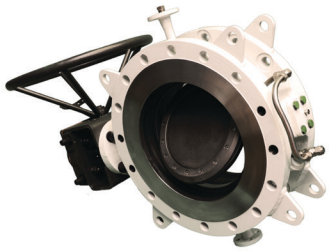
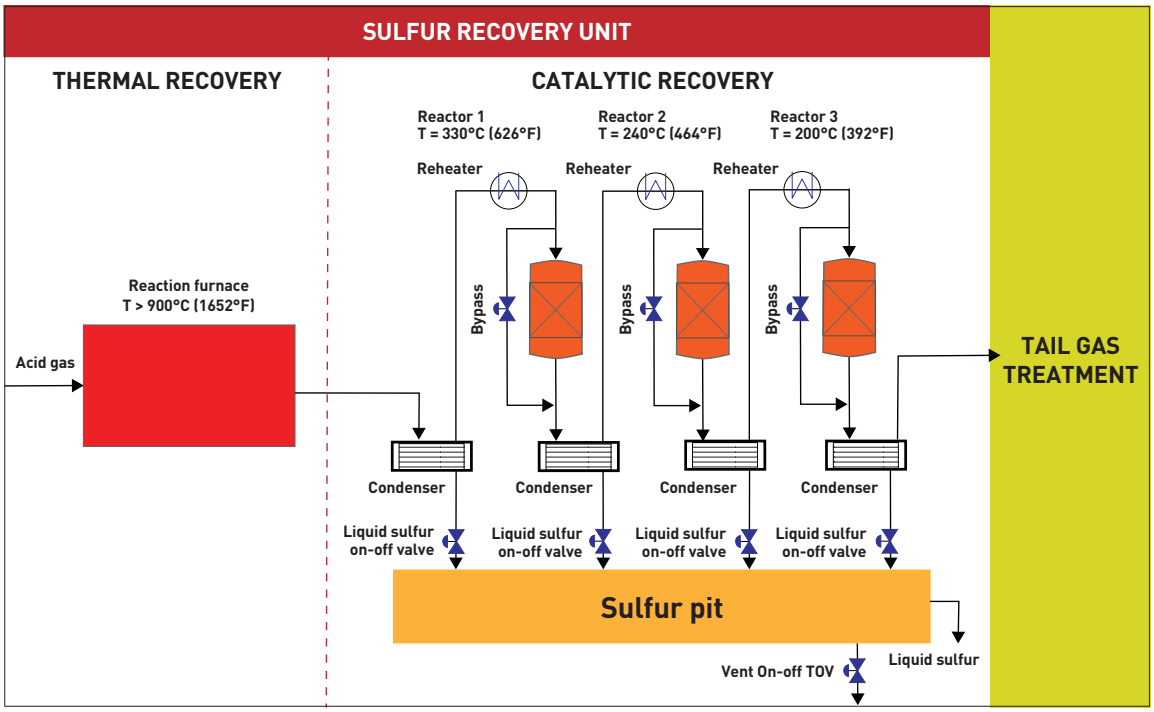
A VANESSA TRIPLE OFFSET VALVE SOLUTION

TO OPERABILITY ISSUES IN SULFUR RECOVERY UNITS

A Sulfur Recovery Unit (SRU) extracts elemental sulfur from acid gas streams containing hydrogen sulfide (H2S) typically via a two-step de-sulfuring process (known as the Claus process). Valve operability issues can hugely upset its efficiency and this is why contributing factors such as thermal loss, medium solidification and corrosion inside the valve should always be addressed at specification stage. Triple offset valves (TOVs) featuring a thermal jacket, bearing flushing and with suitable material selection have long proven to be the key solution for both ON-OFF and by-pass functions within the catalytic section of SRUs and for the handling of tail gas.





In the Claus process, one-third of the H2S reacts into sulfur dioxide (SO2) through combustion (thermal recovery). The reaction continues in a three-stage catalytic section through heating, catalytic reaction (the SO2 reacts with the remaining H2S) and cooling/condensation.

Build-up of solids in the valve internals and bearing journals can cause sticking and difficulty in cycling. This issue will lead to poor valve performance and unnecessary maintenance or repairs, which in turn increases operational costs and generates loss of revenue.

