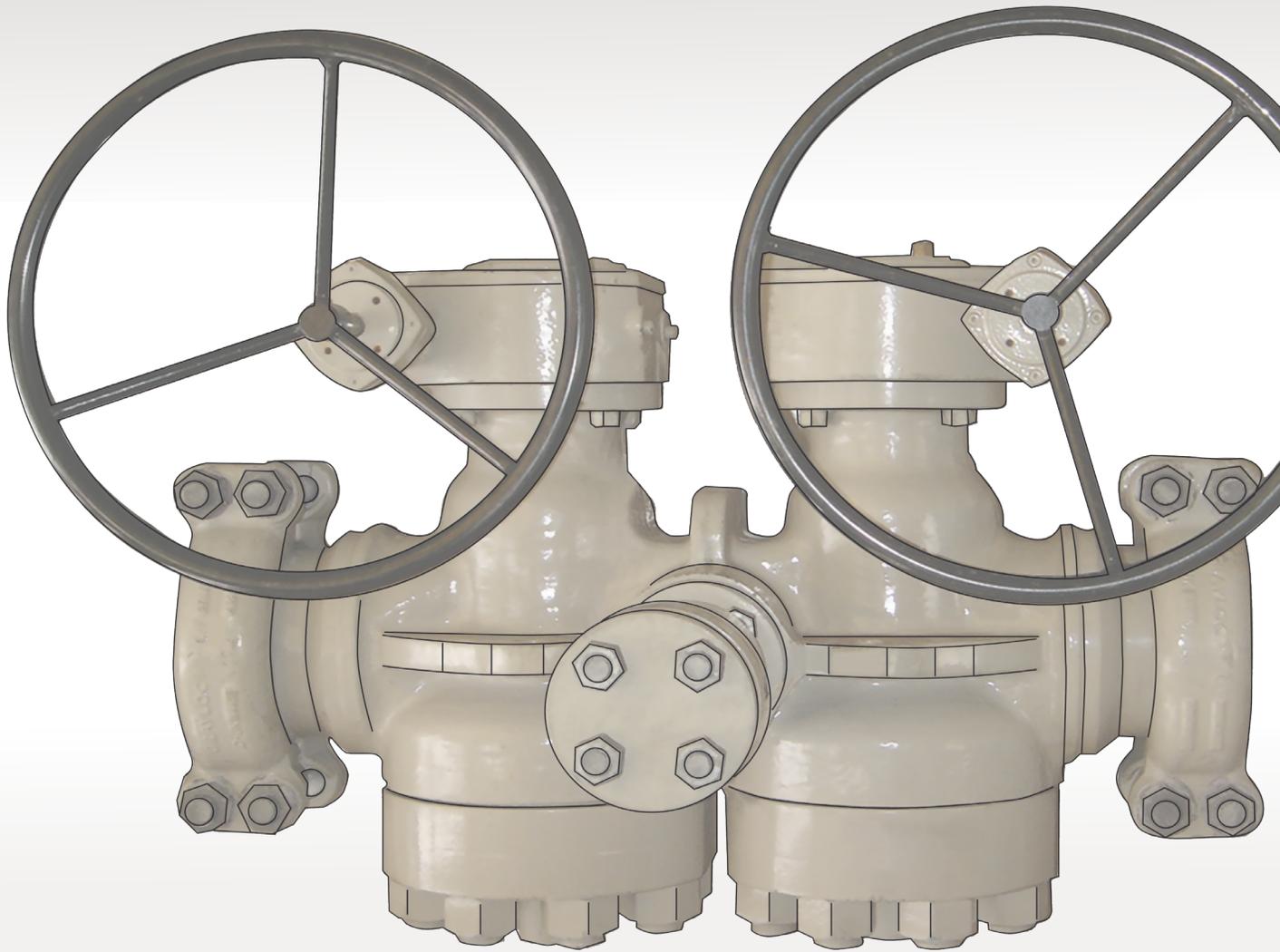


# **Plug Valve Solutions for the Upstream Exploration and Production Pipelines**

Production manifolds, test manifolds and other dirty services



## Introduction

In upstream exploration and production (E&P), uptime is critical, as every second of inactivity is an expense to O&G operators. Keeping the crude moving safely to the process points without interruption is vital to an efficient process, and valves play a crucial role in ensuring just that. Operational inefficiencies resulting from valve failures can result in millions of dollars in downtime and production losses.

