

RELY ON EXCELLENCE

## DF-(P)DGS6 – Dry Gas Seal for multiphase pump applications

The innovative and unbeatable sealing solution for a low vapor margin, flashing hydrocarbons, liquid and supercritical CO<sub>2</sub> applications



DiamondFace



>80 %  
reduced pump leaks



>5 years  
seal service life



## Methane, ethane, ethylene, propane, carbon dioxide: Light vaporous media sealed safely – in every condition

### **Difficult environment:**

#### **Conventional seals are reaching their limits**

The pumps used in liquefied gas fractionation and in the pump stations of NGL (Natural Gas Liquids) pipelines are API 610 high-performance pumps, e.g. BB3 and BB5 process pumps, and vertical VS6 pumps. Traditionally the shafts of these machines are sealed with conventional liquid lubricated mechanical seals. To function correctly, the mechanical seals are reliant on stable operating conditions and continuous lubrication of the sliding surfaces.

NGL processes primarily pump light hydrocarbons (i.e. ethane and propane). In other processes, methane, ethylene, liquid and supercritical CO<sub>2</sub> are pumped. Temperature and pressure fluctuations can cause phase transitions between liquid and gas in conjunction with the low vapor pressure margin of the medium at the sealing surfaces. The consequential dry running will damage the mechanical seal and result in seal failure.

An additional cause of failure occurs for standby pumps: pump and seal are often under full pressure for long periods of time (sometimes for months). When the pump is started, the sliding faces of the seal come into direct contact with each other, run dry, and can be damaged or even destroyed.

**A better option:**

**DF-(P)DGS6 can do more than others**

Thanks to its broad and structured seal faces, the DF-(P)DGS6 runs contact-free and can operate in both modes: gas-lubricated as well as liquid-lubricated. And above all: the sealing system is extremely reliable. In addition to the robust design is the unique diamond technology of EagleBurgmann: DiamondFace.

Sliding faces with DiamondFace permit a much smaller sealing gap design. Minimal leakage during operation and optimal leak tightness during standstill – unrivalled by any other seal! Minimal leakage eliminates Joule Thomson effect related icing issues. Therefore, no external seal gas heater or buffer gas is required, which simplifies the seal supply system significantly. DiamondFace also makes the seal extremely robust in transient conditions where contact between the sliding faces can occur.

**This pays off:**

**DF-(P)DGS6 is consistently economical**

Noticeably improved plant availability through extended operating periods and significantly increased process reliability through superior seal technology are the advantages correlated with the use of an EagleBurgmann DF-(P)DGS6. As a result, we have achieved an increase in MTBR (Mean Time Between Repair) intervals from several weeks or months to more than 5 years. Resulting in a rapid return on investment (ROI).

In use, the DF-(P)DGS6 shows additional strengths: the seal exhibits low power consumption, has a convincing low leakage rate and does not require an oil supply. They are mostly operated with API Plan 76. Plan 02, 12, 13, 32, 72 and 75 are optional, depending on application and customer requirement. Plan 11 or Plans with cooler (e.g. 21, 22, 23) are not recommended.

## DF-(P)DGS6 API plans

### Recommended

- Plan 76

### Optional, depending on application

- Plan 02
- Plan 12
- Plan 13
- Plan 32
- Plan 72
- Plan 75

### Not recommended

- Plan 11
- Plans with cooler e.g. 21, 22, 23



More information on all API piping plans can be found here

# The reliable solution: EagleBurgmann DF-(P)DGS6

## Features

- Primary seal faces with DiamondFace
- Fully operational in both liquid and gas phases
- Stiff sealing gap creates necessary heat and doesn't require additional heating
- Shrouded rotating ring
- Bi-directional
- Ready-to-fit cartridge unit
- Single, double, tandem and tandem seal with intermediate labyrinth available

## Advantages

- DiamondFace sliding surface technology enables multiphase compatibility (liquid, gaseous, supercritical)
- Ideal upgrade solution for wet mechanical seals with dry running problems
- Simple set up: seal gas heating and nitrogen buffer is not required
- Significantly lower leakage rate which avoids also icing problems with CO<sub>2</sub> and ensures low emission rate
- Extended life span
- High gas film stiffness in all operating modes
- Proven, reliable and economical solution
- Can be adjusted to extreme narrow installation space - retrofits are easy to implement

## Standardized operating range\*

Shaft diameter: D = 32 ... 154 mm (1.26" ... 6.06")

Pressure: p = 0 ... 120 bar (1,740 PSI)  
with PTFE option: 0 ... 250 bar (3,625 PSI)

Temperature: t = -46 °C ... 150 °C (-51 °F ... 302 °F)  
with PTFE option: -100 °C ... +200 °C (-148 °F ... +392 °F)

Sliding velocity: v<sub>g</sub> = 0.6 ... 140 m/s (2 ... 459 ft/s)

\* For applications outside the standardized operating range,  
please contact us.

