

PRP-Keto EZ™ Seal Systems:

1.0 Background Discussion

Many people want the leak free advantages mechanical seals have to offer in 'clean' solutions extended to slurry pump applications. These advantages include:

- (i) No spillage or leakage for improved safety.
- (ii) Reduced pollution and environmental damage.
- (iii) Easier to maintain pumps as parts aren't covered in slurry.
- (iv) Better energy efficiency than expellers and packed glands.
- (v) Significantly less flush water consumption.

Our aim is to offer the advantages listed above with a mechanical seal that is similar in price to a set of gland packing with shaft sleeve. The seal can then be changed during shuts with a similar philosophy to replacing gland packing and other wet end parts.

1.1 Drawback of Gland Packing: Gland packing is changed during every shut along with the shaft sleeve and requires constant attention. In slurry applications they also consume significant amounts of flush water. When the impeller to throatbush clearance is adjusted, the grooves worn into the sleeve by the packing become misaligned and excessive packing leakage often occurs (leading to many sites not adjusting the pumps for peak efficiency and longevity).

1.2 Drawback of Expellers: Expellers can only be used in services with limited suction pressures, and when the expellers are set to work most efficiently, the increased clearance between the throat bush and impeller results in more slurry 'slippage' between discharge and suction pressure. The consequence of the higher slippage is that the pump becomes less energy efficient, absorbs significantly more power, and has increased wet end wear.

1.3 Drawback of Mechanical Seals: To date, reliable slurry mechanical seals have proven to be extremely expensive for two main reasons: the highly specialised design required when the seal faces are in direct contact with a high content of solids; and secondly they need to cope with the extremely high run outs and tolerances found in heavy duty slurry pumps (that were not designed with mechanical seals in mind).

In contrast the mechanical seals used in pumps that have less arduous 'clean' or slightly turbid liquids, particularly when the pumps have been designed for mechanical seals are known to be extremely reliable.

1.4 Slurry Pump Run Outs and Tolerances: Conventional slurry pump designs locate the bearing assembly into the base. The seal adaptor (or packed gland or expeller) is spigoted into the frame plate and in turn into the base. The bearing

assembly and seal chambers therefore rely on different locations to align them in the pump. When components corrode, particularly the saddle where the bearing assembly sits into the base, there are massive run outs and concentricity issues for conventional mechanical seals to cope with. Several mm has been measured during repair of competitor pumps in our facility.

1.5 Site Wants for Mechanical Seals: Many sites wanted the advantages mechanical seals have to offer but reported:

- (i) Specialised slurry mechanical seals needed major modification of the pump. An impeller with the back vanes removed and a special frame plate liner or frame plate liner insert was often needed. This resulted in non-standard inventory and caused sites to keep stock of two different styles of wet end parts: one to suit packed glands and expellers; the other to suit mechanical seals.
- (ii) Impellers without back vanes (filled or removed) result in a very high pressure in the seal chamber for the seal to operate against. It was recommended that if a flush was used that its pressure was above the maximum discharge pressure of the pump (as the back vanes no longer existed that enable lower seal chamber pressures).
- (iii) As removal of impeller back vanes result in a higher pressure on the seal side of the impeller it thereby results in a force which increases the thrust bearing loads.
- (iv) Impeller boss caps were often prematurely damaged when 'opened' throats were used in slurry seal applications.
- (v) Expensive mechanical seals were often damaged during the normal site 'shuts' when the wet end parts were replaced.
- (vi) The specialist mechanical seals with change over parts were long lead time items.

