

GEO THERMAL



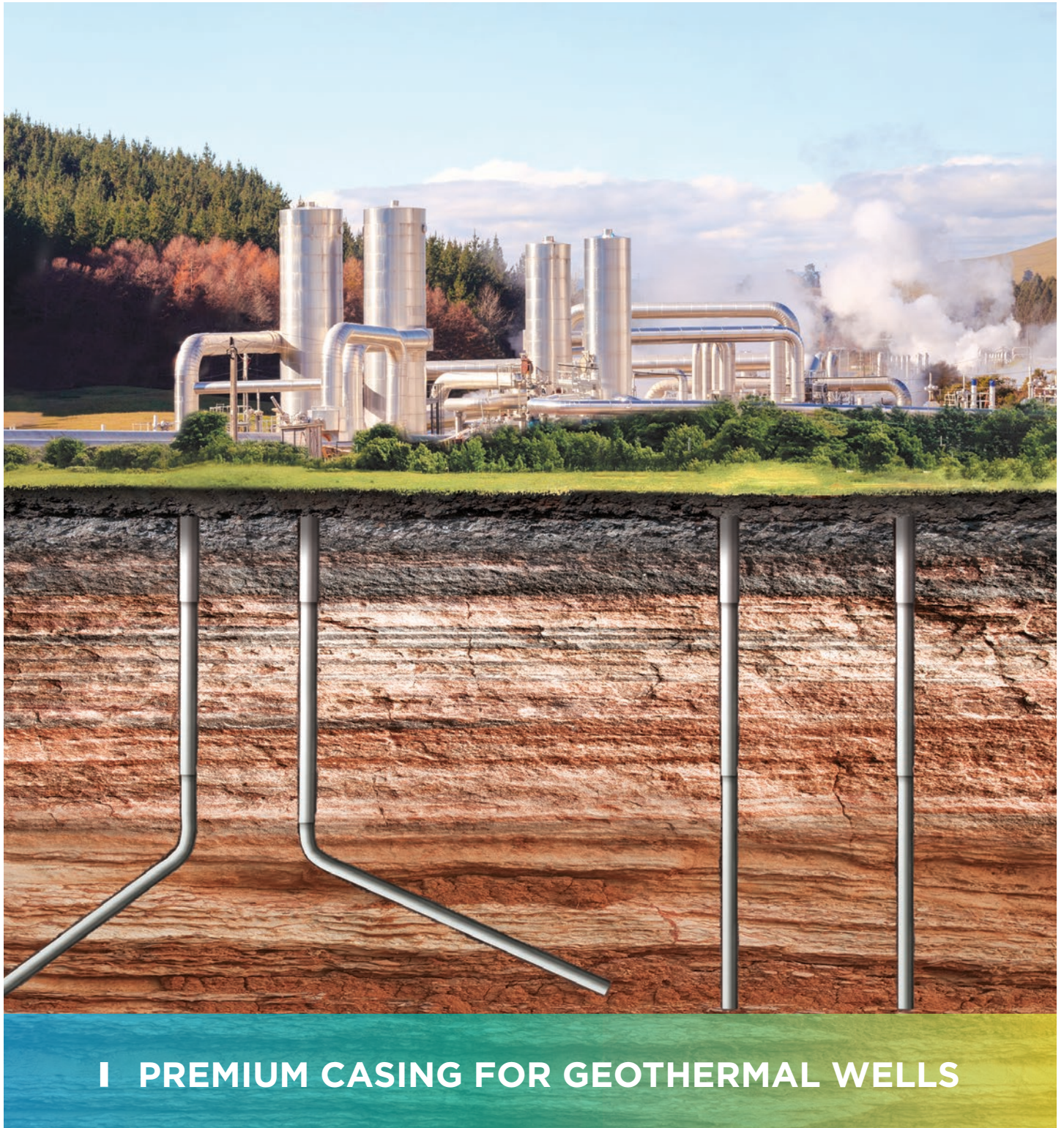
EXTENDED
LIFETIME



RELIABLE
CONNECTIONS



WELL
INTEGRITY



I PREMIUM CASING FOR GEOTHERMAL WELLS

The unique challenges of geothermal

As a cost-competitive, renewable and sustainable energy source, geothermal is a rapidly-growing sector. But the specificities of geothermal mean that well operators face unique challenges:



Very **high temperatures** of up to 350°C are observed in geothermal drilling wells. This puts constraints on pipes and connections, with high levels of dilation, compression loads on connections, and high collapse loads on the pipes.