## Materials

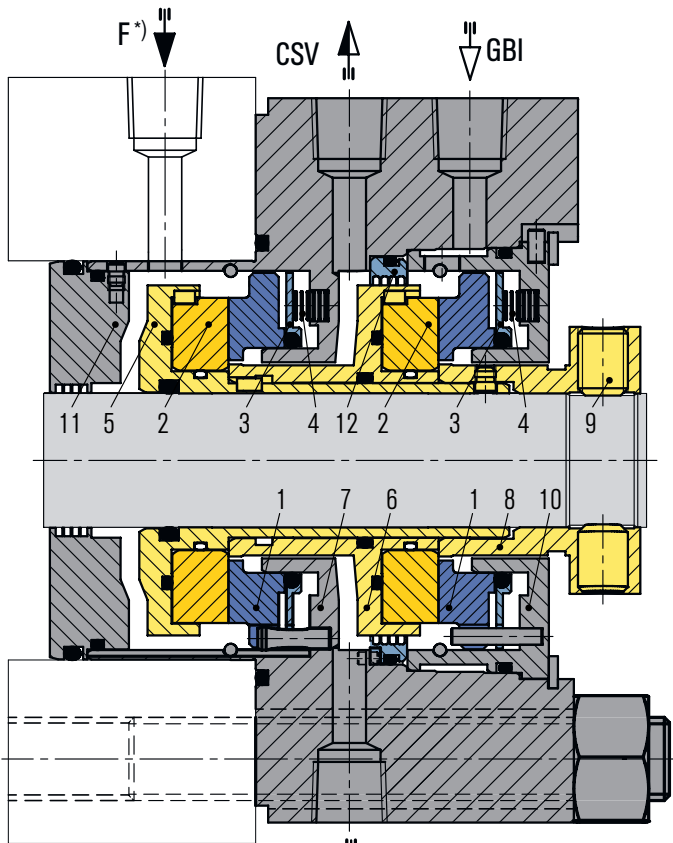
Primary seat and seal face: Silicon carbide with  
DiamondFace

Secondary seat and seal face: Silicon carbide with  
DLC coating or optional DiamondFace

Secondary seals: FKM, FFKM, PTFE (DF-PDGS6) or other  
elastomers, depending on product gas composition

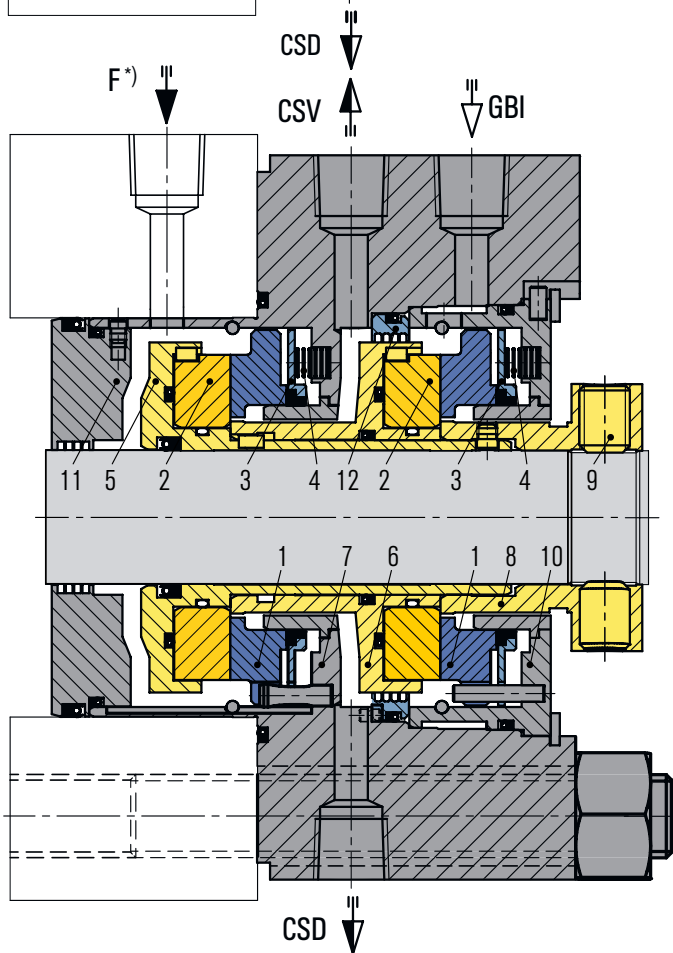
Metal parts: 1.4006(410) and other stainless steels





