DICKOW PUMPEN

*our contribution for environmental protection*

# Process Pumps
# acc. to API 685 2nd Edition
# Type PRM / PRMW

## General

Magnetic coupled DICKOW-pumps of the series PRM according to API 685 are heavy duty sealless pumps. The containment shell forms a closed system to separate the pumped liquid from the atmosphere by confined gaskets.

The equipment (including auxiliaries) is designed for a minimum service life of 20 years (excluding normal wear parts) and an uninterrupted operation of at least 3 years.

## Application

Magnetic coupled PRM-pumps improve plant and personnel safety and reduce maintenance costs, because 90% of these costs are caused by leaking seals. The PRM-pumps will handle nearly all kinds of liquids in the chemical and petrochemical industry, in refineries and industrial heating plants. Especially liquids which are toxic, flammable, bad smelling or which react on contact with the atmosphere, that means if no leakage is acceptable. For all these services the magnet coupling replaces the double acting mechanical seal with its external supply system and the related instrumentation.

The performance range of the PRM-pumps is subdivided such that the best efficiency is guaranteed for all service conditions.

Maximum capacity and head:

50 Hz: 900 $m^3$/h and 150 m
60 Hz: 1000 $m^3$/h and 215 m
(4400 gpm and 700 ft)

## Design

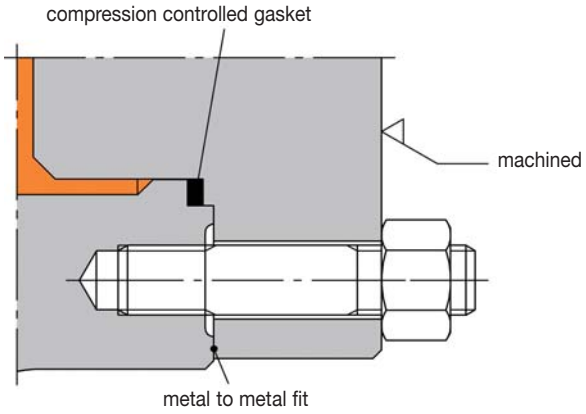
The PRM-pumps are end suction, top discharge, single stage, radial split volute casing pumps of back-pull-out design with closed impellers. The mechanical design meets the API 685 requirements.

The bearing bracket design allows the removal of the complete unit including outer magnets and ball bearings without stress relieving the pump or exposing the handled fluid to the atmosphere.

## Volute casing

The standard volute casing is cast en bloc and centerline supported.

The pump casing forms - together with the containment shell - the pressure retaining pump part. Maximum allowable pressure at PT is determined by the shell design and the material. The pump casing has metal-to-metal fits with confined compression controlled gaskets.




Pump flanges are full or spot faced on the back and designed for through-bolting.

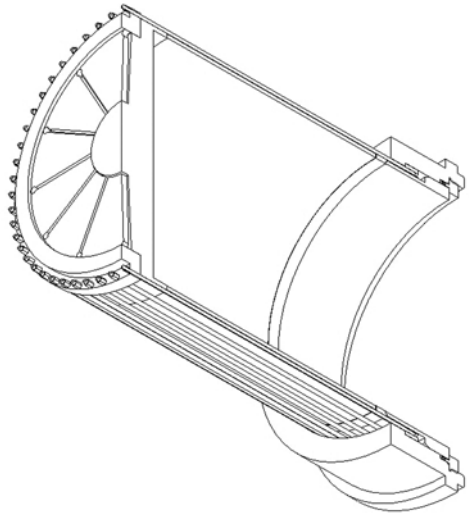
## Containment shell

The containment shell is a pressure vessel to separate the pumped liquid from the atmosphere only. The shell is not used as an additional bearing holder. Therefore, no dynamic stress occurs.

The standard containment shell is a one piece deep-draw design without additional welds made of 2.4610 (Hastelloy C).