Offshore and onshore high-pressure piping systems convey crude oil or natural gas from various wells to the central processing facilities. These systems pose difficult and challenging operational conditions for flow control solutions. The environments are often punishing and demand a valve solution capable of performing in severe operating conditions, while guaranteeing safe operation and reliable shutoff. The valves are also expected to have longer service life and provide the

highest level of efficiency in order to maximize return on investments and recognize the true total cost of ownership.

Many end users consider pressure-balanced plug valves as their preferred choice in these applications based on the valve's intrinsic design advantage and proven track record.

## Production and Test Manifolds

Once a production site is identified, several wells are drilled and tested. Each successful well is connected by flow lines to the production and test manifolds, which are located in the main processing facility. In these manifolds the well fluids are gathered into separators for further processing.

Valves play a crucial role in this process by controlling the flow through the various manifolds.



**Figure 1a:** *Offshore manifold with DB&B plug valves*

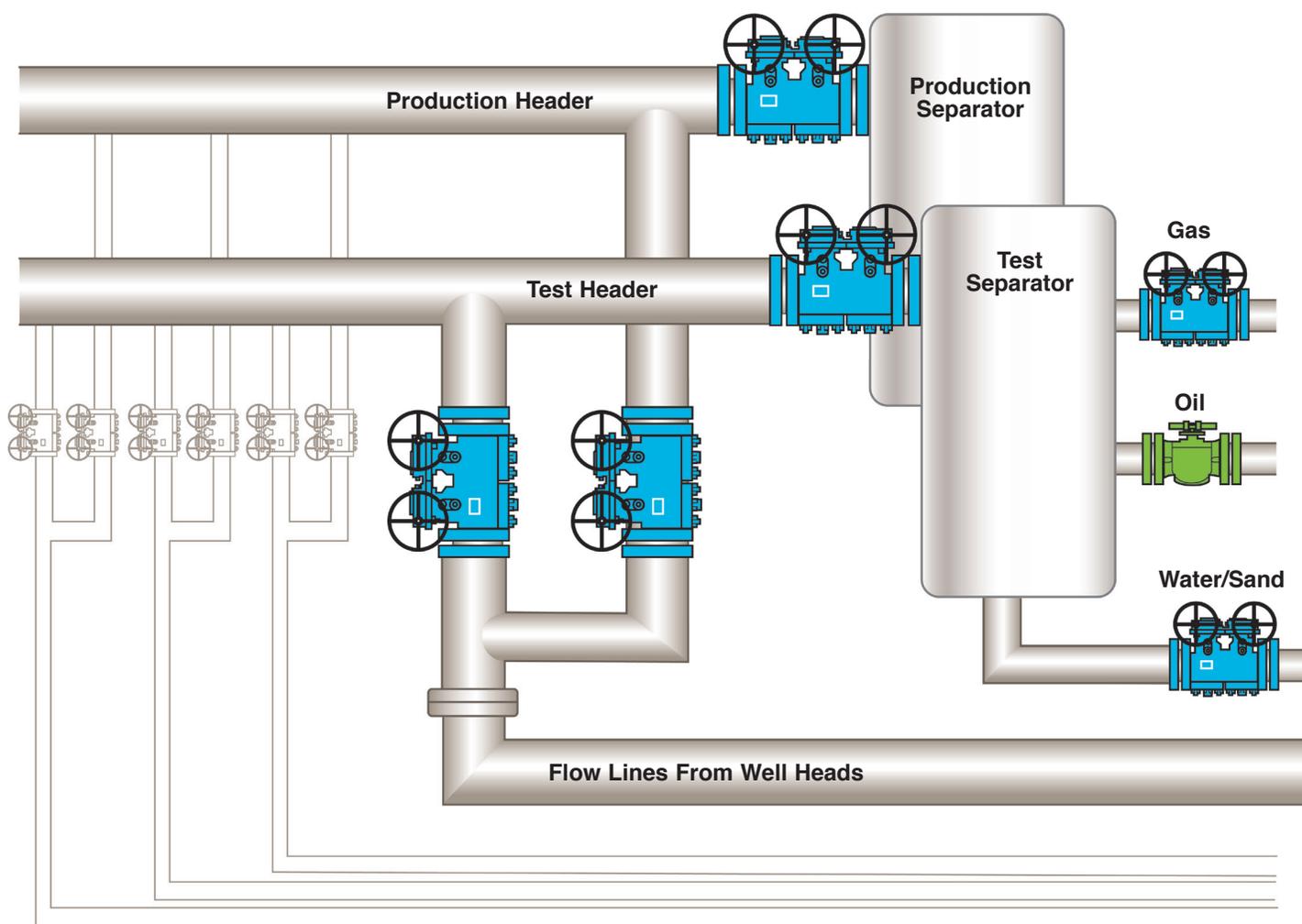