### DF-DGS6

Standard design with elastomers



### DF-PDGS6

For high pressure and both low and high temperature applications; with U-cups and special dynamic sealing elements; secondary seals made of PTFE

Well suited for CO<sub>2</sub> applications

#### Item description

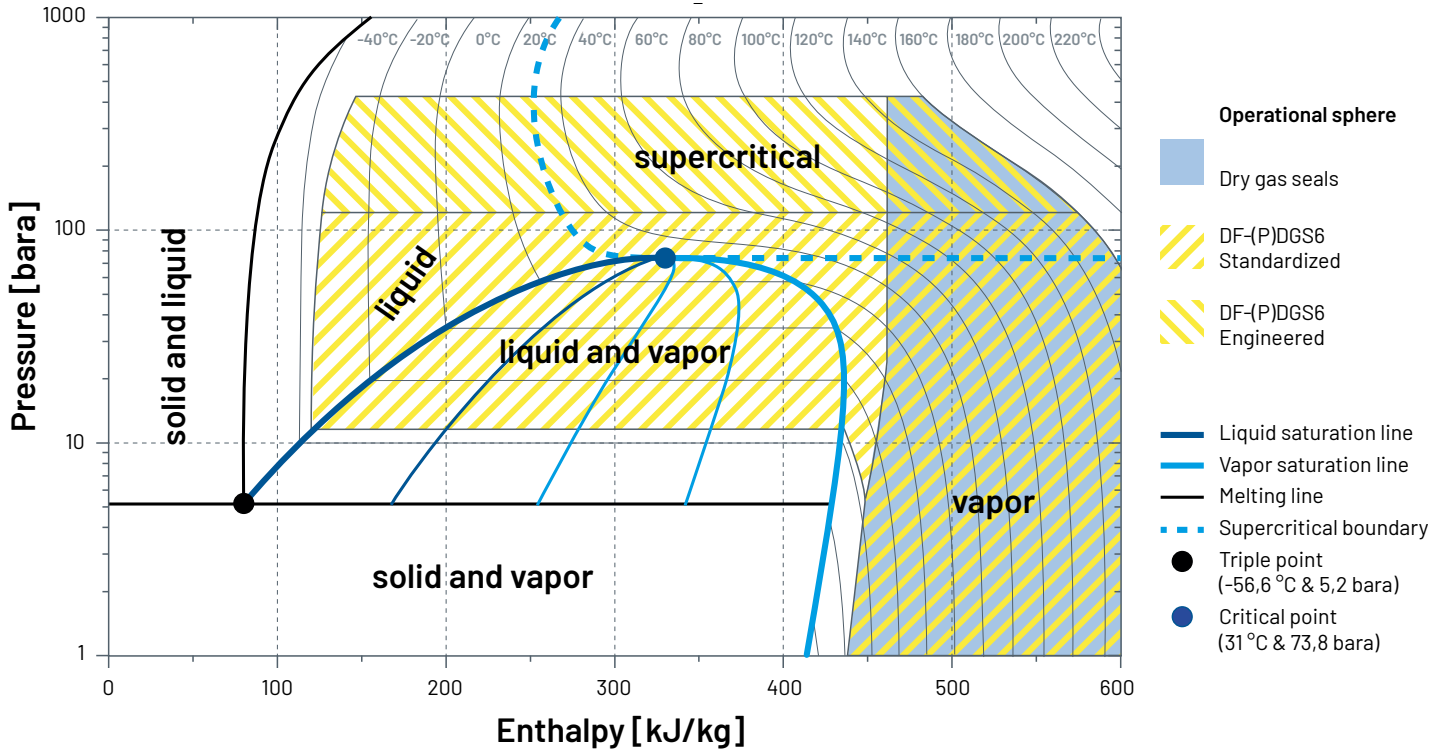
- |     |   |
|-----|---|
| 1   | Seal face, stationary - primary seal face with DiamondFace* |
| 2   | Seat, rotating - primary seat with DiamondFace*             |
| 3   | Thrust ring   |
| 4   | Spring  |
| 5   | Shaft sleeve  |
| 6   | Intermediate sleeve   |
| 7   | Housing (adapted in size to the installation space)         |
| 8   | Clamping sleeve   |
| 9   | Set screw   |
| 10  | Adapter   |
| 11  | Process side labyrinth                                      |
| 12  | Internal labyrinth  |
| F   | Flush - optional  |
| CSV | Containment seal vent                                       |
| CSD | Containment seal drain                                      |
| GBI | Gas buffer inlet  |