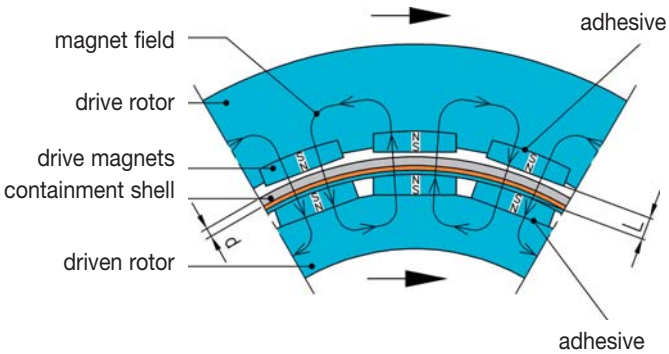
Other available material options are:

- Zirconium oxide (industrial ceramic) without eddy current losses.
- PEEK composite (carbon fibre reinforced Polyetheretherketon) without eddy current losses.
- Titanium for high pressure applications.
- Segment containment shell with duplex segment rings (design SCS) or zirconium oxide tube (design SZCS) for high power and high pressure applications.



**Magnet coupling**

The single elements of the multipolar magnet coupling are permanent magnets made of Cobalt Samarium. Power is transmitted by a magnet field, built up by the outer and inner magnets, through the containment shell. This kind of magnet coupling is working synchronous without slip and transmits the required torque to the impeller.

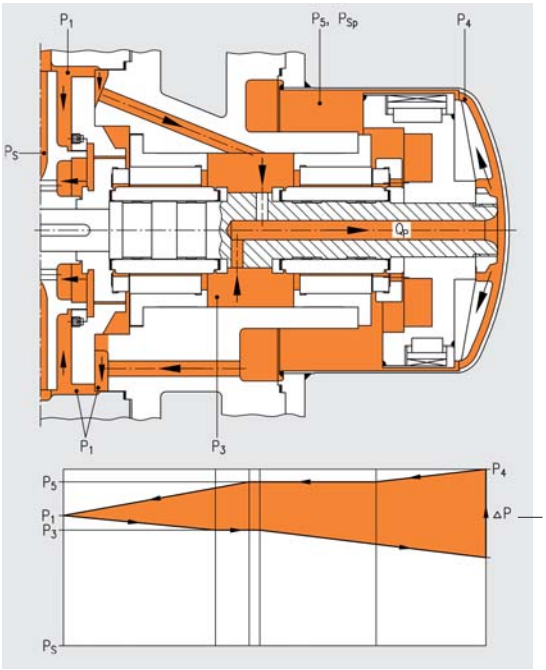



The couplings are designed to transmit rated motor power up to 220 kW (295 hp) at 2900 rpm, respectively 260 kW (348 hp) at 3500 rpm.

The couplings are sized to fit the maximum power consumption of the rated impeller and allow also at least 5% increase of the installed impeller diameter. If nothing else is specified, the magnet coupling is sized for direct-on-line starting of the electric motor.

**Internal cooling flow from discharge to discharge**

In the magnet coupling, eddy currents and friction losses are generated which lead to heat and cause temperature rise.
To dissipate this heat and to cool and lubricate the sleeve bearings, the PRM-pumps use a internal cooling flow with the pumped liquid in standard execution.