The complexity of drilling in urban areas means that **well integrity** is extremely important. Wells must be built with proven and validated components, and comply with local regulations.



High flow rates of 80+ litres per second induce high fluid velocity and increase the risk of localized **erosion and corrosion** if the bore ID is not completely flush. Ultimately, this can **reduce well life**.



Economic constraints mean that any equipment installed in the well must be **designed to last** at least 30 years, the target lifespan of a geothermal well. Equipment must be fitted rapidly and efficiently, highly reliable, and optimized for its environmental impact.



OUR OFFER

[PROVEN CASING FOR LONGLASTING PERFORMANCE]

- **Wide range of casing sizes:** OD from 7" to 16": all API 5CT grades from K55 to Q125
- **High Collapse and Sour Service grades** available for the most challenging wells
- **Low-carbon footprint:** Best-in-class ESG certifications
- **Dedicated support** to help you optimize casing design and material selection
- **Semi-premium and premium connections offering:** T&C and Integral connections adapted to each performance needs
- **Extensive track record:** Vallourec technology has decades of proven performance with main operators in O&G and geothermal
- **Cost-effective manufacturing routes /** Qualified API 5CT / qualified by main operators

VAM® 21: PREMIUM TECHNOLOGY FOR RELIABLE CONNECTIONS

VAM® 21

VAM® 21 is the latest generation of advanced premium threaded and coupled (T&C) connections. It combines proven technical performance and robustness with outstanding sealability and extreme compression resistance.

Furthermore, VAM® 21 is TWCCEP*-qualified for use at temperatures of up to 350°C, making it perfectly-adapted for geothermal wells.

- Proven track record since 2010 with major for various energy applications
- Fast and reliable running
- Qualified on grades from 80 ksi to 125 ksi
- Validated with High Collapse pipes at collapse rating
- Flush ID reduces risk of fluid turbulence (erosion and corrosion)

*TWCCEP: Thermal Well Casing Connection Evaluation Protocol



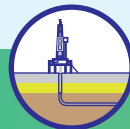
WELL INTEGRITY

- Our cost-effective casing solutions have proven performance in high collapse geothermal environments.



RELIABLE CONNECTIONS

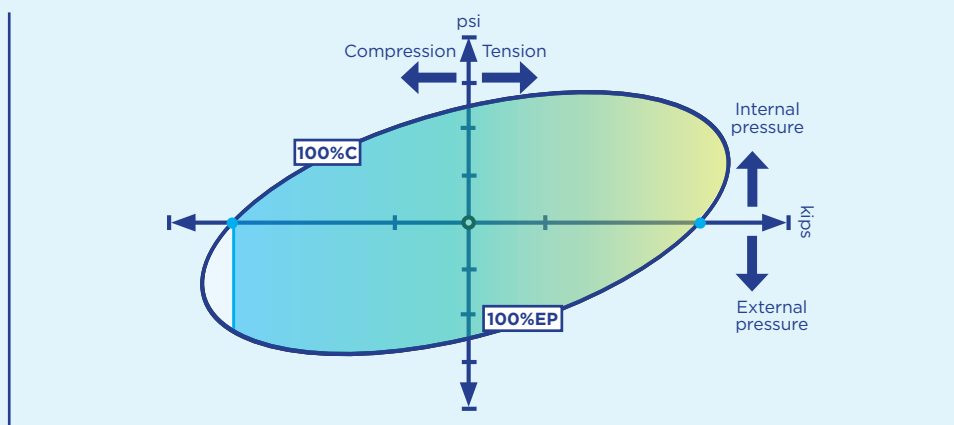
- VAM® 21 connections are TWCCEP-qualified for use at temperatures of up to 350°C.