\*optional secondary seal face and seat also with DiamondFace

Yellow colored seal parts are rotating, blue are stationary, gray parts: housing

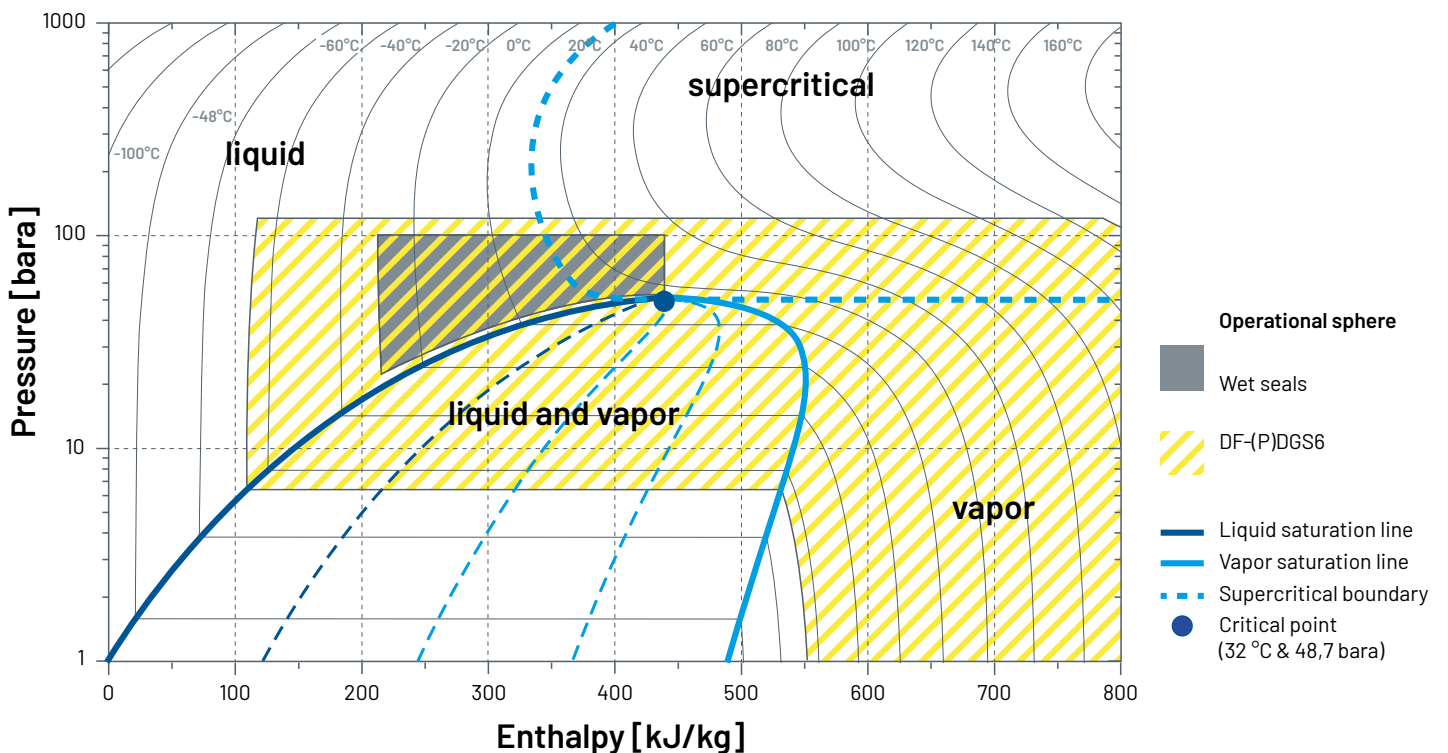
### Pressure vs. enthalpy phase diagram CO<sub>2</sub>