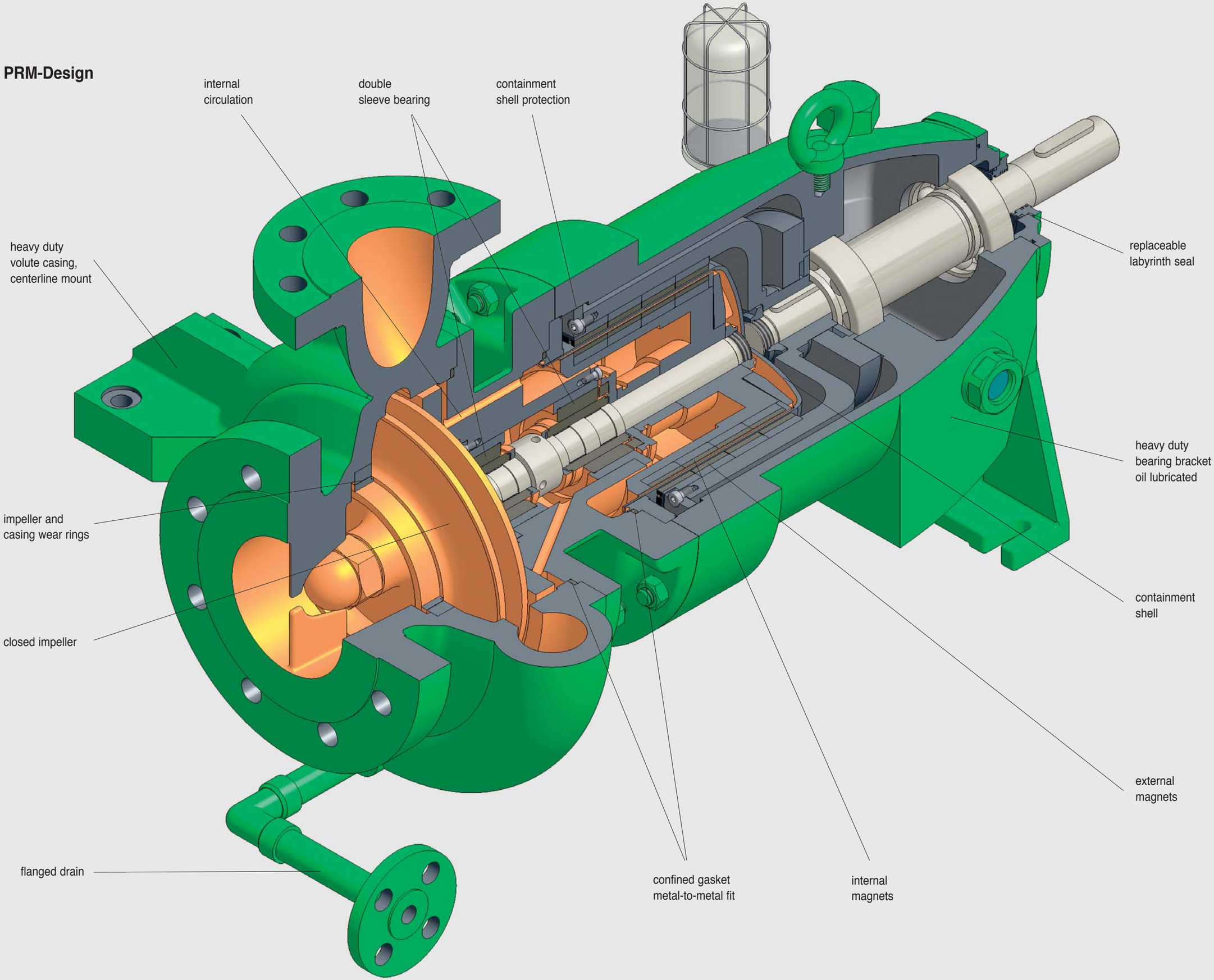



The cooling flow is led from the discharge side behind the impeller into the chamber between the slide bearings and through the pump shaft via the auxiliary impeller again to the discharge side. This design pressurizes the slide bearings and the containment shell with nearly the full discharge pressure and the product remains stable in this area.
The internal cooling flow works without auxiliary piping, no additional thread or flange connections are available.

In case of solid handling the following options are available:

- external circulation through edge type filter from discharge to magnet coupling
- external flush

## PRM-Design


internal
circulation
double
sleeve bearing
containment
shell protection
heavy duty
volute casing,
centerline mount
replaceable
labyrinth seal
heavy duty
bearing bracket
oil lubricated
impeller and
casing wear rings
closed impeller
containment
shell
external
magnets
flanged drain
confined gasket
metal-to-metal fit
internal
magnets

### Double sleeve bearings

The pump shaft is carried by wetted sleeve bearings. Standard material is pure Silicon Carbide with diamond layer, providing limited dry-run capability. SiC is highly resistant to corrosion and wear and can be used for all kind of liquids, also for solid containing products. The SiC-components are shrinkfitted and therefore protected against shock and thermal stress. Both sleeve bearings are bolted in one common bearing housing to grant a correct alignment.