EXTENDED LIFETIME

- Our casing is designed to endure the harsh conditions of geothermal for the entire lifespan of the well.

VAM® 21 MAXIMUM LOAD SERVICE ENVELOPE FOR TWCCEP PERFORMANCE



SHOULDER AND SEAL FOR IMPROVED PERFORMANCE

FLUSH ID: NO FLUID TURBULENCE

HIGH COLLAPSE GRADES: MINIMIZE THE RISK OF CASING COLLAPSE

The elevated temperatures of geothermal wells can induce significantly high collapse loads on casing. There are two main risks:

- During the cementing phase, the inside of the casing is full of water at a lower density, while the annulus is under hydrostatic pressure from the liquid cement. This creates a high collapse load on the casing (Fig. 1).
- The circulation of hot geothermal fluid within the casing raises the temperature of water pockets surrounding the casing or trapped between the casing and the cement, leading to collapse loads on both the cement and the casing (Fig. 2).
- In certain cases, the collapse resistance of classic casing grades (K55, L80) is insufficient to sustain these collapse loads.

size	K55	L80	VM 80HC	VM 110HC
9 5/8 47.00#	3890 psi	4760 psi (+22.30%*)	6740 psi (+73.2%*)	7570 psi (+94%*)
13 3/8 68#	1950 psi	2270 psi (+16.50%*)	2980 psi (+52.8%*)	2980 psi (+52.8%*)

*Collapse rating increase vs. K55 pipe collapse rating. K55 is a classical grade used in geothermal wells with limited collapse performance.

Using High Collapse grades can fix casing collapse issue

Figure 3: Vallourec proprietary High Collapse grades provide higher collapse rates than standard API grades

➤ READ MORE
ABOUT OUR HIGH
COLLAPSE GRADES

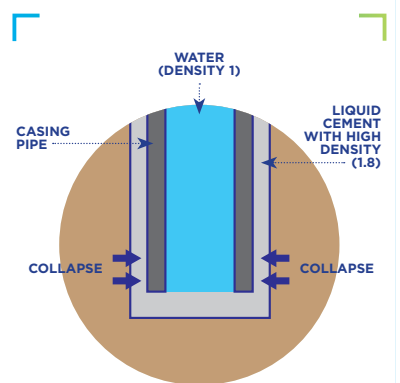


Figure 1: Pressure exerted by water inside the casing is inferior to external pressure on the annulus especially with fully cemented casing.

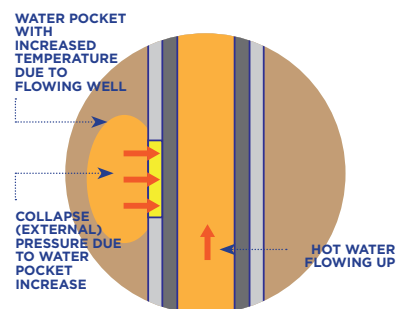
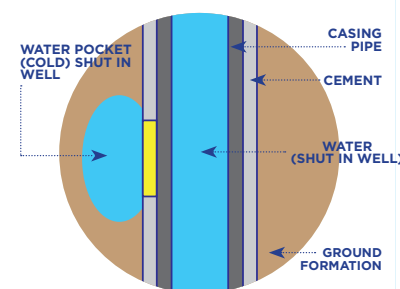


Figure 2: Water pocket dilation can generate external pressure on the pipes.

High Collapse grades are a cost-effective solution, providing collapse ratings up to 50% higher than API. High Collapse grades can also be used to reduce the weight of the string and overall cost while maintaining collapse ratings and providing internal pipe clearance.

AVAILABLE IN
80-140 KSI



CASE STUDY #1

LONG-TERM WELL INTEGRITY WITH VAM® 21

Geothermal wells are designed to operate for decades, and casing plays a significant role in ensuring a lifetime of well integrity.

- ▶ An Indonesian operator needed production casing to withstand severe compression loads generated by water and vapor at temperatures of 275°C to 330°C.
- ▶ VAM® 21 was shown to meet all the operator's requirements, and a production string of 13 3/8" 68.00# and 72.00# L80 VAM® 21 was installed.
- ▶ VAM® 21 was run quickly and efficiently with zero rejects, and additional testing confirmed its reliability and resistance to the well's high temperatures.