In the transcritical area, above the critical point, physical properties change rather smoothly with pressure and temperature. Inside the „dome”, properties change significantly when moving towards and eventually crossing the liquid saturation line. The dome is bounded by the two saturation lines „liquid” and „vapor”. In the supercritical region, sCO<sub>2</sub> adopts properties midway between gas and liquid. Even in the liquid phase, CO<sub>2</sub> retains certain properties more like a gas.



### Pressure vs. enthalpy phase diagram ethane

The properties of ethane are such that no longer a solid phase has to be considered but a substantially increased liquid and vapor phase.





## DiamondFace: Innovative sliding surface technology for maximum operational performance of pump and compressor seals

DiamondFace is an innovative microcrystalline diamond technology for mechanical seals. It is characterized by extreme hardness, high wear resistance, excellent heat conductivity, maximum chemical resistance and low friction coefficients. The coating adhesion also exceeds all known practical requirements. For example, this makes partial dry running possible while increasing the lifespan of mechanical seals by many times, prolonging the maintenance intervals and significantly reducing the life cycle costs.



Video: DiamondFace



**To date more than 700 seals of the type DF-(P)DGS6 are shipped in gas processing applications, sCO<sub>2</sub> power cycles, CO<sub>2</sub> pipelines and injections, NGL fractionation, NGL pipelines and in ethylene applications. We would be pleased to provide you with additional references upon request.**

- CO<sub>2</sub> pumps in USA were successfully sealed by DF-PDGS6 seals in different sizes. Operating conditions: p = 89 ... 152 barg (1,289 ... 2,202 PSIG), t = +9 °C ... +33 °C (+49 °F ... +92 °F), n = 5,650 ... 5,980 min<sup>-1</sup>
- EagleBurgmann equipped NetPower CO<sub>2</sub> pumps in Texas, USA, successfully with DF-PDGS6 seals in different sizes. Operating conditions in multiple services: p = 100 ... 158 barg (1435 ... 2,202 PSIG), t = +9 °C ... +33 °C (+50 °F ... +90 °F), n = 5,650 ... 5,980 min<sup>-1</sup>



See 360° virtual tour

- Ethane pumps which are applied in a fractionation plant in Mont Belvieu, Texas, USA (picture above) have been sealed successfully by EagleBurgmann DF-DGS6/98-ZT1-U seals since July 2011. The seals with DiamondFace technology provide much longer operational life with very low leakage compared to the originally used liquid-lubricated seals. Operating conditions: p = 41 ... 50 barg (590 ... 725 PSIG), t = -13 °C ... +21 °C (+9 °F ... +70 °F), n = 3,570 min<sup>-1</sup>
- A number of EagleBurgmann DF-DGS6 seals in different sizes and operating conditions are installed in pumps of several OEMs in fractionation plants, which process mixed NGL streams into purity NGL products like ethane, propane etc. These pumps are located throughout USA.
- PetroRabigh operates monomer recovery pumps in Saudi Arabia in which DF-DGS6/56-ZT2-U seals are successful in operation since 2019. Operating conditions: p = 20 barg (290 PSIG), t = -20 °C ... +40 °C (-4 °F ... +104 °F), n = 1,780 min<sup>-1</sup>
- DF-(P)DGS6 seals in different sizes and operating conditions performing successfully since 2014 in ethylene plants of several endusers and pump manufacturers in USA.

## EagleBurgmann – Leading Innovation in Sustainable Sealing Solutions

We are your leading international specialist in industrial sealing technology. We combine innovative technologies, digital solutions and our passion and enthusiasm to create sophisticated and reliable sealing systems. Our products help make entire industries safer and more sustainable. 6,000 employees create added value for our customers around the world with their enthusiasm and competence. EagleBurgmann is a joint venture between the German Freudenberg Group and the Japanese Eagle Industry Group.

**Rely on excellence.**



**More than 100 service centers worldwide**

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