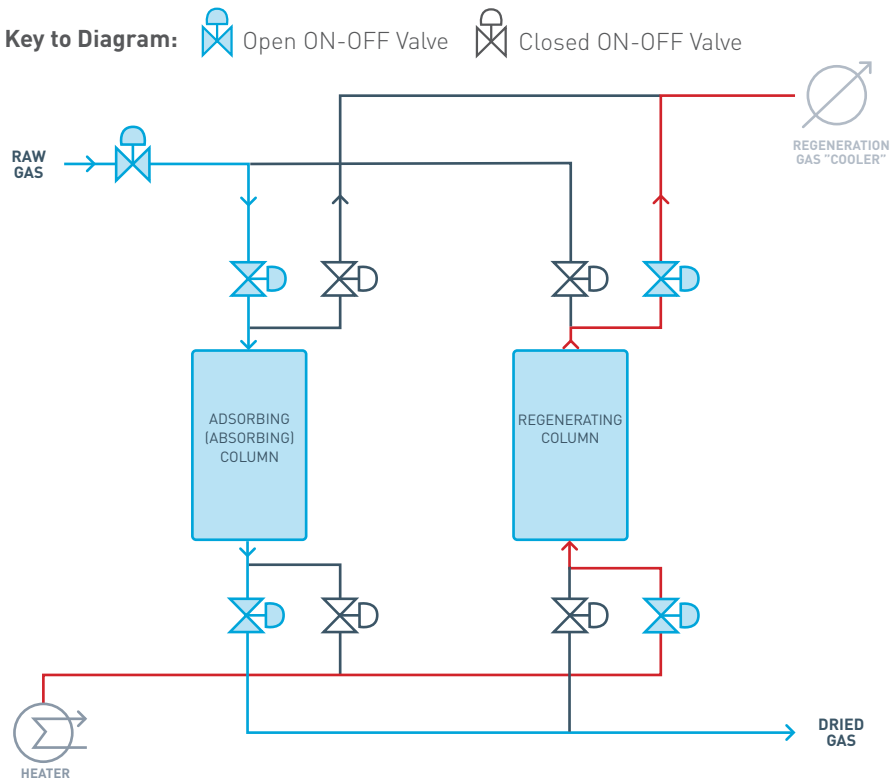
# A VANESSA TRIPLE OFFSET VALVE SOLUTION
## FOR MOLECULAR SIEVING IN GAS TREATMENT PLANTS

The oil and gas industry often uses molecular sieves to dehydrate or separate contaminants from natural gas. This process involves several operational challenges that put valves under severe strain, potentially causing damage and service disruptions.
Triple offset valves (TOVs) represent an innovative solution for molecular sieving due to their design and ability to handle extreme conditions. TOVs provide a significant footprint reduction compared to conventional ball valves while minimizing the need for, and the cost of, maintenance.




The molecular sieve sequencing is based on one vessel operating in purification mode, and the opposite one in regeneration mode (and vice versa). The former separates contaminants from the natural gas by flushing the ambient temperature raw gas stream through the adsorber/absorber column (containing Zeolite, ceramic materials, activated carbon, silica gels, or absorbing membranes). The latter then removes the contaminants trapped in the adsorbent / absorbent by using a high temperature regeneration gas flushed in the opposite direction. Switching valves continuously invert this process and are therefore subject to high frequency open and close cycles, thermal cycles, corrosive gases and residuals (contained in outlet gases).

Rising stem (tilting) ball valves, in sizes and pressure classes up to 24" / ASME class 900 have been specified for this application for several years. However, with mounting pressure on delivering higher efficiency, reducing down time and capital expenditure, these valves are often seen as too expensive and difficult to maintain by end users and process licensors.
Vanessa TOVs were first adopted three decades ago for molecular sieves by several users in the USA. Many Vanessa TOVs were installed and are currently in operation across various sites in Oklahoma and Texas on a dehydration service. Only a few repair/maintenance support requests have been received over the past ~30 years. Several other end users have followed suit allowing Emerson to gain significant know-how in corrosion resistant weld overlays for acid gas offshore applications as well. In addition, important references in molecular sieve applications have also been developed beyond the natural gas treatment, especially within air separation units (air dehydrators) in China and cracked gas (ethylene plant) around the world.