Historically, high performance butterfly valves were widely specified and, while adequate in principle, have been displaced over time by triple offset technology as a more reliable solution to the challenges of such critical service. Vanessa Series 30,000 TOVs in steam-jacketed configuration have been successfully installed in several SRUs around the world as liquid sulphur ON-OFF valves, reactor bypass valves (whenever present) and sulphur pit vent valves with excellent performance and reliability. Outside the Claus process, Emerson Vanessa has also gained vast experience in handling tail gas with both ON-OFF and control functions.

The steam jacket is fully welded around the body wall and is able to uniformly distribute heat around the body circumference including the hub areas. This combined with an efficient thermal insulation of valve and adjacent piping*, ensures that the temperature of valve seat/bearing areas will not fall below the sulfur crystallization point causing critical operability issues. Appropriate valve material selection (Vanessa TOVs always come in full metal construction) ensures suitability irrespective of the presence of a corrosive fluid or thermal transients.

* provided by the contractor/end user

VANESSA SERIES 30,000 TRIPLE OFFSET VALVES
PRODUCT INFORMATION

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 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

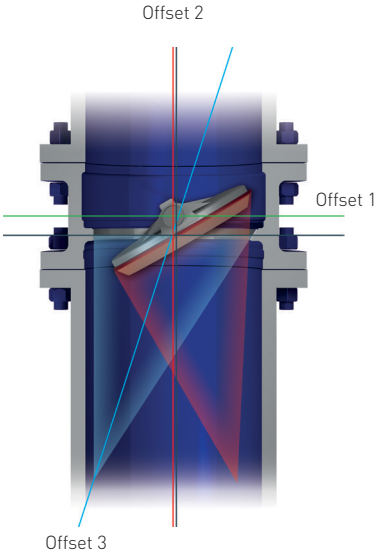
The elasticity and radial compression of the Vanessa Series 30,000's seal ring enable the contact pressure to be uniformly distributed around the seating surface - guaranteeing zero leakage*.

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

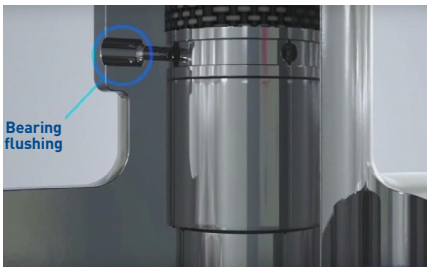
The seat and seal cone centerlines are inclined in respect to the pipe/valve centerline. This third offset completely eliminates rubbing.

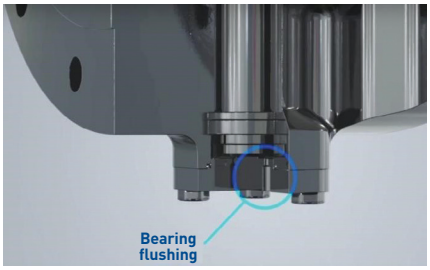
VANESSA SERIES 30,000 TRIPLE OFFSET VALVES
BENEFITS IN SULFUR RECOVERY

THE VANESSA TRIPLE OFFSET VALVE BENEFITS

Sulfur recovery generates tremendous demands on valves, and potential failures heavily impact the process integrity and associated costs. Vanessa quarter turn non-rubbing, metal-to-metal torque seated valves have demonstrated over time to be capable of overcoming the key challenges of this application.

CHALLENGE	BENEFITS
Thermal loss	The valve jacket delivers additional heat against the existing pipe insulation, which is designed to minimize heat dissipation.
Medium solidification	The asymmetrical, frictionless triple offset design, resulting in a line contact between seat and seal, prevents jamming or sticking effects. The camming action of the seal ring occurring during seating promotes the sweeping of build-ups off the sealing surface. A bearing flushing device keeps the valve critical areas, the seat and the bearings, clean at all times by using positive pressure differential against line service pressure to inject a clean fluid (typically steam or nitrogen). Its combination with bearing protectors and the absence of cavities represent the ultimate protection of these areas from build-ups of crystallized fluid. Consistent valve tightness is ensured by durable Stellite grade 21 seats and high alloy seal rings, while a hard faced thrust bearing eliminates the risk of shaft lock-ups.
Corrosion	A suitable materials selection combined with a steam jacket and an efficient valve-to-piping thermal insulation protect against sulfur crystallization, and consequently prevent corrosion.