### NPSH-conditions

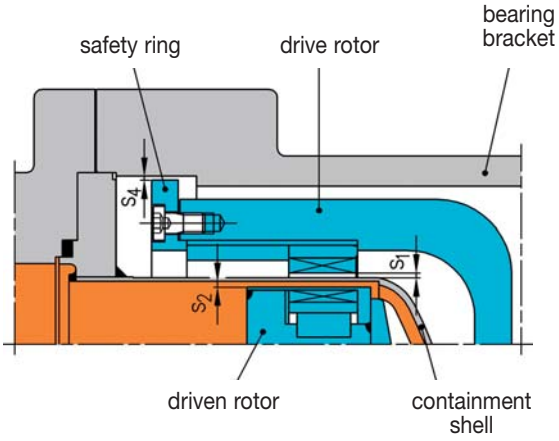
Due to the internal circulation from discharge to discharge, there is no temperature elevation in the impeller eye. Handling of boiling liquids is therefore possible and there is no increase of NPSH-required.

### Balanced thrust loads

The thrust loads of the closed impellers are hydraulically balanced by wear rings, balance holes, back vanes and / or auxiliary impeller. The pump shaft connected to the impeller is floating.

### Containment shell protection / internal clearances

The clearance between the rotating drive magnets and the stationary containment shell is larger than the clearance between the rotating safety ring and the bearing bracket. This prevents containment shell rupture in case of ball bearing failure.

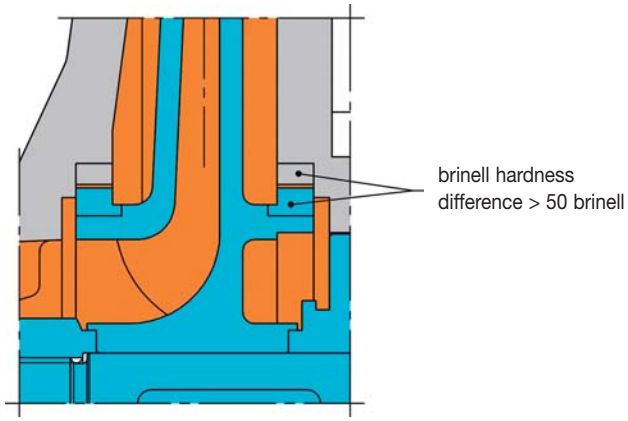



$S_1 > S_4$, $S_2 > 1{,}25$ mm

Due to the radial clearance $S_2 > 1{,}25$ mm the pumps can handle non-metallic (non-ferrous) particles in the fluid up to 1,0 mm.

### Wear rings

Renewable wear rings are furnished on both the casing and the impeller.
Front and back wear rings are part of the axial balancing system.




Mating wear surface materials have a difference in Brinell hardness of at least 50 HB.

### Monitoring

Connection for temperature detection element for containment shell surface temperature is available as standard. Dry running protection and monitoring of ball bearings and containment shell temperature with the patented "mag-safe" system is highly recommended.

