

## Field Proven

Ease of running and a net improvement in service life were immediately experienced from the very first drilling operation runs in Indonesia in 2006, with VX 39 drill pipe rented by Weatherford International on behalf of Chevron. The drill string was composed of 500 joints of drill pipe and 30 joints of heavy-weight drill pipe. It was used by Chevron between May and October 2006, which gave us a 6-month period of analysis with excellent results.

More recently, VAM Express was used by Devon to develop the Polvo Project in offshore Brazil. The Polvo project is a platform drilling rig located in an offshore block of the Campos Basin about 95km off the Brazilian coast. The field has two distinct reservoirs and a sandstone reservoir to the east as well as a carbonate reservoir to the southwest. It was discovered in 2004 and drilling began in March 2007 with a total of 32 wellbores, including "short reach" and "ultra extended reach" wells. The deviation spans from 3-7°/100' DLS at inclinations of 30-92°. Wellbores have been designed 3-dimensionally in order to improve total reservoir exposure.

## Conclusion

The VAM Express connection design has shown substantial improvements in mechanical performance and significant savings in operating costs thanks to:

- **Superior torque capability** up to two times that of API connections, resulting in optimum performance in the most demanding drilling environments;
- **Significant trip time savings** of up to 16% compared to other high-performance connections, which represents thousands of dollars saved daily;
- **Extended durability and reduced operating cost** as a result of fewer recuts and refacing operations.

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After the installation of the platform and the start of the drilling operations, the productivity of the sandstone reservoirs in the eastern part turned out to be higher than expected. Subsequent to the drilling of 12 wells and various lessons learned, the furthest extended reach well in the history of Brazil was attempted and successfully completed. The Pol-O wellbore was drilled to a total measured depth of 6,489 m (2,429 m TVD) and a vertical section step out of 5,615 m. This wellbore still holds the record for the furthest reach wellbore in the history of Brazil.

Besides this, the Polvo project also attained the record for the fastest drilling in an 8-1/2" hole with 1,610 meters drilled within 24 hours. This record was not only obtained through high on bottom ROP, but also through significantly improved make-up time linked to the use of the VAM Express connection. VAM Express prevented drill string failure even after having drilled over 100,000 m of total well depth using the same drill string in highly deviated wellbores. Throughout the entire project, no twist-offs or back-offs have been observed.

The successful and efficient drilling of those extended reach wellbores has proven further reserves that can be produced by the Polvo platform with no need of another platform or subsea tiebacks. Current plans are to improve the top-drive to achieve higher torque, while staying with the same VAM Express connection size.



Designed to Perform

## Technical #4 Bulletin MARCH 2011

# Understanding How Non API Compatible Double Shoulder Connections Can Help Save You Time and Money

As oil & gas exploration continues to expand into new and unexplored frontiers, complex horizontal and extended-reach wells are becoming a daily challenge for drilling contractors today. When associated with high-pressure / high-temperature down-hole conditions, wells need high performing tools to ensure safety, productivity and superior performance.

The nature of complex well profiles in combination with HP-HT conditions can result in very high stresses on the drill string, which requires greater safety margins in the drill string design. To ensure successful operations, drill string with a higher tensile and torsional yield strength drill pipe body and superior torque capacity tool joints must be used.

The high financial risks linked to drilling operations and the high cost of rig use means that oil and gas companies need to mitigate risks and reduce total costs by optimizing drilling programs and drilling efficiency. One can improve drilling efficiency by increasing rates of penetration (ROP) and by lowering non productive time (NPT). Selecting the appropriate tools for your drilling program prior to start-up can help guarantee the achievement of your targets within maximum safety margins and at reduced costs.

In order to optimize drilling performance, a number of factors regarding the drill string assembly must be taken into consideration:

- Pipe and tool joint dimensions for hydraulic efficiency;
- Pipe yield strength for torque and drag optimization;
- Pipe body, weld zone and connection mechanical properties for maximum tension and torsion capacity;
- Other design related drill pipe features for improved fatigue resistance, serviceability and operating cost optimization.

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## Design and Qualification

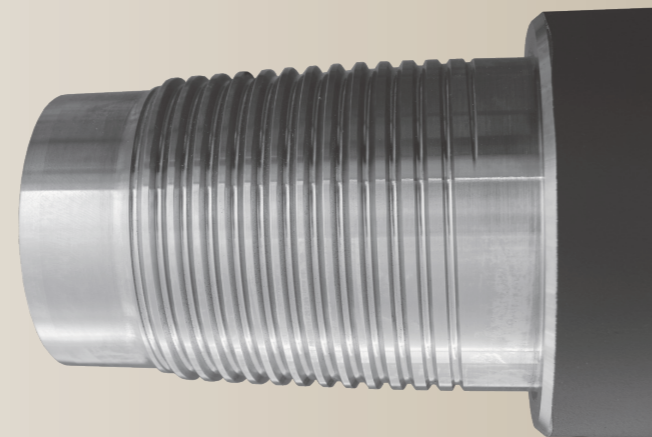
### Design

The VAM Express™ high-torque connection brings together a reliable double-shoulder design and a high performance proprietary thread profile. The primary torque shoulder provides initial seal and pre-load during make-up to full recommended torque while the secondary torque shoulder provides high torque capacity. The connection allows for easy

stabbing thanks to a laid-down stab flank. A back beveled crest increases freedom of movement and allows easy connection make-up while reducing the chance of wedging. Resistance to rotational-induced bending is increased by the connection's elliptical root.