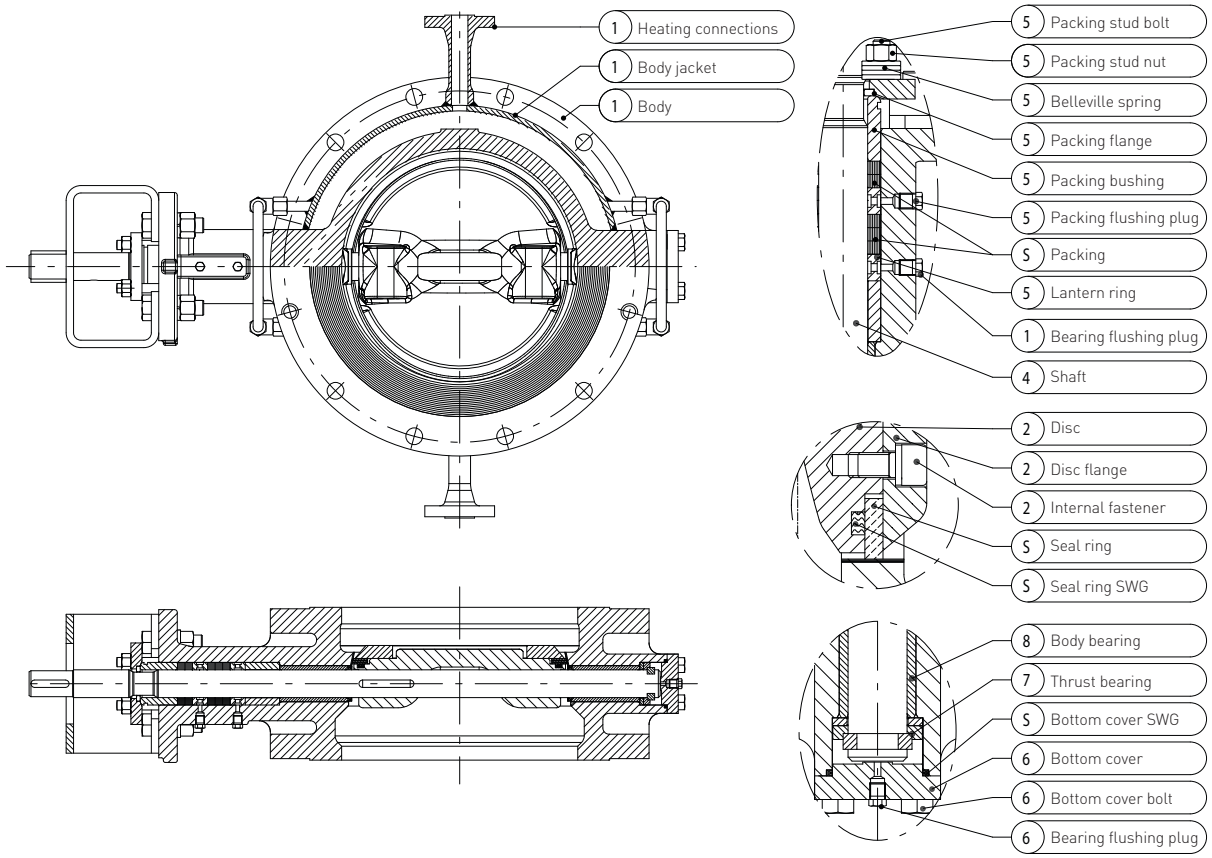


VANESSA SERIES 30,000 TRIPLE OFFSET VALVES

SECTIONAL DRAWING AND TYPICAL MATERIAL SELECTION – CARBON STEEL

Steam Jacketed Configuration

Carbon steel valve body bill of material: BOM DW01
Design temperature range: -46°C to 426°C (-50°F to 800°F)



GROUP	ITEM DESCRIPTION	ITEM MATERIAL
1	Body	ASTM A216 WCC
	Body seat facing	STELLITE® 21
	Body jacket*	ASTM A516 GR. 70 or ASTM A105
	Heating connections	ASTM A105
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)
5	Packing flange*	ASTM A240 / A182 / A276 UNS S31600 (AISI 316)
	Packing bushing*	ASTM A240 / A182 / A276 UNS S31600 (AISI 316)
	Lantern ring	UNS S31600
	Plug	UNS S31600
	Belleville spring (option)	Stainless steel
	Packing bolt	ISO 3506 A4 (ASTM F738 grade A4)
	Packing nut	ISO 3506 A4 (ASTM F738 grade A4)
6	Bottom cover*	ASTM A516 GR. 70 or ASTM A216 WCC or ASTM A105
	Bottom cover bolt	ISO 3506 A4 (ASTM F738 grade A4)
7	Thrust bearing	UNS S31600 (AISI 316) Hard faced
8	Body bearing	UNS S31600 (AISI 316) Hard faced
	Bearing protector	Graphite ring
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
** Special option: also available with steam tracing. See details on page 6
• Suggested spare parts