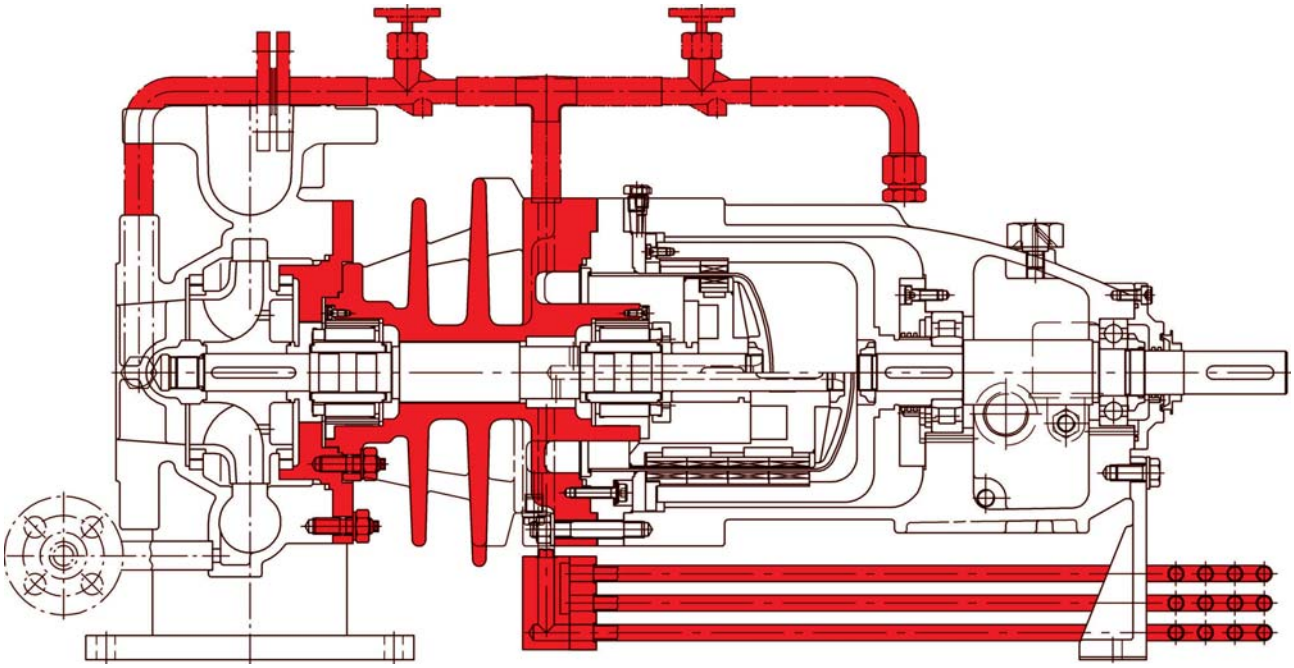
### Drain connection, venting

The complete pump can be drained by the drain connection at the bottom of the volute casing. There is no separate drain connection in the magnet end. The PRM-pumps are self-venting. No air or gas will remain in the magnet end when filling suction and discharge pipe. Exception is taken for PRMW hot oil pumps where magnet coupling must be vented.

### Antifriction bearings

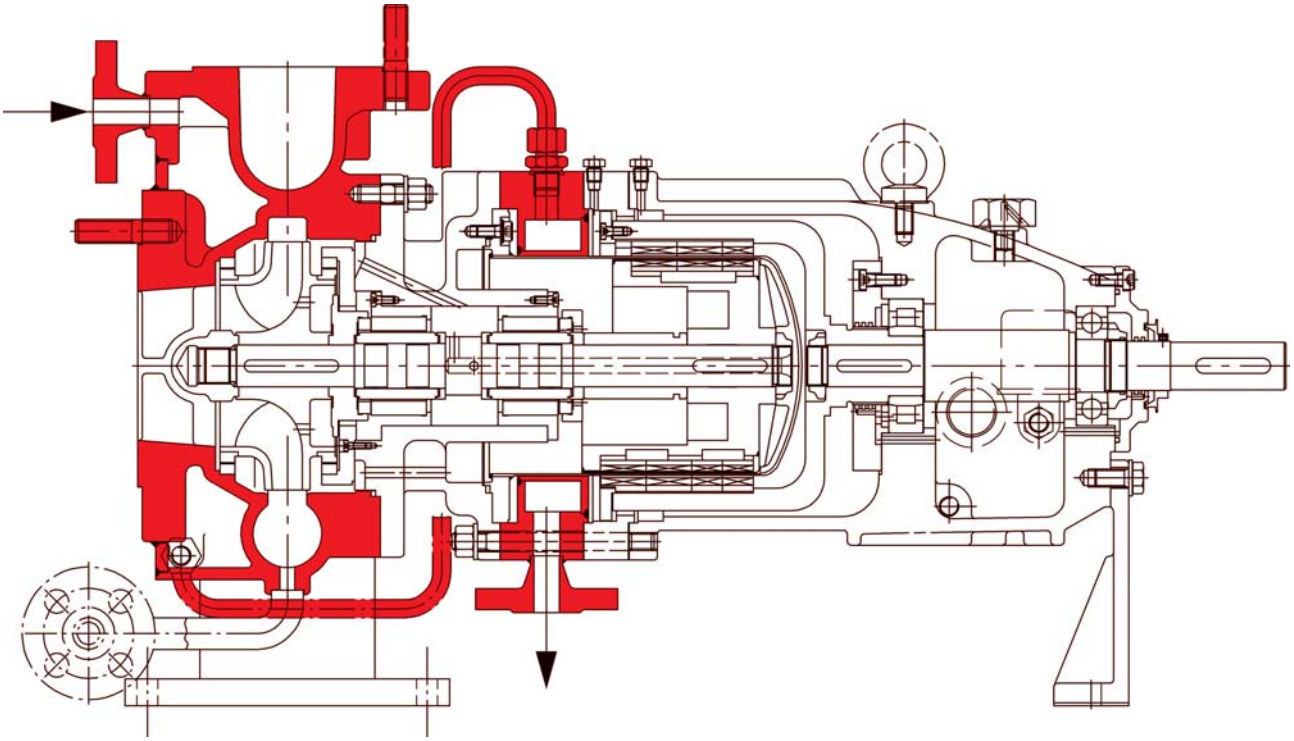
The outer magnet shaft is fitted with generously dimensioned antifriction bearings. The bearings are L10 rated for an average life in excess of 3 years. The oil bath is protected against the atmosphere by replaceable labyrinth seals. Oil level is controlled by a constant level oiler and additionally by a bull's eye sight glass. Oil mist lubrication is available as an option.