**Figure 1b:** *Onshore manifold with single plug valves*

These piping systems are subjected to high and fluctuating working pressures of ASME Class 900 and above. They are also subjected to severe conditions, where the fluid media carries suspended solid particles and is abrasive in nature. It is vital to select a robust valve that can withstand these higher pressures and abrasive services. Pressure-balanced plug valves are usually the preferred choice, as they not only withstand

higher pressures and abrasive service conditions but also provide a bubble-tight shutoff over a long service life.

The pictures in Figure 1a and 1b show typical manifolds in both offshore and onshore environments. A schematic for the production and test manifolds is shown in Figure 2.

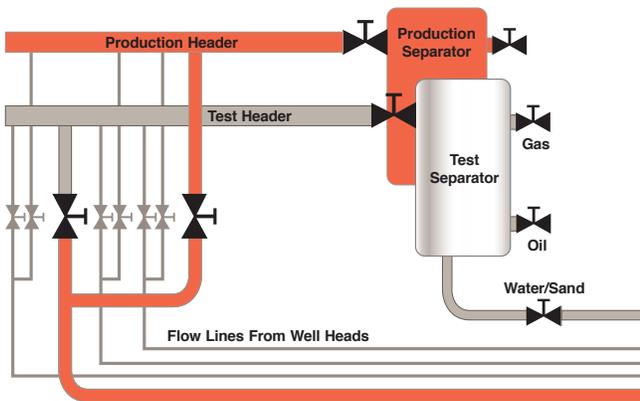


**Figure 2:** Production and test manifolds schematic using DB&B plug valves

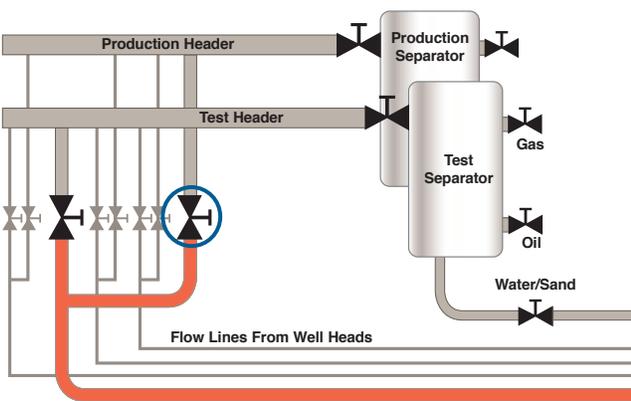
# Manifold Operation During the Well Testing Process

The production and test manifolds connect multiple flow lines from as many well heads to the test headers and production headers. The quality of the mixture

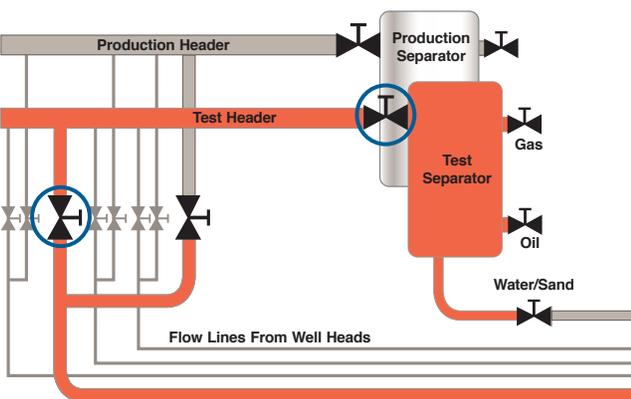
from each well head needs to be monitored at regular intervals as they are being produced. Valves play an important role in these stages, alternating the fluid flow between the test headers and production headers through a multi-stage process. The stages are explained as follows:



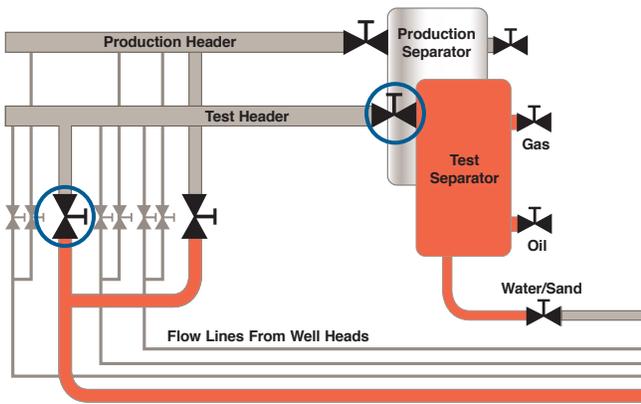
**Stage 0:** In a standard production scenario, the flow line valves to the production header are open so the well head fluids can be processed, whereas the flow line valves to the test header and the test separator isolation valve will all be closed.



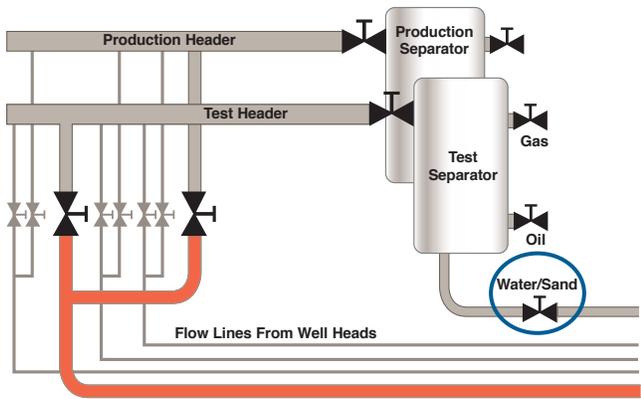
**Stage 1:** To begin the process for testing a specific well, its valve to the production header is closed so the flow line is isolated. The valve connected to the production header should not leak to accurately measure the flow from the well.



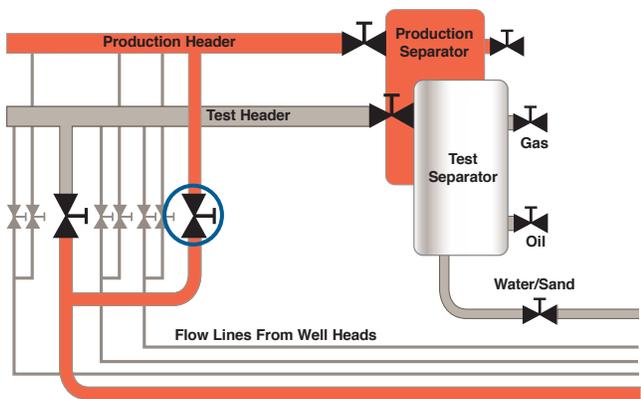
**Stage 2:** The valves to the test separator and test header are opened. It is critical that all other flow line valves connected to the test header are tight, to avoid any contamination to the tested fluid.



**Stage 3:** Once the quality of the mixture is measured and inspected, the valves to the test header and test separator are closed.



**Stage 4:** The test separator is drained. This drain contains a high proportion of sand and foreign particles, making this a particularly abrasive service.



**Stage 5:** Once the quality of the mixture is analyzed and if the well head is suitable for production, the flow line valve to the production header is opened once again for regular production.

## Other Abrasive Processes

### Produced Water Injection

To maintain pressure in the reservoirs and continue with regular production, produced water or gas are often re-injected into the reservoir at high pressures.

