	HRC max mean value
SOUR SERVICE CARBON STEEL ENHANCED	VM 80 SS	80 (552)	95 (655)	22.0
	VM 90 SS	90 (621)	105 (724)	24.0
	VM 95 SS	95 (655)	110 (758)	25.0
	VM 100 SS	100 (689)	110 (758)	25.4
	VM 110 SS	110 (758)	120 (828)	29.0
	VM 125 SS	125 (862)	135 (931)	34.0
	VM 95 SS-D	95 (655)	110 (758)	25.4
	VM 100 SS-D	100 (689)	110 (758)	25.4
	VM 110 SS-D	110 (758)	120 (828)	29.0
	VM 125 SS-D	125 (862)	135 (931)	34.0
	VM 80 IRP	80 (552)	95 (655)	22.0
	VM 90 IRP	90 (621)	105 (724)	25.0
	VM 95 IRP	95 (655)	110 (758)	25.0
	VM 80 HCSS	80 (552)	95 (655)	22.0
	VM 90 HCSS	90 (621)	105 (724)	24.0
	VM 95 HCSS	95 (655)	110 (758)	25.0
	VM 110 HCSS	110 (758)	120 (828)	29.0
	VM 125 HCSS	125 (862)	135 (931)	34.0
	VM 95 HCSS-D	95 (655)	110 (758)	25.4
	VM 110 HCSS-D	110 (758)	120 (828)	29.0
VM 125 HCSS-D	125 (862)	135 (931)	34.0	
SOUR SERVICE CARBON STEEL SHORTER LEAD TIME	VM 80 S	80 (552)	95 (655)	22.0
	VM 90 S	90 (621)	105 (724)	24.0
	VM 95 S	95 (655)	110 (758)	25.0
	VM 80 HCS	80 (552)	95 (655)	22.0
	VM 90 HCS	90 (621)	105 (724)	24.0
	VM 95 HCS	95 (655)	110 (758)	25.0

→ Super 13CR and 13CR

Vallourec offers the best of OCTG suitable for Sweet CO₂ environments with limited H₂S presence. It covers the requirements and parameters of such inhospitable conditions including high pressures, high temperatures and more.

Martensitic grades to be used in wells with CO₂, chlorides and/or some H₂S up to 180°C. Martensitic grades and High Collapse are available upon request.

Type	Name	Yield Strength ksi (MPa)	U.T.S. ksi (MPa)	HRC max mean value
SUPER 13CR	VM 95 13CRSS	95 (655)	110 (758)	28.0
	VM 110 13CRSS	110 (758)	140 (965)	32.0
	VM 125 13CRSS	125 (862)	140 (965)	32.0
	VM 110 13CRSSCY	110 (758)	125 (862)	32.0
	VM 95 13CRSSHC	95 (655)	110 (758)	28.0
	VM 110 13CRSSHC	110 (758)	140 (965)	32.0
13CR	VM 80 13CR	80 (552)	95 (655)	23.0
	VM 85 13CR	85 (586)	100 (690)	24.0
	VM 90 13CR	90 (621)	105 (724)	26.0
	VM 95 13CR	95 (65)	110 (758)	28.0

→ Corrosion Resistant Alloy

► **Nickel Based Alloy austenitic grades** to be used in wells where high concentrations of H₂S, CO₂ and chlorides are present.

Type	Name	Yield Strength ksi (MPa)		U.T.S. min ksi (MPa)	HRC max mean value
		Min.	Max.		
NICKEL BASED ALLOY	VM G3 110	110 (758)	140 (965)	115 (793)	35.0
	VM G3 125	125 (862)	150 (1034)	130 (896)	37.0

► **Austenitic grades** to be used in wells where high concentrations of H₂S, CO₂ and chlorides are present.