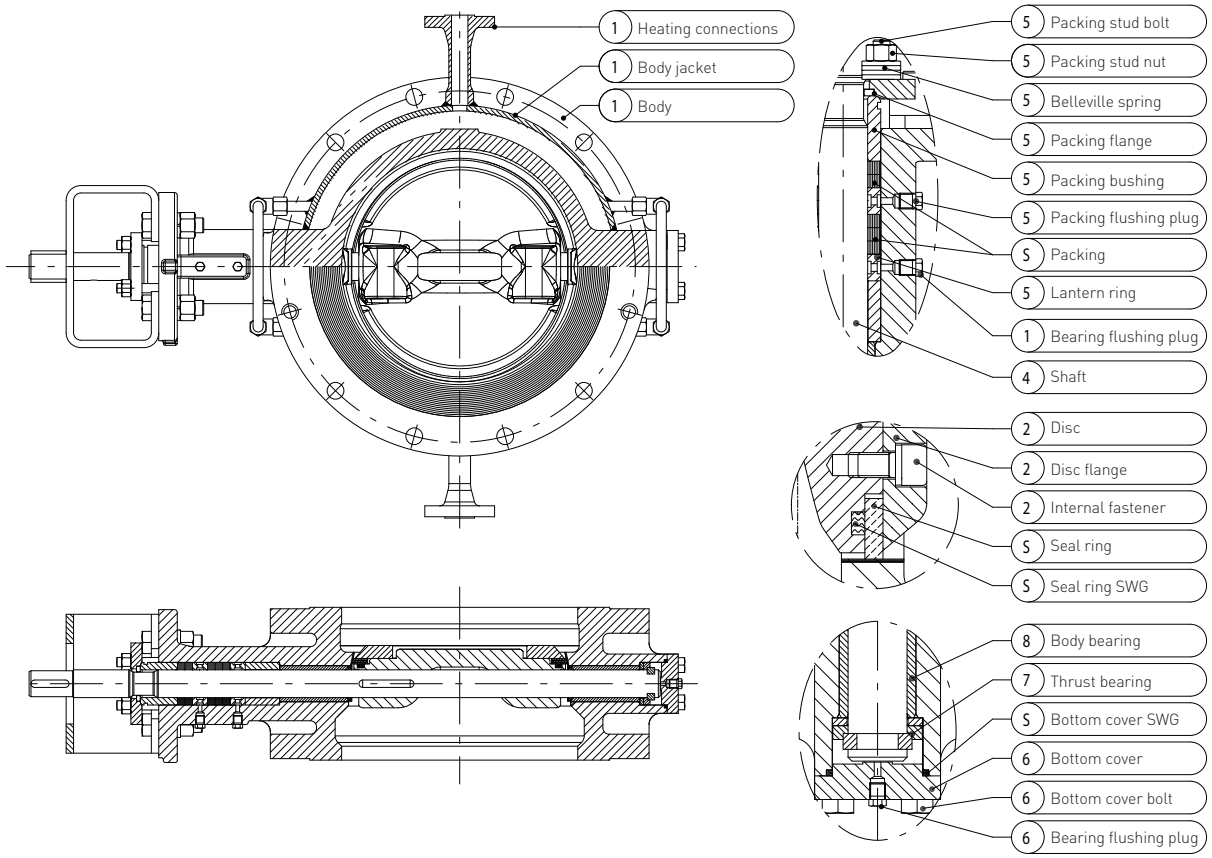
The sectional drawing and the relevant typical material selection represented on this page shall not be detached from the present document (VCBUL-13244-EN) nor used or distributed as a single document. BOMs are applicable depending on end user's pipe class, fluid composition (especially in regards to H2S content) and valve lifecycle acceptability/maintenance scheduling.