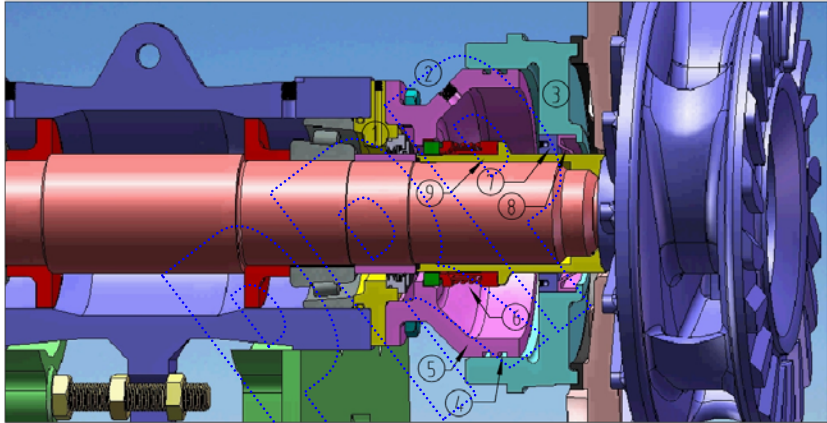
Slurry pumps with packed glands use a significant amount of water flush. Instead of using water to flush packed gland pumps, a substantially lower water flush flowrate (around 1/10th of the flow) can be used to cool a heavy duty turbid service mechanical seal.

After listening to site demands, PRP have developed and patented a seal chamber for use in our slurry pumps which enables lower cost more conventional mechanical seals to be fitted: The PRP EZ™ Seal System.

PRP EZ™ Seal System

Flow Control Valve and Relief Valve Not Shown.

Item	Part No	Matl.	Rev Description
1	LKIT-E		PRP Labyrinth Upgrade Kit
2	CV-5	316/EPDM	Constant Flow Control Valve (5 l/min)
3	MSA-E	DI21	Mechanical Seal Adaptor
4	MSAOR-E	EPDM	O Ring
5	MSC-E	M05	Mechanical Seal Chamber
6	MS-E	SIC/SIC/EPDM	Mechanical Seal SIC/SIC/EPDM
7	RB-E	PEEK	Restrictor Bush
8	LIP-E	EPDM	Flush Loss Seal
9	SLV-E/EMS	420SS	Easy MS Shaft Sleeve



Rev No	Date	By	Rev Description

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TITLE: General Arrangement Drawing
G&E HS with PRP EZ Mechanical Seal
W SERIES: PUMP

SCALE: 3/32"=1"
DATE: 23/05/07
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The PRP mechanical seal chamber (5) spigots directly onto the standard well proven LKIT (1) also designed and manufactured by PRP. Refer our catalogue for further details of the PRP LKIT, which is a high quality non-contacting labyrinth with no piston rings or lip seals. This results in the mechanical seal (6) now being kept concentric with run outs and tolerances well within the limits of standard mechanical seals.

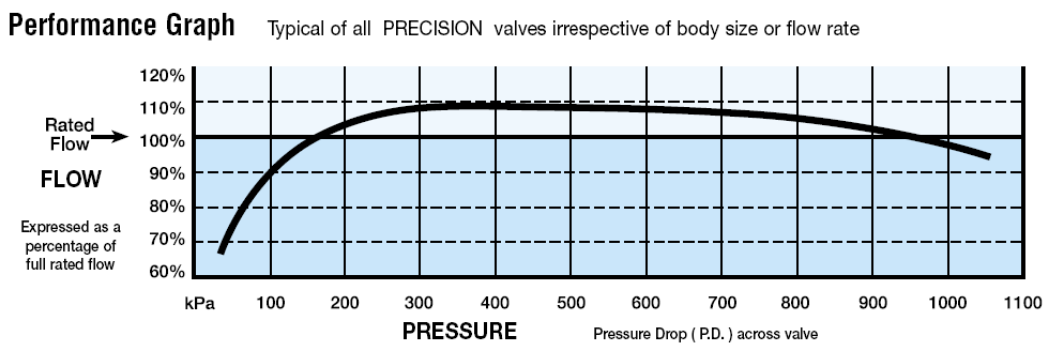
Additionally, instead of using the spigot in the frame plate to locate the mechanical seal adaptor (3), which in other designs results in significant concentricity problems when the saddle in the base corrodes, our design locates the seal adaptor (3) using the flow restricting bush (7).