Produced water is a by-product of the well fluids and is often rich in chlorides and other corrosive elements. It also typically contains a high percentage of sand and other solid particles. This means that valves on the injection lines face similar challenges to the valves being used in the flow lines: the pressures are generally higher than the well pressures, often class 1500 or above, and the media is corrosive and rich in abrasive particles.

The injection process is similar but inverted to the gathering system. Water through a single pump line is diverted through an injection manifold into the various injection wells. All valves in this manifold will have to withstand these severe conditions.

### Sand Separation Systems

Well fluids carry different percentages of sand, which are all gathered into the separators. Sand exits the separators together with produced water. Sand is an unwanted product due to its abrasiveness, so it is separated from the water as part of a water treatment process. All sand-entrained lines as part of this process will pose significant challenges to piping components including valves, as they will be extremely abrasive and erosive.

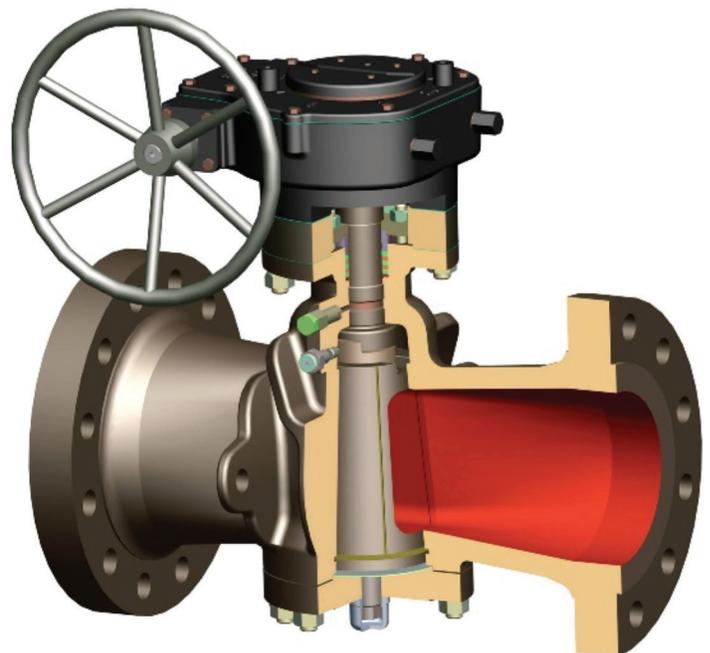
### Drains

Drains invariably collect solid particles depositing from the various processes being handled. This will pose a specific risk for closed drains, where isolation is particularly critical. Solids can in fact easily score any isolating valve or prevent them from operating properly if the wrong valve is selected.

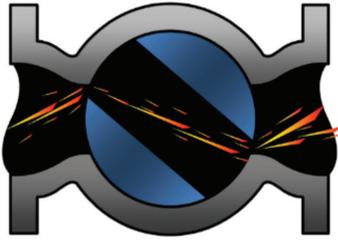
## Operational Challenges for Valves

Valves used in gathering system units are subject to high operating pressures and must perform with maximum reliability. Unexpected outages or unplanned maintenance cannot be tolerated. Foreign particles within the fluid medium can abrade valve seats and sealing components, causing process leakages, contaminated product and even safety hazards.

For most upstream operators, the preferred valve type continues to be the purposefully designed pressure-balanced plug valve (Figure 3), with its metal-to-metal seats for positive shutoff and superior resistance to erosion and abrasion. Its time-tested service record has proved it to be the most suitable design for optimal long-term performance in severe applications, delivering unequaled reliability.

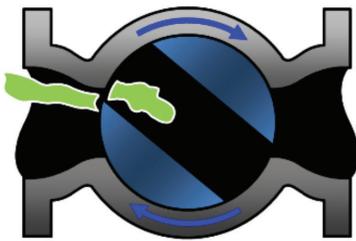


**Figure 3:** *Pressure-balanced plug valve*



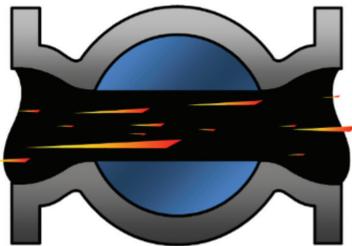
### Full Differential Opening at High Pressures

Gathering systems often carry high and fluctuating fluid line pressures during the various stages of production. With a large metal to metal sealing area, a plug valve is unaffected by the full and fluctuating differential pressures of the fluid line medium. Operating the valve against full differential pressure is also possible, without risk of damaging the seats.