**Hot oil pump, type PRMW with air cooler**



For handling heat transfer fluids up to 400°C (750°F) the PRMW-design with air cooler reduces the fluid temperature in the magnet area to maximum 250°C (485°F) and keeps away dirt and pipe scale from the magnetic coupling.

**Pump with heating jacket, type PRM b**



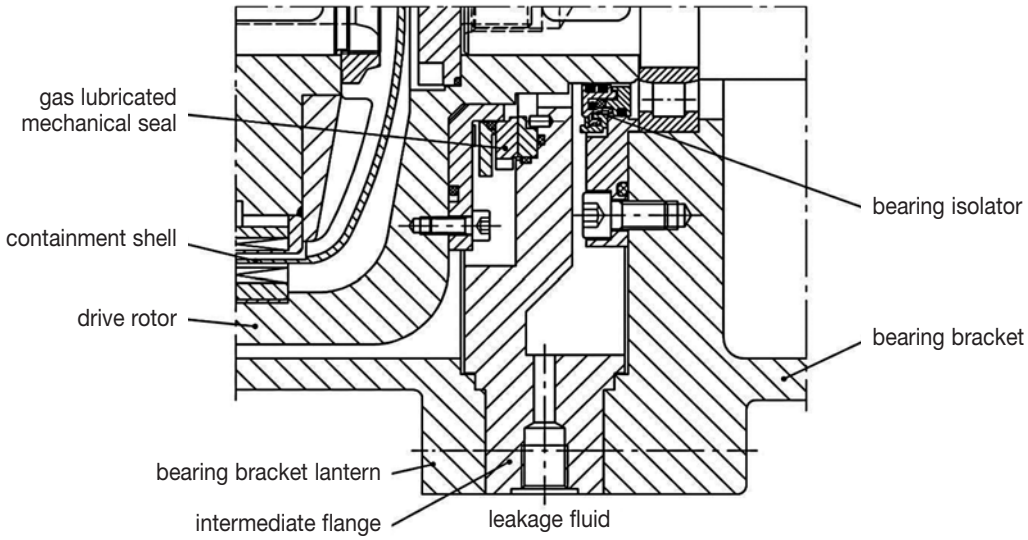
For handling fluids with melting temperature above ambient.
Design data for heating jacket 24 bar / 250°C (485°F).

**Secondary control / containment**

**Secondary control design**

Minimization of release of pumped liquid in the event of failure of the containment shell.