The mechanical seal faces have also been located at a spot with minimal shaft overhang, resulting in virtually no shaft deflection at the seal faces even during the most unfavourable pump operating conditions.

The shoulder on the shaft sleeve (9) means the mechanical seal (6) is self setting and will retain the correct working length when the impeller is adjusted against the throat bush. As the impeller adjustment is possible without the hassle of setting clips and the like, the pump can be kept at optimum efficiency and the wear life of the wet end parts, particularly the impeller and throat bush, can be increased.

By using a constant flow control valve (2), with inbuilt check valve, the seal chamber pressure is maintained to a pressure above the pressure in the wet end of the pump. This way the flow through the seal chamber to cool the mechanical seal is controlled, and it automatically compensates against changes in suction pressure and wet end wear. As the water flow is always present through the mechanical seal chamber, passing through the flow restricting bush (7) and under the flush loss seal (8) into the wet end, the seal chamber and all its components are sealing against water. The flowrate is less than 1/10th of the flow used in normal packing applications!

The flush water pressure needs to be available at a minimum 150kPa or 100kPa above the maximum pump discharge pressure, whichever is higher. The valve supplied by PRP with the EZ™ seal system automatically opens and closes to maintain a constant flow through the seal chamber no matter what the wet end pressure is as detailed in the below performance graph.



A reed switch can be fitted in the flush water line to alert of flush water loss, however even in such an event, the flush loss lip seal (8) will close and prevent reverse flow of slurry into the seal chamber. It also keeps the seal chamber clean when the pump is offline. This 'disaster' flush loss seal is in fact the same slurry design lip seal as already well proven and used in expeller applications.

Additionally, the positive water pressure in the seal chamber enables the mechanical seal to cope better during unfavourable conditions such as those found during cavitation, on high suction lift applications and even lets the pump run dry without damage!

1.7 Explosion Protection: If *any brand* of slurry pump gets 'bogged' (the suction and discharge line become blocked) the action of the impeller turning heats the slurry (like Latents Paddle Wheel experiments). If there is sufficient energy available, the slurry can boil, form steam, and as the steam has nowhere to escape, the internal pump pressure can rise to the point that the *pump can explode*. Without a pressure relief device, this is the case with ANY centrifugal pump design and brand. The PRP EZ™ Seal overcomes this problem by fitting a standard pressure relief device into the water flush line prior to the flow control



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valve. The relief valve recommended and offered by PRP as an optional extra is a conventional 'off the shelf' style. As the bursting disc is usually in contact with water and not slurry, the scaling and erosion issues found in other designs is not applicable.

1.8 Erosive Services: Even through the mechanical seal used in the PRP EZ™ Seal System can be used in direct contact with slurry, it is sealing against water. The only component with direct slurry contact is the seal adaptor and slurry lip seal. The seal adaptor is a simple part, has no drilled or tapped parts, and accordingly is relatively low cost to manufacture in extremely hard erosion resistant materials. Our standard seal adaptor is M05 which is hardened 27% Chrome White Iron, typically used in most conventional slurry pump wet ends. As the frame plate liner insert protects the seal adaptor, others often make similar stuffing boxes in much softer materials as cast iron, however PRP aim is to extend the wear life.

1.9 Corrosive Services: As the mechanical seal and seal chamber is removed from the pumpage, and flushed with clean non-corrosive liquid, special corrosion resistant materials are not deemed necessary. The mechanical seal adaptor in contact with the pumpage is available with a ceramic coating or a range of exotic alloys.

1.10 Non-Flush Services: The PRP EZ™ seal should NOT be used on services where flush water is not available. Our seal system has been designed to assist users replace gland packing and expeller seals. Heavy duty slurry seals such as the John Crane 5800 or Flowserve SLC should be considered where flush water is not available and for very arduous services.