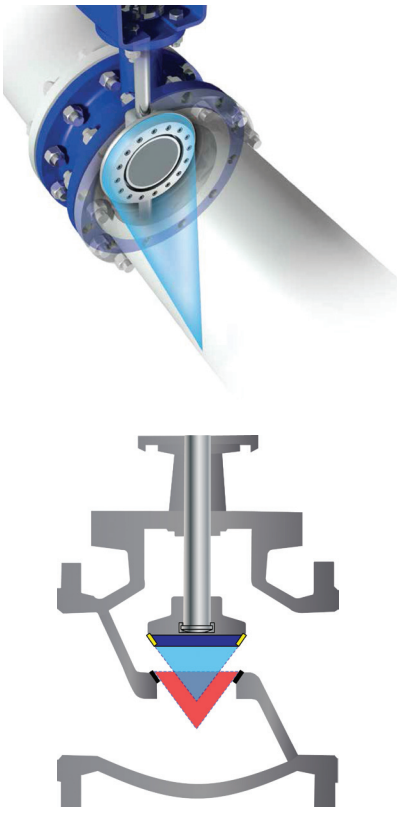
## WHAT IS A TRIPLE OFFSET VALVE (TOV)?

As the concept of triple offset technology has evolved, so has the Vanessa Series 30,000. From meeting the need to eliminate leakage, triple offset valves have evolved to become the ultimate process valve - one that's even better positioned to deliver metal-to-metal torque seating, quarter turn non-rubbing rotation and withstand the harshest service conditions.

**Triple Offset Design**
The Vanessa Series 30,000 valve shares the same cone-to-cone principle with a globe valve, but sealing is performed by quarter turn rotation. TOVs use a sealing system consisting of a stationary seat and a rotating sealing surface sharing an identical shape: an inclined conic section. When these cones overlap, closed position is reached and sealing occurs. Such 'quarter turn globe' concept is made possible by the use of three 'offsets' meant to completely eliminate rubbing. Optimized seating angles and rotational characteristics guarantee superior tightness via an ingenious combination of the triple offset design and a flexible metal seal ring across all basic, cryogenic and high temperature configurations.

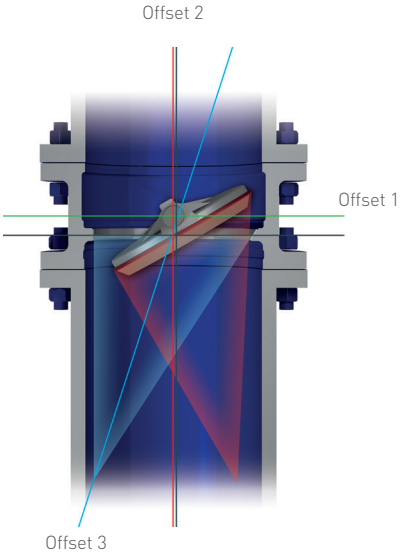
**Seal Ring**
The elasticity and radial compression of the Vanessa Series 30,000's seal ring enable the contact pressure to be uniformly distributed around the seating surface - guaranteeing zero leakage*.

**Seat Stellite® Grade 21**
The Vanessa Series 30,000 features overlays made from Stellite® grade 21 - an incredibly robust material that is specifically designed to withstand flow generated wear and guarantee a robust surface to withstand the radial compression of the seal ring.



Cone-to-cone sealing principle in a TOV (rotational movement) and in a globe valve (linear movement)

* Vanessa triple offset valves perform bidirectional zero leakage tightness (no visible leakage when tested at high pressure with water and low pressure with air according to 'Leakage Rate A' of ISO 5208 and EN 12266-1 standards, and the 'Resilient Seat Valves' requirement of API 598) through non-rubbing 90-degree rotation and metal-to-metal torque seating.