Type	Name	Yield Strength ksi (MPa)		U.T.S. min ksi (MPa)	HRC max mean value
		Min.	Max.		
AUSTENITIC	VM 28 110	110 (758)	140 (965)	115 (793)	35.0
	VM 28 125	125 (862)	150 (1034)	130 (896)	37.0
	VM 825 110	110 (758)	135 (931)	115 (793)	35.0
	VM 825 125	125 (862)	150 (1034)	130 (896)	37.0

→ Special applications

► 1% - 3% Cr

1% Cr: often used for water injection applications and combined with internal coating such as GRE lining. Upon request, they can be available with High Collapse properties. VM 80 L1CR • VM 80 N1CR • VM 95 R1CR • VM 110 P1CR

3%Cr: used for marginal oil and gas wells where corrosion may occur due to fluids containing CO₂ and H₂S. This grade may slow down metal-loss corrosion in specific conditions (some H₂S, CO₂ and T ≤ 90°C).

► Arctic

Low temperature grades for tubing and casing are used in arctic regions where high impact toughness at subzero temperatures are requested.

Type	Name	Yield Strength ksi (MPa)	U.T.S. ksi (MPa)	Charpy V-Notch mean value*
LOW TEMPERATURE	VM 55 LT	55 (379)	80 (552)	30 lb. Ft (41 J)
	VM 80 LT	80 (552)	95 (655)	30 lb. Ft (41 J)
	VM 95 LT	95 (655)	110 (758)	30 lb. Ft (41 J)
	VM 110 LT	110 (758)	140 (965)	30 lb. Ft (41 J)
	VM 125 LT	125 (862)	150 (1034)	30 lb. Ft (41 J)

*These guaranteed values for Charpy V-Notch absorbed energy have been determined at -50°F (-46°C) on three full size impact specimens taken transversally when it is possible, or longitudinally, on pipes and coupling stocks.

→ Standard: API 5CT grades

From K55 to Q125, Vallourec supplies the full range of API 5CT grades including Chromium martensitic steels. All Product Specification Levels (PSL) and Special Requirements (SR) from API 5CT can be delivered, with PSL 2 standardized on all quenched and tempered grades. In addition and upon request, Vallourec can customize production to meet customers' special requirements such as PSL 3, restricted tolerances, non standard pipe sizes and walls, CTOD requirement.

► **Super Duplex ferritic-austenitic grades** to be used in wells with CO₂, chlorides and/or some H₂S up to 250°C.

Type	Name	Yield Strength ksi (MPa)		U.T.S. min ksi (MPa)	HRC max mean value
		Min.	Max.		
SUPER DUPLEX	VM 25S 80*	80 (552)	105 (724)	110 (758)	28.0
	VM 25S 125	125 (862)	150 (1034)	130 (896)	36.0
	VM 25S 140	140 (965)	160 (1103)	145 (1000)	38.0

* Solution annealed grades, higher grades are obtained by cold working.

► Risers

The VAM® Riser grades were developed for the high fatigue conditions experiences in top tension riser systems. Riser grades are available in 95ksi to 125ksi yield strengths. They were developed with a API 5CT PSL2 level as a basis, with additional tests specific for riser fatigue usage these enhancements in: chemistry, manufacturing route, hardness, impact toughness, CTOD performance, microstructure control, sulfide stress cracking resistance (for sour service grades), dimensional control, and non-destructive inspection and testing.