▶ TO READ
THE FULL
STORY VISIT



CASE STUDY #2

HIGH COLLAPSE CASING OPTIMIZES WELL DESIGN

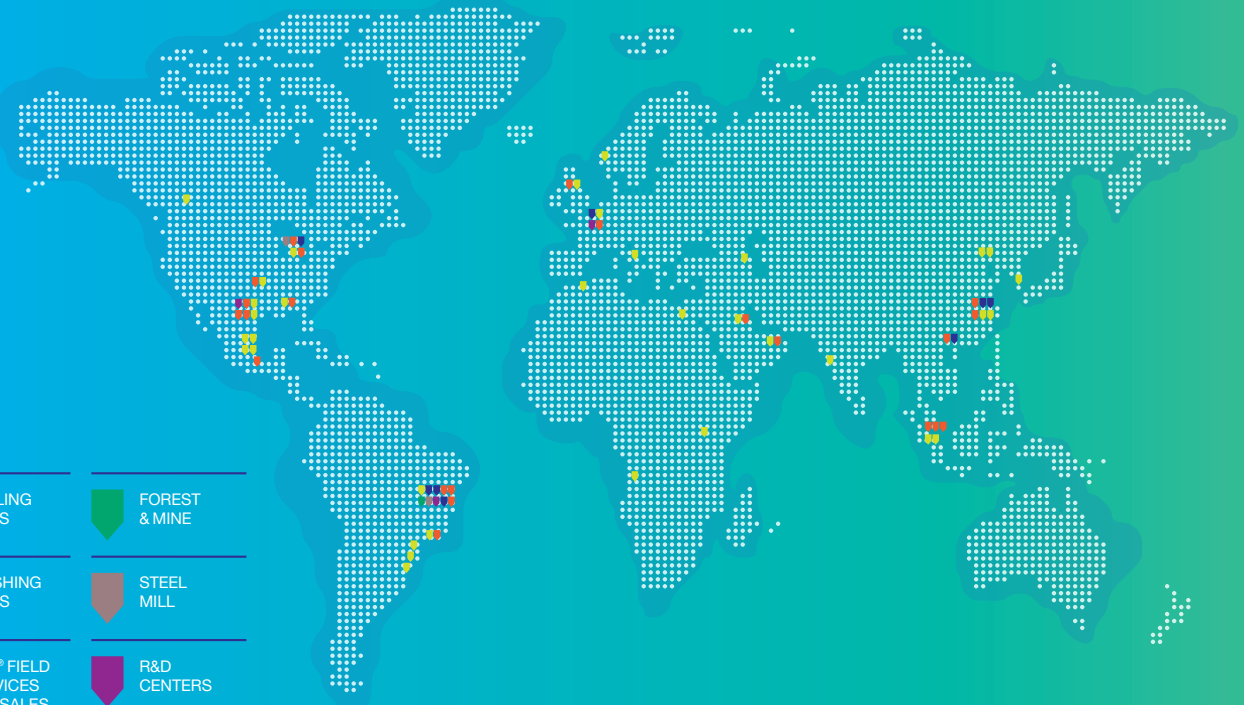
In geothermal wells, the high temperatures of fluid circulating inside the pipe presents a significant risk of high collapse loads.

- ▶ A geothermal operator had initially designed its well using 13 3/8" 68.00# casing in K55, with a collapse value of 1,950 psi.
- ▶ After being consulted, Vallourec offered a solution with 13 3/8" 68.00# casing in VM 80 HC grade, with a collapse value of 2,980 psi.
- ▶ With this change, the operator benefited from a much higher safety margin, and there was no need to modify the well design. Vallourec's support in selecting the right material offered the operator peace of mind while minimizing the impact on overall cost.

+53%
COLLAPSE VALUE VS
K55



YOUR PARTNER, SETTING
THE PACE FOR INNOVATION
AND PERFORMANCE
EVOLUTION



NEED MORE INFORMATION?

Information is available online on
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scanning the following QR code.



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