**Offset 1**
The shaft is placed behind the plane of the sealing surface to provide a continuous seat path.

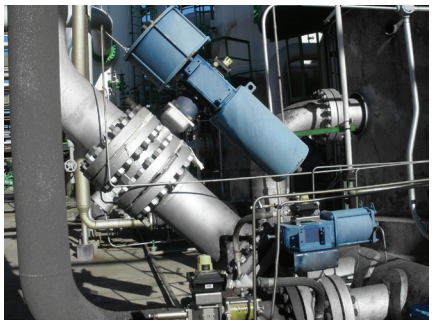
**Offset 2**
The shaft is placed to one side of the pipe/valve centerline to allow the displacement of the seal from the seat during the 90° opening.

**Offset 3**
The seat and seal cone centerlines are inclined in respect to the pipe/valve centerline. This third offset completely eliminates rubbing.

## THE VANESSA TRIPLE OFFSET VALVE BENEFITS

Molecular sieving generates tremendous demands on valves with any failure compromising the process and causing costly problems. Vanessa quarter turn non-rubbing, metal-to-metal torque seated valves have all the key characteristics necessary to overcome the challenges of this application.

| MOLECULAR SIEVE | BENEFITS OF ADOPTING VANESSA SERIES 30,000 |
|---|---|
| High frequency open/close cycles (down to 1 open/close cycle per hour) | The Vanessa triple offset non-rubbing design completely eliminates wear between sealing components. The entire trim, including bearings and thrust bearing, is designed for heavy duty services. |
| Frequent thermal cycles (from ambient to around 315°C / 600°F) | The metal seal ring, located on the disc, is robust, but flexible at the same time - its resiliency allows for a uniform distribution of the contact force to seat across its circumference, ensuring excellent tightness, and compensates for slight differences of expansion between body and disc. Material selection and gaps/ tolerances calculations take into consideration the material expansion within the thermal transient. |
| Corrosive gases | Whenever a piping class requires Inconel material selection, typically on 12" and higher across all pressure classes, in order to handle sour gases, materials are selected to be perfectly suitable. A corrosion resistant weld overlay can be applied on valve body inner surfaces, allowing the fluid to be in contact with noble metals only. This will ensure corrosion protection while permitting the use of a lower cost carbon steel body. |
| Molecular sieve residuals in outlet gases | The Vanessa Stellite® 21 seat overlay offers great resistance to wear generated by the fluid, and is recommended to ensure high resistance to impacts. The seal ring material and surface treatment are usually configured upon careful application analysis, while bearings are in Stellite 6. |