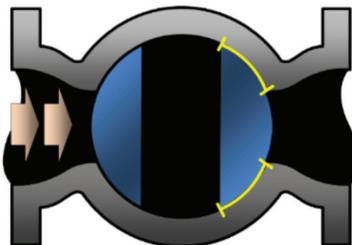
### Damage by Process Particles

The fluid medium passing through the gathering system is often a mix of oil, gas and suspended foreign particles such as sand. These abrasive particles can quickly erode or damage valve seats and seals. Plug valves provide a robust metal to metal sealing, and even large solid objects floating through the valve are sheared by the rotary cutting action of the plug valve.



### Solids Buildup in Cavities

Plug valves have no cavities where solids can deposit and impair valve operation. The metal seats of the plug valves are also well protected from the line media, guaranteeing a longer life for the valve.



### Stringent Leakage Rates

Plug valves are characterized by a large and wide metal sealing area that offers zero leakage, bubble-tight shut-off. Any unlikely damages to the seating areas can be easily resolved by injecting the sealant, making the valve in-line maintainable, even if it is under pressure.

## Twin Isolation Plug Valves, a Compact Solution to DB&B and DI&B Requirements

In several applications, the upstream oil and gas industry is no longer satisfied with the shutoff provided by single block valves. True double block and bleed (DB&B) and double isolation and bleed (DI&B) has become a prime requirement as safety standards are raised throughout the industry, especially where it is necessary for an operator to work downstream of the valve. DB&B is also required where isolation effectiveness needs to be proven from a process point of view, as it is typical on flow lines manifolds.

The Twin Isolation Plug Valve (TIPV) from Nordstrom™ and Serck Audco™ offers true bubble-tight DB&B and DI&B capability within a single valve body. As illustrated in Figure 4, its design is based on the single plug valve and therefore still has its related reliability. However, the TIPV includes two independent obturators in series, with an integrated bleed point between them.

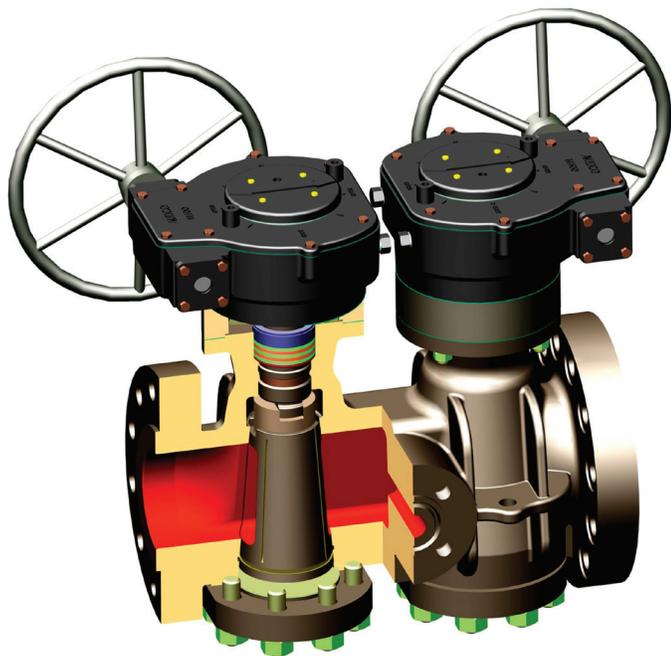


Figure 4: Twin Isolation Plug Valve (TIPV)

Efficient space usage and general weight reduction are critical aspects of offshore platforms engineering. The TIPV provides the upstream industry one of the most compact and lightest true DB&B and DI&B solutions available, which has made it a popular product choice in these installations.