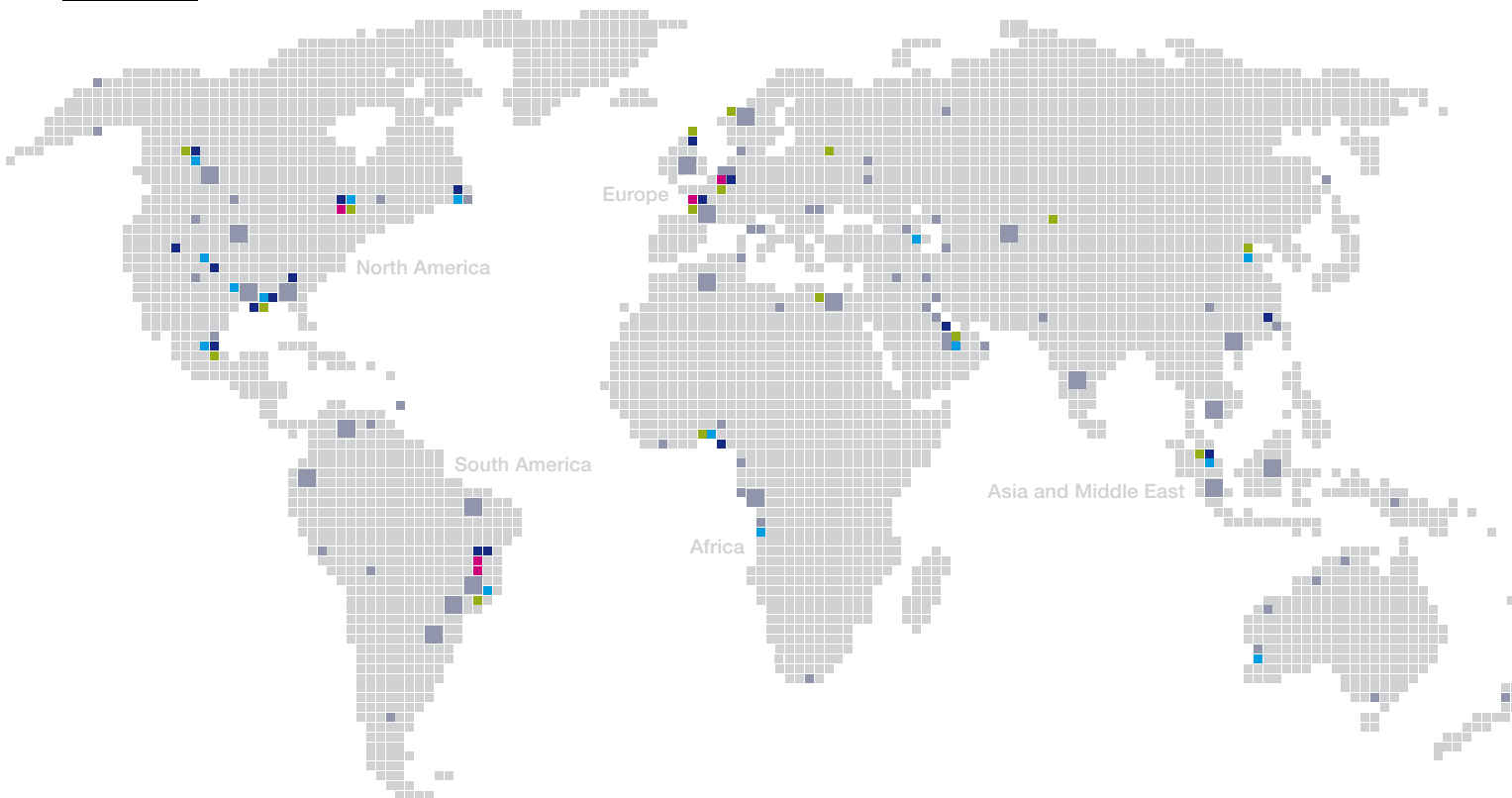
Type	Name	Yield Strength ksi (MPa)		U.T.S. ksi (MPa)	HRC max mean value	K _{ISSC} average (ksi V _{in})
		Min.	Max.			
RISER	VM 95 R	95 (655)	110 (758)	105 (724)	31.0	N/A
	VM 95 RSS	95 (655)	110 (758)	105 (724)	25.4	33
	VM 110 R	110 (758)	125 (862)	120 (828)	33.0	N/A
	VM 110 RSS	110 (758)	120 (828)	120 (828)	29.0	24
	VM 125 R	125 (862)	140 (965)	135 (170)	35.0	N/A

► Expandables

Expandables grades from 50 to 80 ksi used in expandable tubular applications.

Type	Name	Yield Strength ksi (MPa)	U.T.S. min ksi (MPa)	HRC max single value
EXPANDABLES	VM 50 ET	50 (345) - 65 (448)	69 (475)	HBW ≤ 200
	VM 80 ET	80 (552) - 95 (655)	95 (655)	23.0
	VM 80 13ET	80 (552) - 95 (655)	95 (655)	23.0

World Leader in Premium Tubular Solution



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