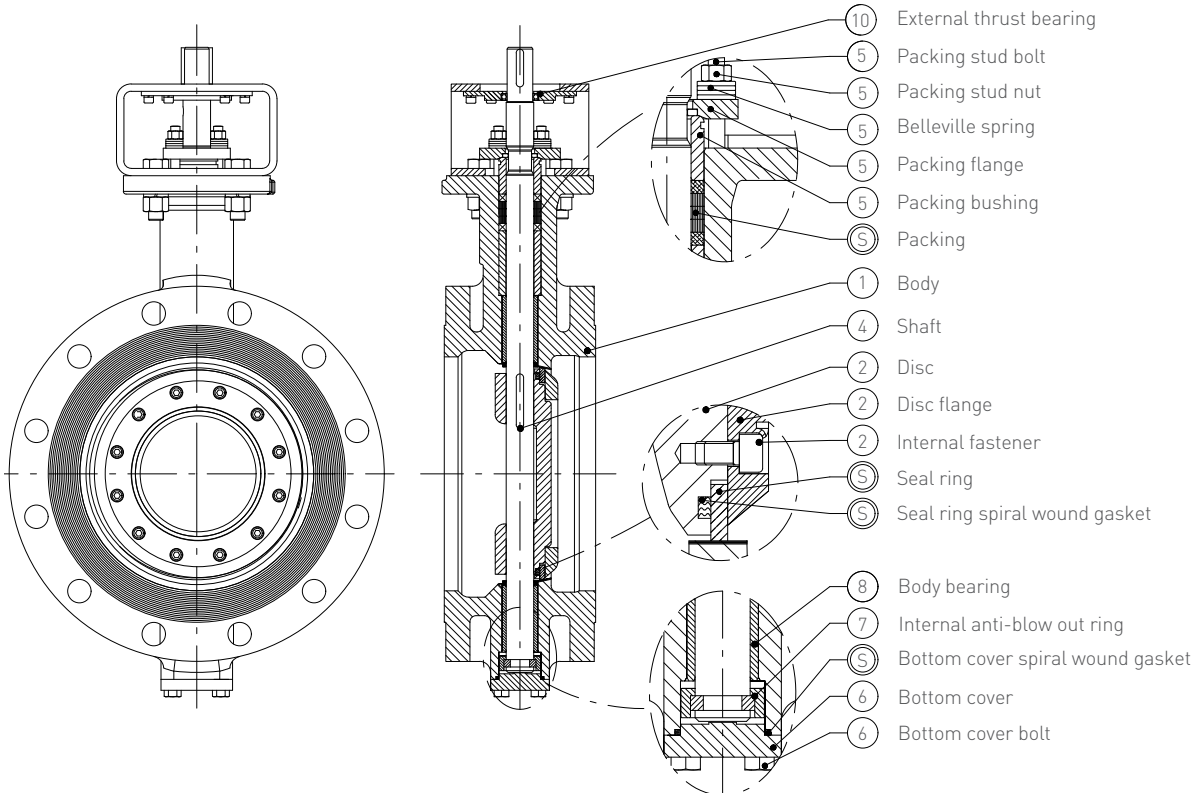


# VANESSA SERIES 30,000 TRIPLE OFFSET VALVES

SECTIONAL DRAWING AND RECOMMENDED MATERIAL SELECTION AND PURCHASE SPECIFICATION

**Basic Configuration**

DESIGN TEMPERATURE RANGE: -46°C to 426°C (-50°F to 800°F)




| GROUP | NOTE | ITEM DESCRIPTION | ITEM MATERIAL |
|---|---|---|---|
| 1 | | Body | ASTM A216 WCC |
| | | Seat hard facing | STELLITE® 21 |
| 2 | □ | Cast disc | ASTM A216 WCC |
| | □ | Forged disc | ASTM A105 / ASTM A350 LF2 |
| | | Disc flange | ASTM A516 grade 70 |
| | | Internal fastener | ISO 3506 A4 (ASTM F738 grade A4) |
| 4 | | Shaft | ASTM A479 UNS S41000 (13 CR SS) + HVOF CHROMIUM CARBIDE (BEARING CONTACT AREA) |
| 5 | □ | Packing flange | ASTM A240 / A182 / A276 UNS S31600 (AISI 316) |
| | □ | Packing bushing | ASTM A240 / A182 / A276 UNS S31600 (AISI 316) |
| | | Packing stud bolt | ISO 3506 A4 (ASTM F738 grade A4) |
| | | Packing stud nut | ISO 3506 A4 (ASTM F738 grade A4) |
| | | Belleville spring | STAINLESS STEEL OR ALLOY STEEL |
| 6 | □ | Bottom cover | ASTM A516 GR. 70 or ASTM A216 WCC |
| | | Bottom cover bolt | ISO 3506 A4 (ASTM F738 grade A4) |
| 7 | | Internal anti-blow out ring | UNS S31600 (AISI 316) Hard faced |
| 8 | | Body bearing | STELLITE® 6 |
| | | Bearing protector | REINFORCED BRAIDED GRAPHITE |
| 10 | | External thrust bearing | ALLOY STEEL |
| | | Thrust bearing flange | STAINLESS STEEL |
| | | Screw | ISO 3506 A4 (AISI 316) |
| S | • | Packing | GRAPHITE |
| | • | Bottom cover spiral wound gasket | UNS S31600 (AISI 316) + GRAPHITE |
| | • □ | Seal ring | UNS S17400 (17-4 PH) Hard faced - Solid |
| | • | Seal ring spiral wound gasket | UNS S31600 (AISI 316) + GRAPHITE |

**NOTES**

Material of construction in accordance with: NACE MR0103 / ISO 17945 and NACE MR0175 / ISO 15156 for H2S partial pressures ⩽ 10 kPa and pH values ⩾ 3.5.

□ Materials are exclusively selected by the factory depending on valve size.