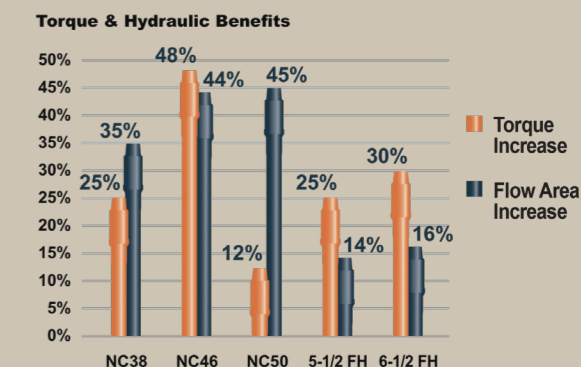
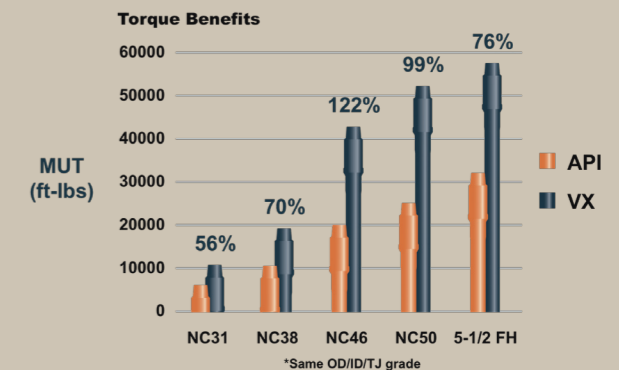
### Qualification

In order to guarantee superior performance, the VAM Express design has been subjected to demanding engineering analysis, including the full FEA model for pure torque loads and combined torque and tension loads. The connection was also subjected to live field tests in the Heather 1-5 wells during final stages of product development.



### VAM Express Performance

- **Higher Torque:** Torque capacity that averages 150 to 200% more than that of API connections.
- **Quick rig make-up:** 6-7 turns from stab-in to full make-up; a performance similar to API connections but with 16% better trip-time as compared to other high-performance double-shoulder connections.
- **Ease of use:** Reduced stabbing damage due to enhanced clearance between box counterbore and pin nose with no need for stabbing or de-stabbing guides. Reduced wedging risk on threads.
- **Strength:** Slim OD/ID to improve hydraulic performance.
- **Durability:** Minimized damage risk on rig and reduced tong loss when a connection recut is required. Improved pin nose durability due to patented design including elliptical thread root that increases the connection's resistance to rotational bending fatigue.



### The test conditions were:

Depth:	18,150 ft
Hole size:	6-1/2"
Section profile:	Vertical
Rig equipment:	Varco top drive and Iron Roughneck
Top drive torque:	Average 3,300 ft-lbs
Top drive RPM:	40
Drill pipe:	4 inch, 14.00-lb/ft S135 pipe, 4-7/8". OD x 2-13/16". ID tool joints, with VAM Express VX 39
Typical bottomhole assembly:	Drill bit, turbine, stabilizer, 14 drill collars, jars, 3 drill collars, 6 HWDP
Thread compound:	Bestolife Copper Supreme Special Blend
Typical average rate of penetration:	3 to 4 ft/hr

### Results

- ✓ Consistent running,
- ✓ No connection reject related to stabbing, make-up or drilling operations,
- ✓ Trip time in line with expectations.

## Ideal for a Wide Variety of Complex Environments

### Shales

Shale wells are often vertical, with a horizontal section just above the formation with build rates around 10°/100'. Wells are drilled horizontally through the shale formation with high build rates which puts further wear on the pipe. VAM Express allows customers to optimize their drill string by providing high torque and the slim profile needed to successfully

drill shale plays. The elliptical thread root is significantly better in dealing with fatigue, especially in the build section. The rugged thread, the fast make-up time and the fact that no stabbing guide is needed in make-up eases handling on rig and saves you valuable time.

### Extended Reach Drilling and Horizontal Drilling

The primary need in extended reach and horizontal wells is torque. Because of the friction that a drill string encounters as it drills, more torque is needed as the well increases in length and in inclination. The drillable length of a horizontal, ERD, or uERD well is limited by the make-up torque of the drill pipe connection used. VAM Express provides the addi-

tional torque required to drill those challenging well designs. In addition, VX's enlarged ID provides hydraulic improvements because it reduces the pump pressure needed from the rig floor. Finally, VAM Express' elliptical thread root, with fatigue performance equivalent to a circular root of about 0.065", reduces connection fatigue risk.