Gas lubricated stand-by mechanical seal, design "CGS":

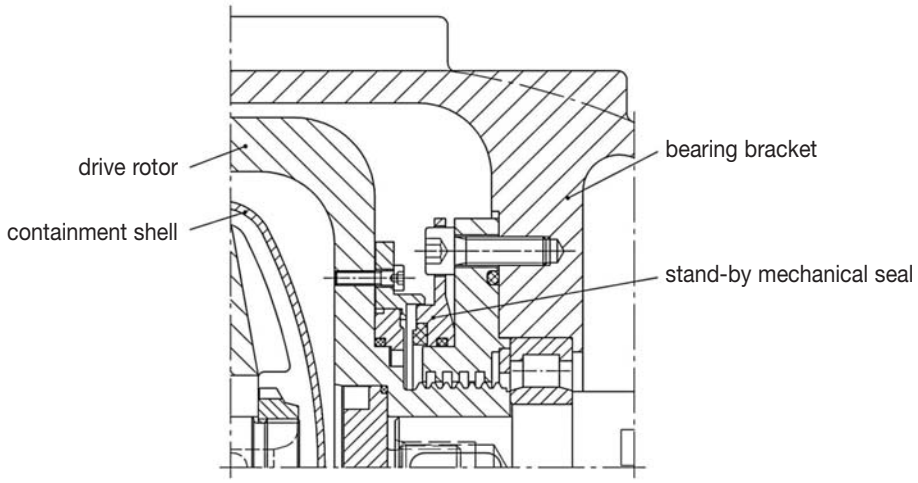



- Gas seal can operate up to 24 hours in case of failure.
- Occuring leakage in case of failure must be drained externally.
- Leakage monitor is required.

**Secondary containment design**

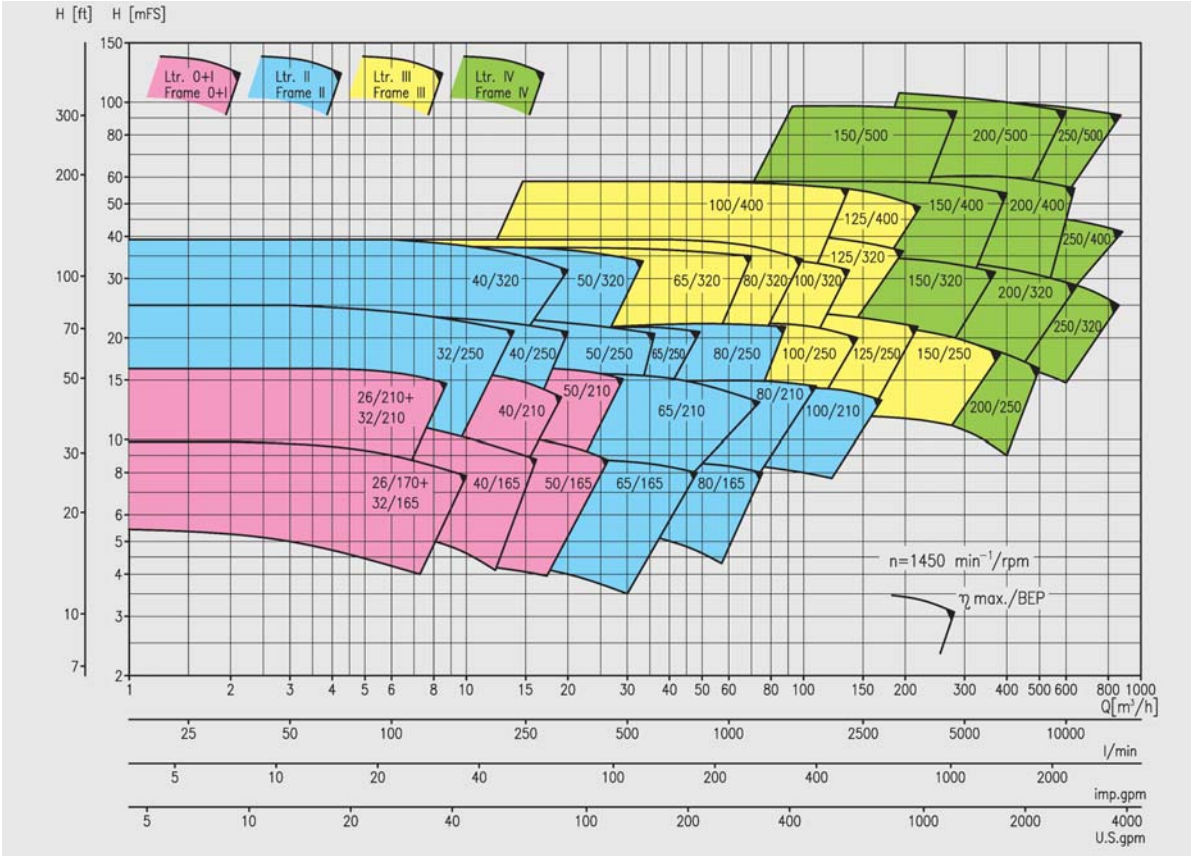
Confinement of the pumped liquid within a secondary pressure casing in the event of failure of the primary containment shell.