• Suggested spare parts

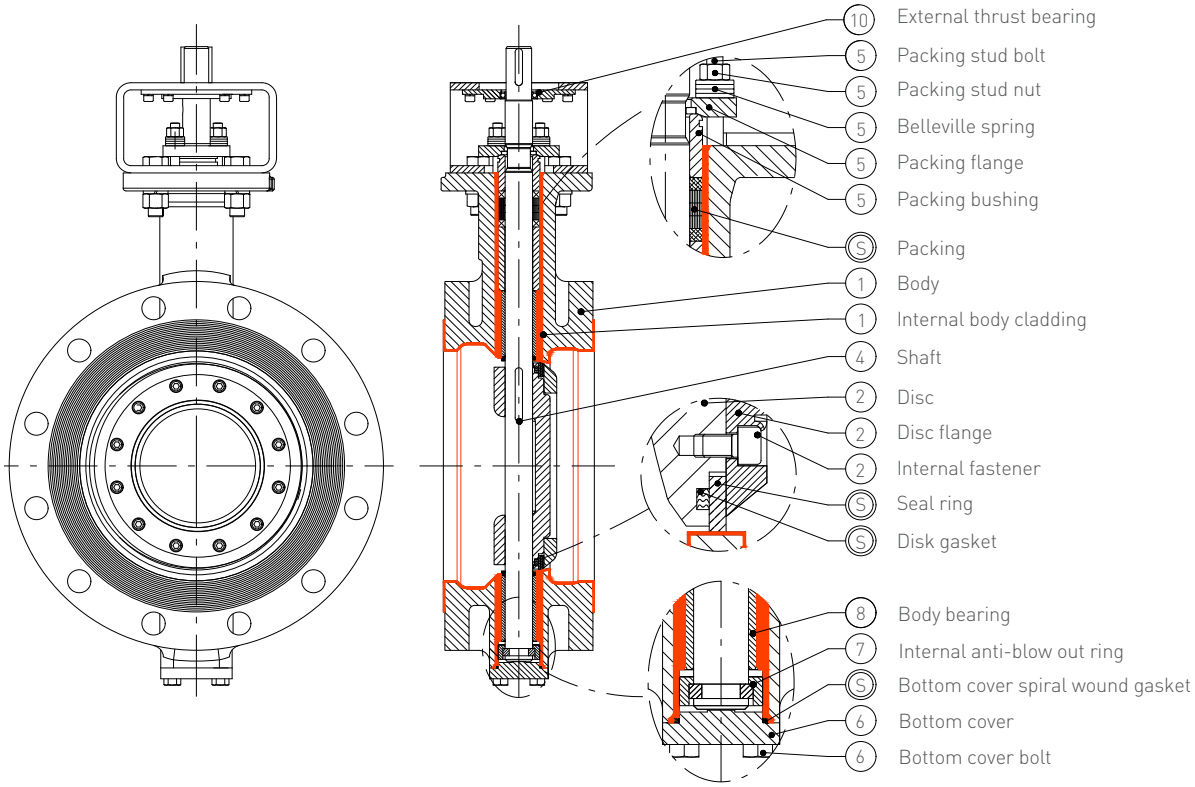
The sectional drawing and the relevant typical material selection represented on this page shall not be detached from the present document (VCBUL-04055-EN) nor used or distributed as a single document. BOMs are applicable depending on end user's pipe class, fluid composition (especially in regards to H2S content) and valve lifecycle acceptability/maintenance scheduling.

# VANESSA SERIES 30,000 TRIPLE OFFSET VALVES

SECTIONAL DRAWING AND RECOMMENDED MATERIAL SELECTION AND PURCHASE SPECIFICATION

**Basic Configuration - Sour Gas**

DESIGN TEMPERATURE RANGE: -46°C to 426°C (-50°F to 800°F)