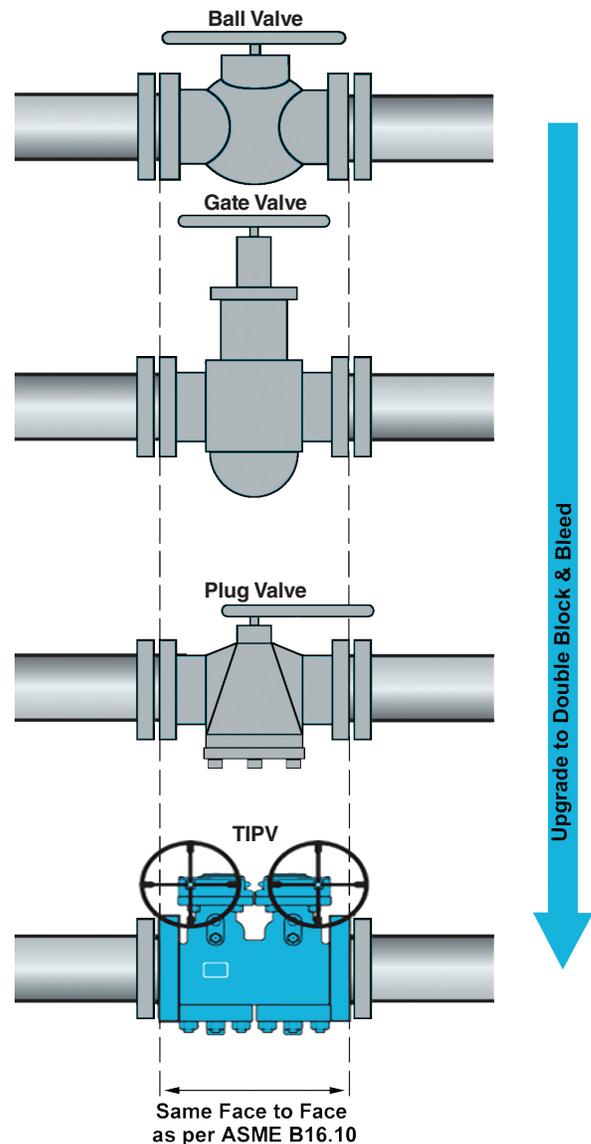
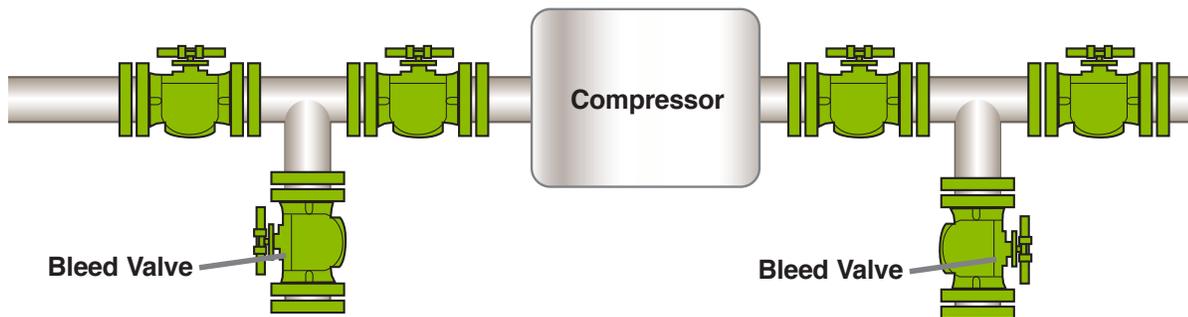


Figure 5: DB&B and DI&B isolation with a TIPV

The TIPV design is so compact that in class 600 and above they are supplied with the exact face-to-face dimensions of a single valve. (See Figure 5.) The face to face will meet ASME B16.10 and API 6D requirements for ball, plug and gate valves. This allows seamless replacement for existing, outdated single block valves where the end user is in need of an upgrade to DB&B or DI&B to comply with changes in internal practices or H&S regulatory requirements.

Nordstrom and Serck Audco have supplied valves for several replacement projects, typically addressing flow line manifold valves (Figures 1a and 1b) or other isolating valves, such as compressor isolation, illustrated in Figure 6.

### DB&B/DI&B Configuration Using Ball Valves



### DB&B/DI&B Configuration Using Twin Isolation Plug Valves (TIPV)



**Figure 6:** DB&B/DI&B with a TIPV



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