VANESSA SERIES 30,000 TRIPLE OFFSET VALVES

SECTIONAL DRAWING AND TYPICAL MATERIAL SELECTION – STAINLESS STEEL

Steam Jacketed Configuration

Stainless steel valve body bill of material: BOM DE01
Design temperature range: -60°C to 450°C (-75°F to 845°F)



GROUP	ITEM DESCRIPTION	ITEM MATERIAL
1	Body	ASTM A351 CF3M / CF8M
	Body seat facing	STELLITE® 21
	Body jacket*	ASTM A240 Type 316L or ASTM A182 Type 316L
	Heating connections	ASTM A182 Type 316L
2	Cast disc*	ASTM A351 CF3M / CF8M
	Forged disc	ASTM A182 UNS S31600 / UNS S31603 (F316 / F316L)
	Disc flange	ASTM A240 UNS S31600 / UNS S31603 (Gr.316 / Gr.316L)
	Internal fastener	ISO 3506 A4 (ASTM F738 grade A4)
4	Shaft**	ASTM A479 XM19 - UNS S20910 (NITRONIC 50®)
5	Packing flange*	ASTM A240 / A182 UNS S31600 / UNS S31603 (AISI 316 / 316L)
	Packing bushing*	ASTM A240 / A182 UNS S31600 / UNS S31603 (AISI 316 / 316L)
	Lantern ring	UNS S31600
	Plug	UNS S31600
	Belleville spring (option)	STAINLESS STEEL
	Packing bolt	ISO 3506 A4 (ASTM F738 grade A4)
	Packing nut	ISO 3506 A4 (ASTM F738 grade A4)
6	Bottom cover*	ASTM A240 / A182 UNS S31600 / UNS S31603 (AISI 316 / 316L) or ASTM A351 CF8M / CF3M
	Bottom cover bolt	ISO 3506 A4 (ASTM F738 grade A4)
7	Thrust bearing	UNS S31600 / UNS S31603 (AISI 316 / 316L) Hard faced
8	Body bearing	UNS S31600 / UNS S31603 (AISI 316 / 316L) Hard faced
	Bearing protector	Graphite ring
S	Packing •	Graphite
	Bottom cover spiral wound gasket •	UNS S31600 / UNS S31603 + Graphite
	Seal ring •	UNS S20910 (NITRONIC 50®) Hard faced - Solid
	Seal ring spiral wound gasket •	UNS S31600 / UNS S31603 + Graphite

Notes

Material of construction in accordance with:
NACE MR103 / ISO 17945 and
NACE MR0175 / ISO 15156 (see DT327 for additional detail).

* Materials are exclusively selected by the factory depending on valve size
** Special option: also available with steam tracing. See details on page 6
• Suggested spare parts

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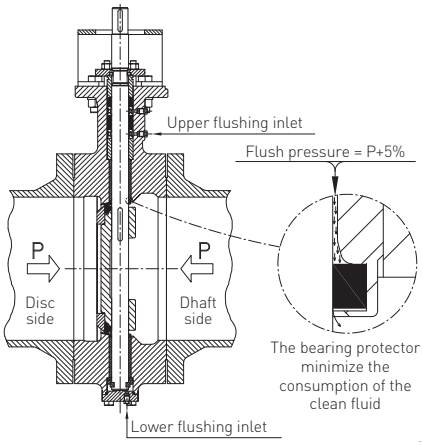
VANESSA SERIES 30,000 TRIPLE OFFSET VALVES
SULFUR RECOVERY SPECIFIC CONFIGURATION