| GROUP | NOTE | ITEM DESCRIPTION | ITEM MATERIAL |
|---|---|---|---|
| 1 | | Body | ASTM A216 WCC |
| | | Internal body cladding | UNS N06625 (ALLOY 625) |
| | | Seat hard facing | STELLITE® 21 |
| 2 | □ | Cast disc | ASTM A494 CW6MC |
| | □ | Forged disc | ASTM B564 UNS N06625 |
| | □ | Cast disc flange | ASTM A494 CW6MC |
| | □ | Forged disc flange | ASTM B564 UNS N06625 |
| | | Internal fastener | ASTM F468 UNS N10276 |
| 4 | | Shaft | UNS N06625 (ALLOY 625) or UNS N07718 (ALLOY 718) + HVOF CHROMIUM CARBIDE (BEARING CONTACT AREA) |
| 5 | □ | Packing flange | ASTM A240 / A182 / A276 UNS S31600 (AISI 316) |
| | □ | Packing bushing | ASTM A240 / A182 / A276 UNS S31600 (AISI 316) |
| | | Packing stud bolt | ISO 3506 A4 (ASTM F738 grade A4) |
| | | Packing stud nut | ISO 3506 A4 (ASTM F738 grade A4) |
| | | Belleville spring | STAINLESS STEEL OR ALLOY STEEL |
| 6 | □ | Bottom cover | ASTM B446 UNS N06625 or ASTM A494 CW6MC (ALLOY 625) |
| | | Bottom cover bolt | ISO 3506 A4 (AISI 316) |
| 7 | | Internal anti-blow out ring | ASTM B564 UNS N10276 IONIC NITRIDING |
| 8 | | Body bearing | STELLITE® 6 |
| | | Bearing protector | REINFORCED BRAIDED GRAPHITE |
| 10 | | External thrust bearing | ALLOY STEEL |
| | | Thrust bearing flange | STAINLESS STEEL |
| | | Screw | ISO 3506 A4 (AISI 316) |
| S | • | Packing | GRAPHITE |
| | • | Bottom cover spiral wound gasket | ASTM B575 UNS N10276 + GRAPHITE |
| | • □ | Seal ring | UNS N06625 (ALLOY 625) or UNS N07718 (ALLOY 718) – Solid |
| | • | Seal ring spiral wound gasket | ASTM B575 UNS N10276 + GRAPHITE |

**NOTES**

Material of construction in accordance with:
NACE MR0103 / ISO 17945 and NACE MR0175 / ISO 15156.

□ Materials are exclusively selected by the factory depending on valve size.

• Suggested spare parts

See additional dedicated documents for available options. Materials of construction for minor components not included in the BOM, are selected with the same or better material grade of corresponding major components.

# VANESSA SERIES 30,000 TRIPLE OFFSET VALVES

MOLECULAR SIEVING VALVE SPECIFICATION

| VANESSA TOV | CONFIGURATION |
|---|---|
| DESIGN | • Shaft hard facing in the bearing contact areas (HVOF - High velocity Oxy-Fuel) to minimize wear due to high cycling.<br>• Screw securing device against each seal ring retainer screw to avoid loosening due to vibrations and temperature transient.<br>• A live loaded mechanism to minimize the need to tighten the packing due to frequent thermal cycling or whenever packing maintenance is not practical.<br>• Double flanged or lug body styles to reduce the valve footprint. Besides, whenever a Vanessa TOV is selected in place of a typical ball valve in service, the double flanged long pattern body prevents any piping modification enabling direct replacement. |
| MATERIALS | • Solid (one piece) seal rings in 17-4 PH (Carbon Steel body) or Inconel (Cladded Carbon Steel body) and in other materials depending on service conditions.<br>• For sour/acid gases applications, Vanessa proprietary cladding procedure for Inconel weld overlays to optimize thickness, dilution and uniformity. |


| VANESSA TOV | INSTALLATION |
|---|---|
| | • To minimize solid particle accumulation in the lower bearing area, the valve installation is recommended with the shaft set in the horizontal position. Vertical shaft installation is acceptable with a higher risk of affecting sealing performance and valve operability over time. To reduce the impact of these issues, the use of a bearing & packing flushing option is recommended. |

| VANESSA TOV | MAINTENANCE |
|---|---|
| | • Live loaded packing shall be re-tightened with the provided torque values whenever bolts become loose. In presence of corrosive gases, the solid seal ring may be subject to regular replacement. Whenever particulate build-up shows sign of negatively affecting valve operability (e.g. longer opening/closing times) or its tightness performance, internal cleaning or full refurbishment of the valve may be required. |