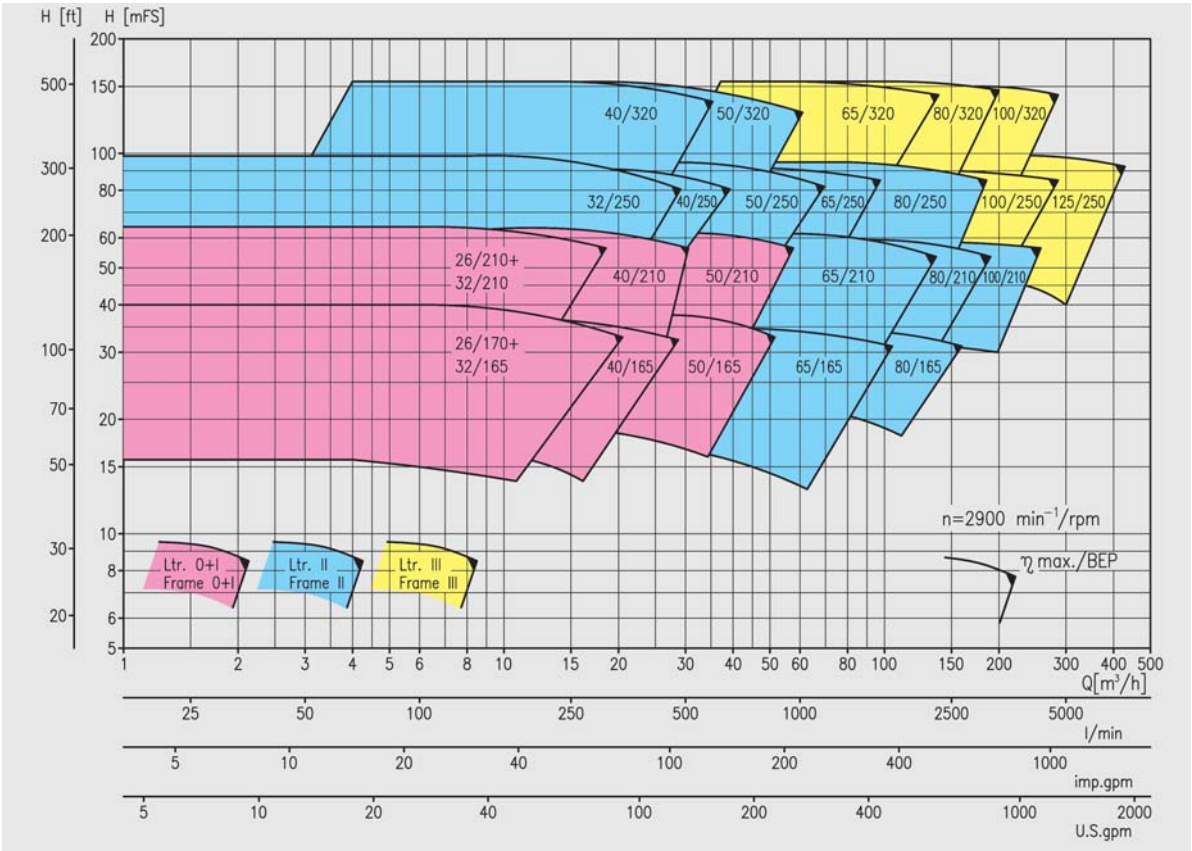
Dry running stand-by mechanical seal, design "Ge":




- in case of pressure increase by 50 kPa seal faces will close.
- Pump must shut down immediately in case of failure.
- Leakage monitor is required.

## Performance range - 50 cycles




Performance curves for the different pump sizes are available on request.

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