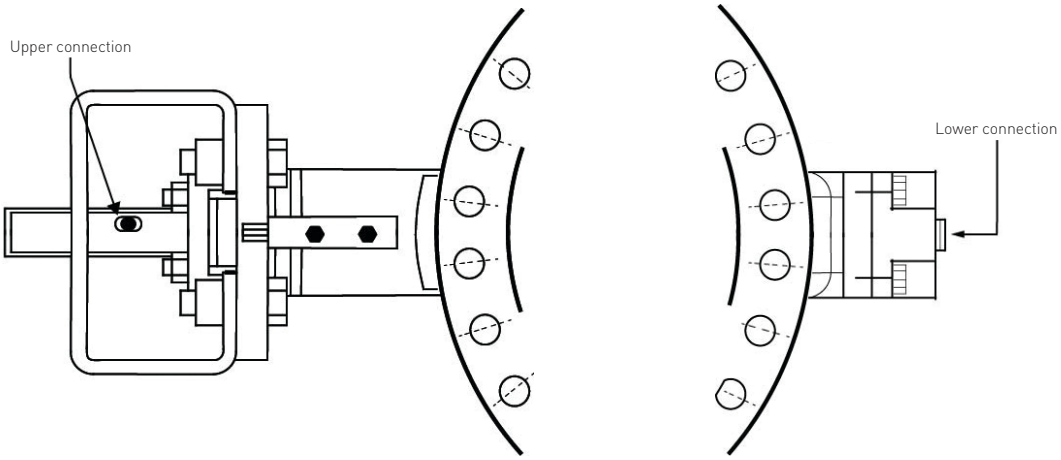
VANESSA TOV	CONFIGURATION
Design	The jacket is sized according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Subsection A, Paragraph UG-27. Plates are welded onto the valve body to form heating chambers around the body wall and cover the body hubs. Communicating jacket chambers are designed to P= 10 bar and T= 200°C typically for clean, saturated steam to maintain the maximum heating efficiency in the critical areas. Emerson Vanessa provides the bearing flushing device as an integral part of the steam jacketed configuration package.
Materials	The jacket material is ASTM A516 gr. 70 for valves with WCC body material and ASTM A240 type 316L for valves with CF3M/CF8M body material.



VANESSA TOV	SPECIFIC INSTALLATION
Design	To prevent any possible fluid deposit into the lower bearing areas and to avoid an increase in the operating torque, the jacketed valve installation is recommended with the shaft set in the horizontal position. The heating inlet should be connected to the upper connections and the outlet to the lower ones in order to allow the condensate to drain. In case of vertical installation, the system is provided with an auxiliary plug in the bottom area to drain condensate.

VANESSA TOV	MAINTENANCE
Bearing flushing	Liquid sulfur shall be flushed out of the bearing areas (suctioned) before any process shutdown and bearings shall be restored to a clean condition.

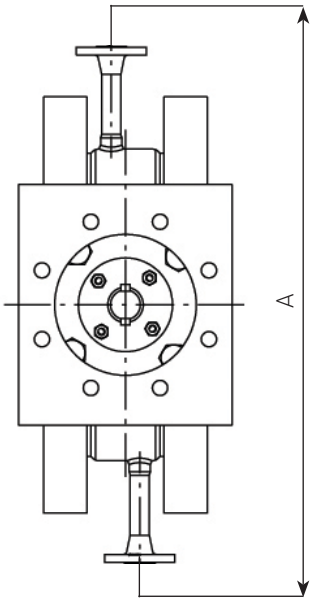
VANESSA TOV	OPTIONS
	** The shaft steam tracing prevents fluid crystallisation in the bearing areas



VANESSA SERIES 30,000 TRIPLE OFFSET VALVES

BODY JACKET FOOTPRINT

VALVE SIZE		CLASS 150	CLASS 300
DN	NPS	A	A
80	3	338	338
100	4	372	372
150	6	426	424
200	8	546	555
250	10	601	608
300	12	650	665
350	14	721	730
400	16	765	792
450	18	817	835
500	20	877	893
600	24	976	993



Notes

1. Class 150: Dp max 25 bar.

   Class 300: Dp max 50 bar.

   Double flanged valves with long pattern face-to-face according to ASME B16.10 Table 1 Col. 9 (ISO 5752 Table 1 Col. 3) and ASME B16.10 Table 1 Col. 11 (ISO 5752 Table 1 Col. 4) are also available. For details, please contact your nearest Emerson office.

2. **Heating connection flanges**

   Valve body with ASME drilling

   For NPS up to 12, the heating connection flange dim. is ½" Cl. 300 ASME B16.5, RF 125÷250 µinch.

   For NPS from 14 and larger, the heating connection flange dim. is ¾" Cl. 300 ASME B16.5, RF 125÷250 µinch.

   Valve body with EN drilling

   For DN up to 300 mm, the heating connection flange dim. is DN 15 PN 40, RF 12.5÷25 µm.

   For DN from 350 mm and larger, the heating connection flange dim. is DN 20 PN 40, RF 12.5÷25 µm.

3. Dimension "A" is applicable for the following valve body face-to-face standards:

   ISO 5752 Table 1 Col. 13

   ISO 5752 Table 1 Col. 14